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Research on the Path of Low-altitude Economy Boosting the High-quality Development of the Sports Industry and Sports Education

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Abstract:

The low-altitude economy is an emerging economic form that relies on low-altitude airspace, centered around various flight activities of manned and unmanned aircraft, and promotes cross-sector integration and innovation. With technological advancements and policy support, the low-altitude economy is rapidly penetrating the sports industry and sports education, creating new opportunities for their high-quality development. This paper systematically explores the mechanisms of the low-altitude economy in event organization, spectator experience, educational reform, and talent development, using methods including a literature review, questionnaire surveys, in-depth interviews, and case analysis. The results show that, through emerging aviation sports such as drone racing, the low-altitude economy has expanded the format and business model of sports events, enhanced the interactivity and viewing experience of events, and promoted the deep integration of sports with industries such as science and technology, culture, and tourism. In education, the low-altitude economy has promoted the renewal of curriculum content and teaching methods, infusing sports education with new elements of intelligence, practical application, and interdisciplinary approaches, thereby promoting the cultivation of multidisciplinary sports talents. However, the study also found that universities currently have shortcomings in relevant curriculum design, faculty development, and practical platforms, and the education system's responsiveness to industry needs remains lagging. Furthermore, technical stability, airspace safety management, and industry standards systems need to be improved. A comprehensive analysis shows that policy guidance, technological innovation, educational reform, and industrial collaboration are key pathways to achieving high-quality development of the low-altitude economy in support of the sports industry and sports education. Based on this, this article proposes strengthening policy support and airspace governance, promoting collaboration between businesses and universities, building an industry-education integration platform, and improving the matching of educational resources with industry needs, thereby achieving the coordinated development of the low-altitude economy, the sports industry, and sports education.

Keywords:

low-altitude economy, sports industry, sports education, drones, new productivity, high-quality development

1. Introduction

In recent years, with the accelerating evolution of a new round of scientific and technological revolution and industrial transformation, the low-altitude economy, as an emerging economic form, has gradually entered the public eye and demonstrated promising development prospects. The low-altitude economy generally refers to an economic model that relies on low-altitude airspace, centered on various low-altitude flight activities by manned and unmanned aircraft, and promotes the extension of related industrial chains and cross-sector integration. Its scope encompasses not only the manufacturing and application of low-altitude aircraft, but also airspace management, infrastructure development, operational services, information dissemination, and collaborative innovation with other industries[1]. Driven by favorable policies and technological breakthroughs, the low-altitude economy is widely viewed as a key growth point for cultivating new productivity and promoting high-quality development. Against this macro backdrop, the integration of the low-altitude economy with the sports industry and sports education demonstrates tremendous potential and value. As a vital component of the modern service industry, the sports industry inherently fosters cross-sector integration. As the sports industry increasingly diversifies, becomes more technologically advanced, and offers a more experiential approach, the inclusion of the low-altitude economy not only introduces new formats and scenarios for sports events and consumption, but also provides new impetus for the upgrading of the sports industry[2]. For example, low-altitude flight technology, exemplified by drones, has spawned emerging sports such as drone racing. These new types of events transcend the time and space constraints of traditional sports. Their high-speed, competitive, and highly entertaining nature have attracted significant attention from young people and the capital market. Furthermore, the application of low-altitude aircraft in live broadcasts, spectator experiences, venue operations, and athlete health monitoring provides crucial support for the digital transformation of the sports industry. It can be said that the low-altitude economy is profoundly reshaping the sports industry's business structure and value chain.

The low-altitude economy is also having a profound impact on physical education. Traditional physical education relies primarily on teacher experience and student self-training. While this can improve physical fitness and athletic skills to a certain extent, it still lacks personalized instruction, scientific training, and interdisciplinary competence development. The integration of the low-altitude economy provides new teaching resources and approaches for physical education[3]. On the one hand, low-altitude technologies such as drones, virtual reality (VR), and augmented reality (AR) can help teachers achieve precise movement monitoring and feedback, enabling personalized instruction and differentiated training. On the other hand, with the expansion of the low-altitude economy industry chain, physical education is facing new job demands, such as drone control, event operations, and airspace safety management. How to enable students to master the multifaceted skills needed for future industrial development through curriculum reform and innovative talent development models has become a critical issue that needs to be addressed in physical education[4].

Existing research has largely focused on the industrial development model of the low-altitude economy, the construction of airspace management systems, and its enabling role in industries such as aviation, logistics, and cultural tourism. However, systematic research on the integrated development of the low-altitude economy with the sports industry and sports education is relatively lacking. In particular, within the educational context, academic circles both domestically and internationally lack in-depth discussion of the "low-altitude

economy + sports education" model, and research findings on related curriculum systems, talent development programs, and practical approaches remain fragmented[5]. This, to a certain extent, has hindered the widespread application and implementation of the low-altitude economy in sports education. Based on this, this paper aims to systematically explore how the low-altitude economy can contribute to the high-quality development of the sports industry and sports education. Specifically, through a literature review, questionnaire surveys, in-depth interviews, and case studies, this paper explores the mechanisms of the low-altitude economy's role in the diversified development of the sports industry and analyzes its practical approaches to event innovation, spectator experience, and industrial upgrading. Furthermore, focusing on the field of sports education, this paper examines the potential and practical challenges of the low-altitude economy in curriculum design, teaching methods, and talent development, exploring its role in promoting the transformation of the education system[6]. This article hopes to provide a reference for government decision-making, a practical path for the sports industry and educational institutions through a systematic study of the integration of low-altitude economy and sports, and lay the foundation for subsequent academic research.

2.Materials and Methods

This study takes "How the low-altitude economy contributes to the high-quality development of the sports industry and sports education" as its core question, and comprehensively uses a combination of quantitative and qualitative methods to ensure the scientificity and comprehensiveness of the research conclusions. In terms of research design, first, through a structured questionnaire survey, the opinions and needs of groups such as college physical education teachers, sports students, and drone industry practitioners are systematically collected, thereby revealing the differences in cognition and expectations of different subjects on the role of the low-altitude economy in the sports industry and education. Secondly, in-depth interviews are conducted, inviting sports education experts with relevant teaching and practical experience, drone company technicians and student representatives to conduct in-depth discussions on the application scenarios, educational difficulties, and industry needs of the low-altitude economy, striving to obtain more explanatory qualitative data from a multi-dimensional perspective[7].

Based on empirical research, the study further analyzes and validates representative case studies, including the Shenzhen World Drone Championships, the International Drone Racing League (DRL), and the development of low-altitude economic pilot zones in Chongqing and Shenzhen. These cases not only showcase cutting-edge practices in event innovation and spectator experience, but also exemplify exploratory approaches to industrial policy and educational reform, providing a solid foundation for research[8]. Through a multifaceted analytical approach encompassing quantitative statistics, thematic analysis, and case studies, this article seeks to uncover the key mechanisms and development paths of the low-altitude economy empowering the sports industry and education, thereby providing scientific reference and practical insights for future policy-making, industrial upgrading, and educational reform.

2.1 Empirical Research

To systematically examine the impact of the low-altitude economy on the high-quality development of the sports industry and sports education, this study designed a structured questionnaire covering multiple

dimensions, including cognitive attitudes, integration needs, development bottlenecks, and policy recommendations. The questionnaire consisted of four sections: The first section covered basic information, including gender, age, occupational status, and educational background, to ensure sample diversity and representativeness[9]. The second section examined respondents' awareness of the low-altitude economy, focusing on their understanding and acceptance of the concept, current development status, and future trends. The third section examined the integration of the sports industry and education, focusing on respondents' acceptance and expectations of the low-altitude economy's potential to empower sports events, promote sports education curriculum reform, and expand employment opportunities. The fourth section, "Influencing Factors and Development Recommendations," sought to gather respondents' opinions on the key drivers, potential challenges, and solutions for the application of the low-altitude economy in sports. The questionnaire included both closed-ended items for quantitative analysis and open-ended items to elicit individual insights and innovative ideas[10]. The structured questionnaire is shown in Table 1 below.

This study employed a combination of random and stratified sampling to select samples, balancing the opinions and characteristics of diverse groups. Three core groups were primarily covered: first, university physical education teachers, who are both practitioners of physical education and direct drivers of curriculum reform; second, physical education students, who are potential future entrants into the industry and education system, and whose understanding and needs reflect the urgency of educational reform; and third, drone industry practitioners, who are directly involved in low-altitude economic industry practices and can provide frontline application experience and feedback on the need for multi-faceted talent[11]. Through a combination of online and offline methods, a total of 300 questionnaires were distributed, ultimately yielding 235 valid responses, for a 78.3% effective response rate. Physical education students accounted for over half of the respondents, with a significant proportion each of teachers and industry practitioners, ensuring a balanced data structure.

Table 1. Questionnaire.

Basic Information	Gender, age, occupational identity, etc. to ensure that the sample is representative
Awareness of low-altitude economy	The survey asked respondents about their understanding of the low-altitude economy, their support for its development, and its potential impact on the sports industry and education.
Cognition on the integration of sports industry and education	This includes the recognition of how low-altitude economy promotes the development of the sports industry and the acceptance of the application of low-altitude economy in the sports education system.
Influencing factors and development suggestions	Survey respondents believe that the low-altitude economy can promote the key factors, challenges and solutions for high-quality development of the sports industry and education.

2.2 Interview

To further obtain authentic feedback and insights regarding the deep integration of the low-altitude economy and physical education, this study designed and conducted semi-structured interviews based on the questionnaire survey[12]. An overview of the interviews is shown in Table 2. The interviewees covered three core groups: first, university physical education teachers with experience teaching drone-related or general avia-

tion courses. They were able to reflect on the opportunities and challenges faced in curriculum development and talent development from the perspective of the education supply side; second, professional operators and event organizers from drone companies. They are not only familiar with the current application status of the low-altitude economy in the industrialization process, but can also clearly identify the gap between talent capabilities and industry needs; third, undergraduate and graduate students majoring in physical education. As direct recipients of education and potential future industry entrants, their cognitive levels and career expectations are of great reference value for educational reform.

Interviews were conducted in a combination of face-to-face and online formats, each lasting 5–10 minutes. After obtaining informed consent, the interviews were fully recorded and organized. The interview outline revolved around the following core topics: understanding and evaluation of the concept of the low-altitude economy; its application in sports event innovation and optimizing the viewing experience; the impact of the low-altitude economy on physical education curriculum, teaching methods, and talent development models; the shortcomings of the current education system in terms of curriculum resources, faculty, and practical platforms; and suggestions for promoting the in-depth integration of the low-altitude economy and physical education in the future. During the analysis phase, the research team de-identified the interview data and organized and summarized them using thematic coding. The conclusions were cross-validated by multiple researchers to ensure objectivity and reliability[13]. The interview results not only supplemented detailed information that was difficult to capture in the questionnaire survey but also revealed differences in cognition, needs, and expectations among different groups, providing a solid qualitative basis for constructing multidimensional research conclusions and proposing practical development paths.

Table 2. Interview Information Overview.

Interviewees	Interviewee requirements	Quantity	Interview content
College physical education teachers	Physical education teachers with experience in teaching or researching drone or general aviation related courses	3–5	In-depth exploration of its educational needs and challenges in the context of low-altitude economy.
drone operators	Corporate personnel engaged in drone operations, event organization, etc.	3–5	Understand the current status and future development needs of the industrialization application of low-altitude economy.
Sports majors	Undergraduate and graduate students majoring in sports	5–10	Understand their understanding of the application of low-altitude economy in physical education and their expectations for future employment.

2.3 Case Analysis

To further explore the practical role and development potential of the low-altitude economy in the sports industry and physical education, this study, based on questionnaires and interviews, further selected representative case studies for a systematic analysis. This case analysis not only helps validate the conclusions drawn from empirical research but also provides strong support for exploring different development paths and practical models[14]. First, the Shenzhen World Drone Championship and the China AOPA International Drone Invitational, both successful examples of the integration of the low-altitude economy and the sports industry, fully demonstrate how low-altitude flight technology is reshaping the competition format. These

events, through their high-speed, highly interactive drone racing, have attracted a large number of spectators and investment, promoting the technological and entertainment aspects of sports events and boosting the development of local sports consumption and tourism. Second, the International Drone Racing League (DRL), as a top global competition, provides an international benchmark. Its mature operating model, spectator experience, and commercial operations offer a reference for the international integration of related Chinese competitions and the sports industry, demonstrating the potential of the low-altitude economy to promote the globalization of the sports industry. Furthermore, the development of low-altitude economic pilot zones in places like Chongqing's Banan District and Shenzhen's Longgang District has provided institutional and environmental support for the application of the low-altitude economy in sports, both at the policy and infrastructure levels. These pilot zones have not only pioneered explorations in airspace management, flight infrastructure, and technological innovation, but have also promoted the deep integration of sports education and industry by introducing educational training and professional practice platforms. Typical cases selected for this article are shown in Table 3.

Table 3. Typical case analysis.

Case	Content
Drone Racing	The World Drone Championship and the China AOPA International Drone Invitational held in Shenzhen, China are successful examples of the integration of the low-altitude economy and the sports industry. They demonstrate how the low-altitude economy can drive the innovative development of sports events and attract a large number of spectators and investments.
Drone Racing League	As the world's leading drone racing brand, the DRL (Drone Racing League) provides an important global perspective for the integration of the low-altitude economy and the sports industry, and has become a benchmark for the application of the low-altitude economy in the sports field.
Construction of low-altitude economic pilot zone	China's Banan District in Chongqing and Longgang District in Shenzhen are actively building low-altitude economic experimental demonstration zones. The construction of low-altitude flight infrastructure in these areas is of great significance to promoting the healthy development of the sports industry.

2.4 Data Analysis Methods

This study employed a comprehensive approach of quantitative and qualitative analysis to ensure the scientific, systematic, and generalizable nature of its findings. The overall approach followed a "data cleaning - quantitative analysis - qualitative induction - multi-method cross-validation" approach, prioritizing both the statistical explanatory power of empirical data and the in-depth insights that qualitative materials can provide into complex phenomena, thereby maximizing the reliability and academic value of the conclusions. For quantitative analysis, the collected questionnaire data underwent rigorous preprocessing, including missing value imputation, outlier detection, and invalid questionnaire removal, to enhance the representativeness and validity of the data[15]. Descriptive statistical analysis was then conducted using SPSS software, calculating the distribution of the sample group based on basic variables such as gender, age, and occupational status. Means, standard deviations, and frequencies were also calculated for key questions such as awareness of the

low-altitude economy, integration needs, and policy expectations, revealing overall awareness trends and differential patterns. Principal component analysis was then used to identify key factors influencing the integration of the low-altitude economy with the sports industry and sports education. The KMO and Bartlett's test of sphericity were then used to validate the model. Further, through stepwise regression analysis, the research team used sports industry development intentions and education reform acceptance as dependent variables, introducing potential independent variables such as policy support, educational resources, technological adaptation, and industry demand to assess their significance and explanatory power. Regarding qualitative analysis, the research team systematically coded and thematically summarized the in-depth interview data[16]. The specific process included verbatim transcription, de-identification, preliminary coding, axial coding, and theme generation. To enhance the objectivity and consistency of the results, the research team employed a two-person independent coding and cross-verification approach, reaching consensus through repeated comparisons and discussions. Ultimately, six core themes were extracted: technology embedded in scenarios, educational curriculum systems, teaching model transformation, career orientation, and the misalignment between policy expectations and talent demand.

Case analysis, a third methodological approach, emphasizes contextualization and practical application. By collecting official data, industry reports, and news reports on representative cases such as the Shenzhen drone race, the International Drone Racing League, and the development of the low-altitude economic pilot zone, the study, combined with content and comparative analysis, explores the specific practical effects of the low-altitude economy on event innovation, sports consumption, and educational reform. Furthermore, the study employed a "complementary validation" strategy to integrate quantitative and qualitative findings. Questionnaires revealed general trends and key contradictions, interview analysis revealed individual differences and underlying motivations, and case studies provided visual examples of practical application. The combination of these three forms a logical closed loop of "data-cognition-practice," ensuring that the research conclusions possess both statistical significance and explanatory power and dissemination value.

3.Results and Discussion

Based on questionnaires, in-depth interviews, and case studies, this study systematically examines and presents the driving effects, key pathways, and challenges of the low-altitude economy on the high-quality development of the sports industry and sports education. The results are presented from three perspectives: quantitative statistical analysis of the questionnaire survey, qualitative thematic analysis of the in-depth interviews, and supplementary and corroborative case studies. This comprehensive analysis demonstrates that the low-altitude economy is becoming a significant force for change in the sports industry and education system through diverse approaches, including the integration of industrial technologies, the reconstruction of teaching models, and reforms in talent development.

3.1 Analysis of questionnaire survey statistical results

The survey results show that respondents generally have a high level of awareness and strong interest in the low-altitude economy. Regarding the question "How familiar are you with the concept of the low-altitude economy?", 56.2% of respondents indicated they were "relatively familiar," 18.5% indicated they were

"very familiar," and less than a quarter were relatively unfamiliar with the concept. This indicates that the low-altitude economy has gradually entered the public eye and has established a preliminary understanding within the sports and education communities. Looking at group differences, drone industry employees have a significantly higher overall level of awareness than sports students and some university faculty. They possess a deeper understanding of the low-altitude economy's policy framework, technological evolution, and industry prospects. Students, on the other hand, tend to remain at a superficial level, focusing on concepts like "drones" and "live sports events," and their systematic understanding of the concept still needs improvement. The results were even more positive regarding attitudes toward the value of the low-altitude economy. Regarding the question "Do you believe the low-altitude economy promotes the development of the sports industry?", a combined 87.4% of respondents chose "strongly agree" and "somewhat agree," demonstrating widespread recognition of the low-altitude economy's empowering potential. In particular, in open-ended questions, respondents frequently mentioned keywords such as "the spectator appeal of drone racing events," "the immersive experience of sports technology combined with low-altitude equipment," and "aviation sports tourism driving sports consumption," reflecting their high expectations for the low-altitude economy to expand the boundaries of the sports industry and innovate the value chain. Further analysis revealed three key areas of focus: First, event innovation. Emerging sports such as drone racing, with their combination of speed and technological sophistication, are believed to attract younger audiences, enhancing the viewing experience and commercial value of sports events. Second, the viewing experience. The application of low-altitude aircraft in event broadcasting, immersive interaction, and data visualization is widely believed to improve traditional viewing experiences and enhance audience engagement. Third, industry expansion. Some respondents suggested that the low-altitude economy could not only play a role in event organization but also potentially integrate with sports tourism and the cultural and creative industries to create new consumption scenarios and growth opportunities.

The survey results show that while respondents generally recognize the potential for the application of the low-altitude economy in physical education, the actual implementation of this approach faces widespread challenges in the education system, including insufficient course offerings and lagging resource allocation. In response to the question, "Does your university offer physical education courses related to the low-altitude economy (e.g., drone control or aviation sports)?", only 11.7% of faculty members stated that their schools have systematically offered relevant courses, while another 18.3% are only in the process of sporadic trials. Over 70% of faculty members responded that they "have not yet offered" or have "no plans to do so." This data clearly reflects the significant lag in university physical education's response to the demands of emerging industries, with the pace of curriculum updates out of step with industrial development. At the same time, students demonstrate a high willingness and demand for learning. In response to the question, "Do you hope to include content related to the low-altitude economy in future physical education?", 82.9% of students selected "yes" or "very much," indicating that they are not only interested in the prospect of integrating low-altitude technology with sports but also hope to acquire practical skills that can translate into employment opportunities through these courses. The students interviewed generally paid attention to practical content such as "drone flight control", "event organization and operation", and "low-altitude safety management", reflecting their urgent need for career-oriented education.

Principal component analysis was used to reduce the dimensionality of the variables influencing the inte-

gration of the low-altitude economy and sports. Four main factors were extracted: policy support (F1), supporting educational resources (F2), technological adaptability (F3), and intensity of industrial demand (F4). The cumulative explained variance of these four factors was 71.2%. Further stepwise regression analysis was conducted, using the sports industry's willingness to develop high-quality development as the dependent variable and the four factors as independent variables. The model results showed that the standardized regression coefficient of the policy support factor on the development of sports industry integration was 0.467 ($p < 0.001$), making it the most significant variable. The regression coefficient of the technological adaptability factor was 0.354 ($p < 0.01$), indicating that the availability and compatibility of technological facilities are the core guarantees of integration efficiency. Supporting educational resources and industrial demand mainly have an indirect effect on educational cognition and skills supply ($p < 0.05$). The adjusted R^2 of the model was 0.612, indicating that the regression model has strong explanatory power. These results confirm that policy encouragement, technological availability, and the responsiveness of the education system are the three major driving factors driving the integration of the low-altitude economy and sports industry.

3.2 In-depth interview analysis results

Based on a questionnaire survey, this study conducted in-depth interviews with 18 university faculty, drone company technical and operations personnel, and sports students, aiming to more closely explore the key issues and practical difficulties in the integration of the low-altitude economy with the sports industry and sports education. Through verbatim transcription and thematic coding, the research team ultimately identified six core themes, as shown in Table 4. First, on the technical level, interviewees generally mentioned emerging application scenarios such as drone racing, VR viewing, and aerial broadcasting systems, which have brought unprecedented interactivity and viewing value to sports events. However, university sports education has failed to keep pace with curriculum and experimental conditions, resulting in a disconnect between educational resources and technological development. Some faculty members frankly stated that even though their schools have some drone equipment, the physical education colleges lack faculty and institutional support, and interdisciplinary collaboration mechanisms have yet to be established. Second, corporate personnel are generally concerned about the shortage of interdisciplinary talent. Currently, low-altitude economy-related projects have a strong demand for interdisciplinary talents with both sports knowledge and flight control or event management capabilities. However, most recent graduates lack the relevant skills, requiring companies to invest additional training costs. Students expressed strong interest in "Technology + Sports" course content, believing that such courses not only enhance professional competitiveness but also expand future career prospects. Furthermore, the majority of respondents emphasized the importance of the policy environment. Teachers and business personnel alike called for accelerated airspace opening, infrastructure development, and the introduction of supporting policies at the local level to promote the in-depth integration of the low-altitude economy and sports education. Overall, the in-depth interviews not only revealed the differentiated needs of different groups, but also highlighted the enormous potential and institutional shortcomings of the low-altitude economy in empowering the sports industry and education, providing a solid basis for the subsequent proposal of a coordinated development path.

Table 4. Summary of interview results

Core Themes	Subtopics
Technology embedded in diverse scenarios	Drone racing, VR viewing, aerial broadcasting system
Slow updating of the education curriculum system	Lack of systematic courses, shortage of experimental equipment, and absence of teachers
The teaching model has not yet been reconstructed	Insufficient project orientation and delayed assessment and evaluation
Career orientation has been significantly enhanced	New careers of "General Aviation + Sports" and "Low-Altitude Instructor" positions
Strong policy awareness and expectations	There are high expectations for local policies and calls for opening up of airspace at the venue.
Mismatch between talent demand and reality	Enterprise needs are diverse and the talent supply structure is unbalanced

3.3 Case Analysis and Supplementary Verification

To further verify the generalizability and practical basis of the survey results, this paper selects three typical cases in Shenzhen, China for analysis and comparison.

(1) Shenzhen "Air F1" Drone Racing Super League

The "Air F1" Super League, hosted by Shenzhen's Longgang District in 2024, marks a breakthrough in China's ability to organize high-level drone sports events. Drone racing, a high-tech sport under the F9U category of the International Air Sports Federation (FIA), has been included in the 2025 National Games and the 2025 World Games. The FPV racing drones used in the competition, capable of reaching speeds exceeding 200 kilometers per hour, have been dubbed the "Air F1." The event attracted over 260 professional pilots from across China and integrated multiple industries: racing, cultural creativity, and education. According to organizers, the event generated over 10 million yuan in direct economic revenue and indirectly attracted nearly 100,000 spectators. The accompanying youth drone science camp also promoted a pilot program integrating drones with school physical education, injecting new vitality into urban sports education.

(2) "Low-altitude + sports" drones were used for the first time to spray and cool the Shenzhen Marathon

The 2024 Shenzhen Marathon will debut a drone formation for high-altitude water mist cooling, achieving a breakthrough in low-altitude applications for large-scale sporting events. As a long-distance, high-intensity sport, marathons can cause runners' body temperatures to rise rapidly during extended runs, especially in the midday heat. This can lead to dehydration, heat stroke, and other heat-related illnesses, which can be life-threatening in severe cases. The deployment of drone spray systems can effectively help runners lower their body temperatures and alleviate the discomfort caused by the high temperatures, while also further reducing the ambient temperature and creating a comfortable competition environment. This technology not only enhances runner comfort but also becomes a technological highlight in broadcast footage, earning praise from runners and media alike. This project pioneers new approaches to "low-altitude + sports event security," demonstrating the synergistic value of low-altitude technology beyond the event itself to overall organizational management. It not only represents the integration of the low-altitude economy and sports events, but also highlights the humanistic care behind technology and demonstrates the enormous potential for comprehensive application of the low-altitude economy.

(3) Low-altitude economic education practice in Longhua District, Shenzhen

Based on the low-altitude economy pilot program, Shenzhen's Longhua District is collaborating with Nanjing University of Aeronautics and Astronautics to establish a Low-altitude Economy Innovation and Development Center. Leveraging the National Key Laboratory of Air Traffic Control and Flight Flow Management Technology, they are developing a "1+1+1+N" system. They are also collaborating with the University of Electronic Science and Technology of China (Shenzhen) Institute of Advanced Studies to build an innovative low-altitude multi-physics scenario environment simulator platform. This platform is the world's first multi-physics scenario coupling simulation device dedicated to low-altitude airspace, providing fundamental support for flight training, R&D testing, and airworthiness certification for low-altitude aircraft such as drones and electric vertical take-off and landing (eVTOL) aircraft. Furthermore, they are collaborating with universities to establish a "Low-altitude Economy Vocational Education Practice Base," which includes an "Experimental Flight Sports Integration Course" involving faculty and students from the School of Physical Education.

3.4 Discussion

(1) Opportunities and challenges of low-altitude economy empowering the sports industry

The integration of the low-altitude economy and the sports industry has brought unprecedented opportunities to the sports industry. From drone racing and aircraft events to high-tech live broadcasts and interactive viewing experiences, the low-altitude economy is reshaping the traditional sports industry. First, the low-altitude economy has led to the emergence of new event formats, particularly drone racing and aerial flight events. These events transcend the time and space constraints of traditional sports competitions, offering more engaging formats and new business models. Drone racing events not only attract a large number of young audiences to the sports industry but also provide new revenue streams for event organizers, diversifying their revenue streams through virtual tickets and digital content sales. With the rapid development of the low-altitude economy, event organizers are able to leverage efficient drone technology for precise monitoring and management of events, thereby improving efficiency and safety. However, the low-altitude economy's empowerment of the sports industry also faces numerous challenges. First, drone technology, the core technology of the low-altitude economy, is still undergoing technological updates and standardization, and existing technologies still have room for improvement in flight stability, endurance, and adaptability to high-altitude operating environments. In addition, the safety issue of low-altitude airspace is also a difficult problem that needs to be solved urgently. The airspace involved in drone flights is not only complex, but also overlaps with other aircraft. Therefore, how to achieve reasonable planning and use of low-altitude airspace while ensuring safety is an important bottleneck in promoting the deep integration of the low-altitude economy and the sports industry.

(2) The impact of low-altitude economy on physical education

The impact of the low-altitude economy on physical education is profound and multifaceted. First, the rapid development of the low-altitude economy has placed new demands on physical education. In the traditional physical education system, most institutions' curricula focus on theoretical learning and the development of basic skills. However, with the rise of the low-altitude economy, physical education needs to better align with

industry needs and provide students with more practical, technical, and innovative learning content. Skills such as drone control, aircraft design and maintenance, and event management have become an integral part of the curriculum for emerging sports majors. Interview and questionnaire survey results indicate that most universities have yet to fully offer physical education courses related to the low-altitude economy. This is particularly true in small and medium-sized institutions, where curriculum and practical platforms for low-altitude economy courses remain relatively weak. Many interviewed physical education teachers stated that while existing teaching resources are sufficient to support traditional physical education courses, they lack the necessary teaching facilities and faculty for courses on technologies such as drones and aircraft. To promote the deep integration of the low-altitude economy and physical education, universities should promptly initiate curriculum reform, introduce relevant interdisciplinary courses, and collaborate with relevant industry enterprises to jointly develop high-quality courses that meet market demand. Secondly, the low-altitude economy has not only transformed the curriculum of physical education but also promoted innovation in educational models. With the continuous advancement of technology, traditional teaching methods are transitioning towards "intelligent" and "digital" approaches. The application of virtual reality (VR) and augmented reality (AR) technologies allows students to conduct flight training through virtual simulations, eliminating the need for high-risk flight practice in actual airspace. This new teaching model not only enhances student learning interest but also reduces teaching costs and risks, providing a new development direction for physical education.

(3) Support needs at the policy and institutional levels

The development of the low-altitude economy is inseparable from policy support and institutional guarantees. Currently, the country has issued relevant policies at multiple levels to promote the industrialization of the low-altitude economy. However, existing policies still have problems such as imperfect implementation details, inconsistent industry standards, and large policy differences between local governments, which have led to certain restrictions on the rapid development of the low-altitude economy. In addition, policy support is not limited to the level of industrial development, but should also focus on the construction and improvement of the education system. The government should encourage universities to cooperate with enterprises, increase investment in curriculum setting, laboratory facility construction, teacher training, etc., and at the same time establish an interdisciplinary education platform to cultivate compound talents who understand both aviation technology and sports management.

(4) The coordinated development path of low-altitude economy, sports industry and education

Through the data analysis and case studies presented above, this article proposes a synergistic development path for the low-altitude economy to support the high-quality development of the sports industry and sports education. First, the application of the low-altitude economy in the sports industry requires dual drivers of technology and industry. The introduction of industrial policies and breakthroughs in technological research and development are key factors in promoting the deep integration of the low-altitude economy and the sports industry. In this process, cooperation between enterprises, governments, and educational institutions is particularly important. The government should provide support for technological innovation in enterprises and the development of sports events through preferential policies, financial support, and strengthened airspace management. At the same time, enterprises should collaborate with universities to regularly organize

technical lectures, practical activities, and curriculum development to promote the seamless integration of low-altitude economy technologies with the sports industry. At the educational level, sports colleges and universities should strengthen the development of low-altitude economy-related professional courses, enhance the technical and practical nature of the course content, and cultivate interdisciplinary sports talents capable of mastering modern aviation technology. Schools and universities should work closely with the industry to establish internship bases and practical training platforms to enable students to gain practical experience and enhance their employability.

4.Conclusions

This study, through an in-depth analysis of the integration of the low-altitude economy with the sports industry and sports education, reveals the role of the low-altitude economy in promoting the high-quality development of the sports industry and sports education and the challenges it faces. The study shows that the low-altitude economy has not only brought new event formats, technological innovations and business models to the sports industry, but also provided new development opportunities for the curriculum setting, teaching methods and talent training models of sports education.

(1) The low-altitude economy has opened up a new situation for the sports industry by promoting the innovation of emerging events such as drone racing. The application of low-altitude flight technologies such as drones has not only improved the interactivity and viewing experience of events, but also driven the digital transformation of the sports industry, bringing unprecedented changes to the commercial operation of sports events and the audience experience. The low-altitude economy has injected new vitality into the sports industry and promoted the deep integration of sports with multiple fields such as science and technology, culture, and tourism.

(2) The low-altitude economy has had a profound impact on the sports education system. With the widespread application of drone technology in the sports field, sports education needs to adjust its course content and teaching methods in a timely manner to cultivate compound talents with technical operation and management capabilities. The study found that there are still certain gaps in the setting of low-altitude economy-related courses, practical teaching platforms and the construction of teaching staff in colleges and universities. It is urgent to increase the intensity of reform to promote the updating of educational content and the optimization of educational resources.

(3) The integration of low-altitude economy with sports industry and education also faces many challenges. First, the coordinated promotion of technological innovation and industrial application is still quite difficult, especially in terms of flight technology, safety management and airspace control. Second, the sports education system responds slowly to the low-altitude economy, and the curriculum setting is out of touch with industry needs. Policy support, industry standards and the perfection of the industrial chain also need to be further strengthened. Therefore, in the future, in the process of promoting the integration of low-altitude economy with sports industry and education, policy guidance, industry collaboration and educational innovation will play a vital role.

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