

# Practical research on orienteering physical education in universities in northeast China

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## Abstract.

**BACKGROUND AND OBJECTIVE:** Orienteering, which is one of the popular physical educations in the world, is an emerging sport integrating knowledge, competition, fun, and collaborative attributes. Although it started late in China, it has developed rapidly in recent years in most places except the northeast and northwest parts of the country.

**METHODS:** In order to accelerate the development of orienteering in the northeast, given the climate and social characteristics of this area, we built a four-in-one orienteering development model including a theory course, a social component, a team, and events based on the longtime practice of Harbin Engineering University.

**RESULTS:** The research results have practical reference significance for orienteering at universities in China, as well as at universities and commercial clubs in other areas of the world.

Keywords: Orienteering, physical education, practical research, universities of northeast China

## 1. Introduction

Orienteering originated in Sweden in 1895. Its purpose was to help soldiers learn boring topography by means of a game so that they could better adapt to mountain forest operations [1]. Afterwards, the sport flourished in the Nordic region and then rapidly spread to the world. Orienteering is both a kind of sports activity and a competitive sports event [2]. Participants are required to choose a route according to the map and visit the marked points in the prescribed order, and the team that effectively completes the competition in the shortest time wins [3]. Orienteering is characterized by social, entertainment, competitiveness, and knowledge features. As a sport that closely combines people's physical strength and intelligence, it can be used for physical fitness training and to cultivate team spirit [4]. For adolescents, it has unique benefits in enriching their geographic knowledge and enhancing their sense of direction, and especially in cultivating independent survival and rapid decision-making ability in unfamiliar environments [5].

Hou believes that orienteering has positive effects on health, intelligence, entertainment, and social interaction [6]. Xiao conducted research on orienteering courses in colleges and universities, and analyzed and pointed out that orienteering can effectively cultivate students' ability to find problems and solve problems, train students' self-challenge and innovation spirit, and improve students' comprehensive quality [7]. Bird et al. had pointed out that regular participation in orienteering is beneficial to cardiovascular health [8]. Lina et al. used questionnaire surveys and group discussions to study the health status of the elderly by orienteering. The study concluded that the health status of the elderly who participated in orienteering was significantly better than that of the freely active elderly [9].

Lorger et al. studied 146 geography and physical education teachers in Croatia in 2017 and 2018 on

Table 1  
Numbers of colleges and universities participating in the National Student Orienteering Championships in the past five years

Year	Total number of colleges	Elite college group	Professional college group	Undergraduate group A	Undergraduate group B	Undergraduate group C	Junior college group A
2015	78	12	19	12	7	21	7
2016	105	15	26	16	16	21	11
2017	126	12	28	20	16	34	16
2018	126	9	27	20	20	33	17
2019	126	13	21	18	20	39	15

their level of knowledge of orienteering courses. It is pointed out that although orienteering is popular in Croatia, it needs to be further strengthened in school teaching, especially in elementary and secondary schools [10]. Karagodina et al. discussed the optimization of the process of physical education in colleges and universities, and concluded that using orienteering in course teaching in colleges and universities can effectively improve students' physical qualities, functional training, and the working capacity [11]. Ye et al. studied the construction of Chinese orienteering curriculum system [12]. Cong studied the current situation of orienteering in colleges and universities in Liaoning Province of China, and pointed out that in Liaoning Province in high latitude areas of China, teachers are weak in the development of orienteering, there are great difficulties in orienteering venues, equipment and funds, and the leading role of functional departments should be improved [13].

In view of the benefits of orienteering, orienteering has developed rapidly in China in recent years, but slowly in the northeast and northwest regions with higher dimensions. This paper makes a comparative analysis of the development of orienteering in China and northeast China, constructs a model of orienteering in northeast Universities, and carries out a practical study.

## 2. Analysis of development status of orienteering in China and northeast China

### 2.1. Development status of orienteering in China

Orienteering was introduced in Hong Kong in 1973. After that, the PLA Institute of Physical Education organized the first experimental orienteering competition at Baiyun Mountain, Guangzhou, in 1983. Following that, it flourished in China, expanding to universities and primary and secondary schools. Also extending from surveying, mapping, and geological systems to all walks of life, it displays great vitality. Taking the National Student Orienteering Championship in China as an example, the number of participating university teams has increased rapidly in recent years. Table 1 shows the numbers of colleges and universities participating in the championship in the past five years [14]. The 2018 and 2019 championships were delayed for one month and were held in mid to late August, which meant some colleges and universities could not participate as the instructors and participating students could not reach a consensus on the school opening time. Except for the special circumstances in 2018 and 2019, Table 1 indicates significantly increased numbers of colleges and universities participating in the National Student Orienteering Championships in the past five years. The numbers of elite and professional college groups have steadily increased, suggesting that the number of orienteering athletes has grown and the competitive level of orienteering in China has increased year by year. The number of group C undergraduates participating in the competition for the first time has grown year by year, indicating the wider popularity of orienteering in China in recent years.

Table 2  
Northeast universities participating in the National Student Orienteering Championships in the past five years

Year	Number of universities in Heilongjiang Province	Number of universities in Jilin Province	Number of universities in Liaoning Province
2015	2	5	1
2016	3	6	1
2017	3	7	2
2018	3	7	1
2019	3	6	2

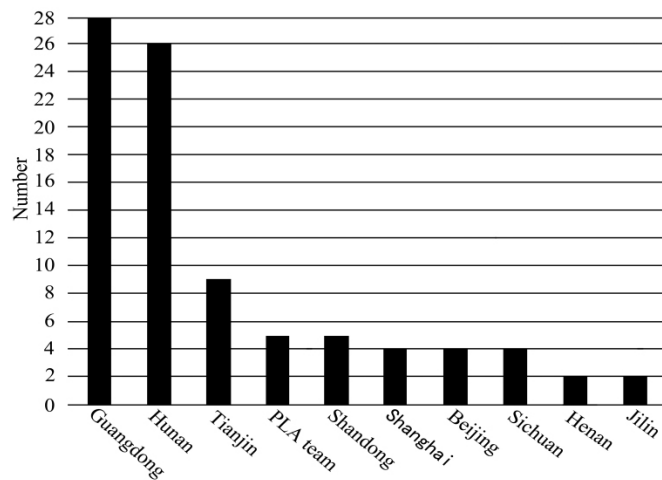


Fig. 1. Sources of players selected for 2019 National Orienteering Training Team.

## 2.2. Development status of orienteering in northeast China

Table 2 shows the numbers of northeast universities participating in the National Student Orienteering Championships in the past five years. It reveals that in the past five years, the number of participating colleges and universities in the three northeastern provinces has grown slowly, and the number is relatively small.

According to data released by the General Administration of Sport of China [15], to prepare for the 2019 World Orienteering Championship and World Cup Finals, the state established the 2019 National Orienteering Training Team, with the source of athletes as shown in Fig. 1. As can be seen from Fig. 1, in 2019, almost all athletes on the training team came from academies and PLA teams in northern, eastern, central, southern, and southwestern provinces of China. The northeast and northwest regions, at higher latitudes, lag behind in the development of orienteering. Only Jilin Province sent two orienteering players for the 2019 training team.

## 2.3. Analysis of reasons for the slow development of orienteering in northeast China

Figure 2 shows the proportion of colleges and universities participating in the 2019 National Student Orienteering Championship in different provinces. Except for Heilongjiang Province, the provinces with a proportion above 5% are marked in the figure, which are in South, East, North, and Southwest China. Hubei Province in Central China accounts for 4.8%.

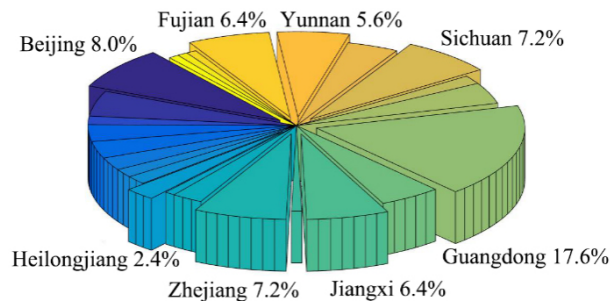


Fig. 2. Proportion of colleges and universities participating in 2019 National Student Orienteering Championships in different provinces.

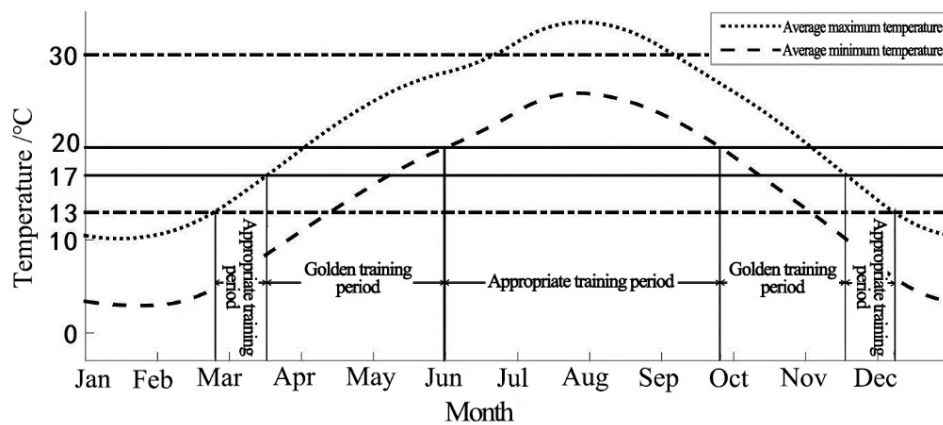


Fig. 3. Analysis curves of appropriate period for orienteering training in Hangzhou.

The temperature conditions of Hangzhou, the capital of Zhejiang Province in East China, which is ranked third in intermediate latitude, and Harbin, the capital of Heilongjiang Province in northeast China, were selected for comparative analysis [16]. Figures 3 and 4 show the analysis curves of the appropriate periods for orienteering training in the two cities. The average maximum and minimum temperature curves were obtained by selecting the daily maximum and minimum temperatures of the two cities on the 2345 weather website for the past five years, then calculating and mapping the five-year average.

The normal temperature of the human body is maintained between 36.5°C and 37.2°C. In terms of physical training, orienteering is similar to track event training. The relatively low temperature is more appropriate, because track training is mainly muscle exercise, and the relatively low temperature can help muscle tissue function better. According to research, the ideal temperature for track training is 17–20°C. Excessively high or low external temperature will cause discomfort [17]. Excessive air temperature will increase the body temperature, which will make the circulatory system transport more blood to the skin, accelerate heat dissipation, and cause a reduction of blood volume in muscle tissue, resulting in insufficient oxygen supply to the cerebral cortex tissue [18]. In case of too low temperature, the subcutaneous blood vessels will contract and less blood will reach the skin and subcutaneous tissue, which will cause numbness and stiffness of the body and increase the viscosity of muscle tissue, reducing the flexibility of joint movement, thus easily causing sports injuries [19]. Studies have shown that 30°C and 13°C are the extreme high and low temperatures for track event training [20]. Orienteering training

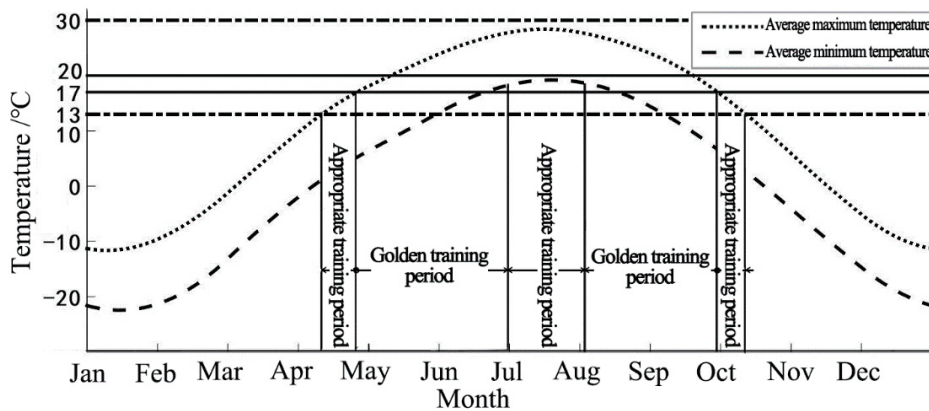


Fig. 4. Analysis curves of appropriate period for orienteering training in Harbin.

above 30°C and below 13°C is also quite dangerous. Based on the ideal and extreme training temperatures, as well as the average high and low temperatures of the two cities over the past five years, appropriate training periods for orienteering in Hangzhou and Harbin were obtained, as shown in Figs 3 and 4. It can be seen from Figs 3 and 4 that trainable periods in Hangzhou and Harbin are from late February to early December, and from mid-April to early October, with Hangzhou exceeding Harbin by nearly four months; Hangzhou's ideal training periods are from mid-March to early June and from late September to mid-November, and Harbin's ideal training times are from late April to early July and from early August to early October. Hangzhou exceeds Harbin by nearly one month. The appropriate training times in Central and Southwest China are similar to those in East China. The appropriate training time in South China is about one month longer than in East China, and that in North China is about one month shorter than in East China.

In general, few colleges and universities offer orienteering in the northeast and northwest regions at higher latitudes. The main reason is the natural climate factors analyzed in Figs 3 and 4. The northeast has large annual temperature differences, long winters, and low outdoor temperature. The average temperature of the cold months differs from that of the hottest months by about 60°. The average annual effective training time is short. Without the protection of indoor training ground, players cannot receive full training. In addition, professional orienteering equipment is relatively expensive, so the south, with better economic conditions and appropriate climate, facilitates the development of orienteering.

### 3. Construction of models for orienteering at colleges and universities

Orienteering is a new type of sport based on basic knowledge of map identification and usage and good physical fitness, combining intelligence and physical strength. Hence, orienteering athletes require a solid theoretical knowledge of orienteering. In addition, orienteering is not only a competitive sport, but also a healthy activity. Accordingly, the development of orienteering should consider both its competitive nature and social features. Based on comprehensive consideration, the four-in-one orienteering development platform was built, as shown in Fig. 5.

### 4. Practical research on orienteering in northeast China

Combining the climatic characteristics, economic foundation, and cultural characteristics of college

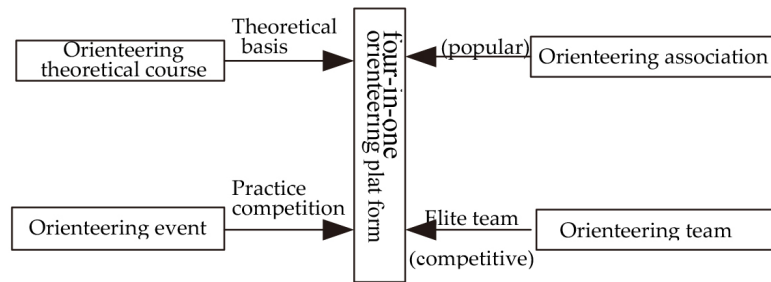


Fig. 5. Four-in-one orienteering development platform for colleges and universities.

campuses in northeast China, the constructed orienteering development model was put into practice, and 15 years of practical exploration was conducted at Harbin Engineering University so that the four elements of orienteering theory courses, events, social organizations, and competitive teams would complement and influence each other.

#### 4.1. Orienteering theory course

Orienteering theory courses are mainly offered in two forms at domestic colleges and universities: elective general education courses and compulsory physical education courses [21].

As early as 2004, the undergraduate major curriculum program for physical education in national institutes of higher education stipulated that orienteering, outdoor survival, outdoor sports, etc., could be taken as optional track and field courses. As the basis of physical education courses, track and field can train students' endurance, speed, sensitivity, flexibility, strength, and other qualities, which are the most important elements in college physical education courses [22]. However, traditional track and field courses are boring and monotonous, thus are neglected by college students year after year. Accordingly, in recent years, many sports teachers have integrated orienteering into track and field teaching to enrich the content of the courses and strengthen students' interest in learning. In addition, some colleges and universities offer orienteering courses as elective general education courses.

General education and physical education courses have different educational purposes. The former focuses on cultivating students' knowledge and providing a spiritual education, and the latter focuses on training students' physical fitness. As a general education course, orienteering focuses on cultivating college students' grasp of topographic knowledge, training their ability to identify maps, cultivating teamwork, and improving their physical and mental qualities. Hence, there is a relatively large number of theoretical teaching hours. As a physical education course, orienteering focuses on cultivating students' physical fitness, so there is a relatively large number of outdoor practice teaching hours. After investigating the development of orienteering courses at domestic colleges and universities, the author summarized a development model for orienteering theory courses, as shown in Table 3.

Table 3 shows the development mode of orienteering courses at universities based on the general education courses at Harbin Engineering University for nearly 15 years and research on peer colleges. In view of the particularity of orienteering courses being both theoretical and practical in nature, for the sake of a better course effect, the elective courses of Harbin Engineering University make cumulative assessments to promote teaching by examination, with an assessment mode as shown in Table 4. Practice has proved good teaching results. According to data provided by the Undergraduate School of Harbin Engineering University, in recent years, the online teaching evaluation score of students in orienteering courses has been around 95 points.

Table 3  
Teaching content design for orienteering courses at Chinese universities

No.	Teaching content	Teaching hours	
		General education	Physical education
Theoretical part			
1	Introduction to orienteering	2	1
2	Basic knowledge of topography and orienteering map	4	3
3	Basic orienteering skills	2	1
4	Orienteering competition rules and equipment use	1	1
5	Theoretical knowledge assessment	1	0
Practical part			
6	Map identification training	2	2
7	Orienteering skill training	2	2
8	Campus orienteering Simulation exercise	2	2
9	Physical training	0	2
10	Orienteering practice competition (100 m race, short distance race, point race, etc.)	8	10

Table 4  
Cumulative assessment of orienteering

Classroom performance	Theoretical examination	Practice assessment		
		Simulation practice	Campus 100 m race	Park short distance race
10 points	40 points	10 points	20 points	20 points

The development mode of orienteering courses shown in Table 3 and the cumulative assessment method of orienteering at Harbin Engineering University shown in Table 4 are mainly intended to provide a certain idea for the development of orienteering at colleges and universities. Each school can adjust the teaching plan based on its respective reality.

#### 4.2. Orienteering organization building

Building an orienteering organization includes constructing social organizations, associations, and elite teams, which complement each other.

##### 4.2.1. Recruitment publicity

Recruitment and publicity work are a necessary part of recruiting new players and retaining old players. Harbin Engineering University adopts three methods in this regard: organizational publicity, on-site recruitment, and new media platform. As soon as freshmen enter the school, the orienteering associations organize their own publicity. Using the platform for collective recruitment of school associations, on-site recruitment further publicizes the orienteering associations and teams. A new media platform based on a WeChat public account, HEU Orienteering, promotes orienteering knowledge and enhances the influence of associations and teams, which also increases the influence of orienteering on campus.

##### 4.2.2. Internal construction

Internal construction is a necessary link to enhance team cohesion and competitive effectiveness. The orienteering organization of Harbin Engineering University has established three internal organizations with clear divisions of labor: theory learning, training, and organization publicity departments. Under the guidance of team leaders, the organizations perform their respective duties in a well-organized manner, carry out various campus orienteering activities, and organize communication activities among internal members, thus forming their own culture.

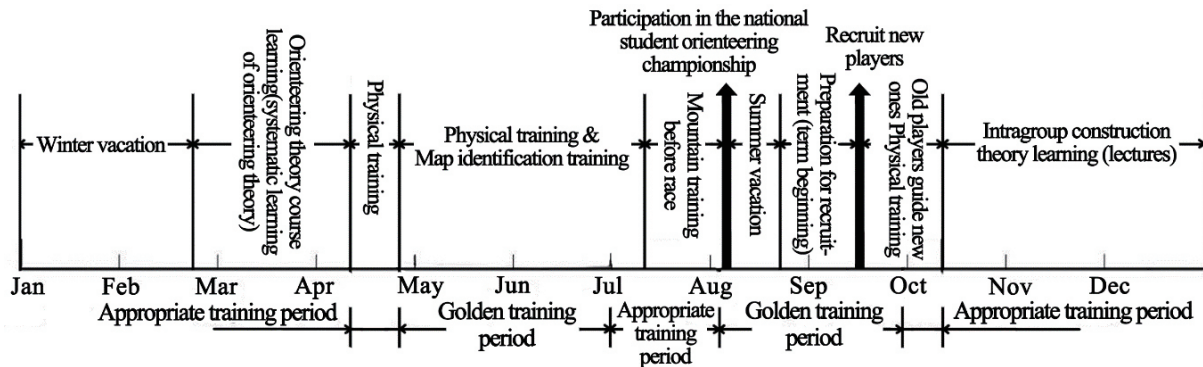


Fig. 6. Annual training plan for orienteering team at Harbin Engineering University.

#### 4.2.3. Daily training

Daily training is mainly targeted at players [23], and association members can also participate voluntarily. According to the analysis curve of the appropriate period for orienteering in Harbin shown in Fig. 4, the university formulated a year-round training plan, as shown in Fig. 6.

The daily training of the university orienteering team mainly includes theoretical, physical, and map identification training.

Theoretical training is the basis of daily training. Lectures in the early stages after new players enroll in autumn and winter is the major training approach. Physical training in the spring semester of the second year is the focus of daily training [24]. Physical training takes full account of the distinctive features of orienteering. Physical training gives athletes enough reserve energy to meet the needs of competition. To a certain extent, it is possible to refer to middle-distance running training in track and field events to improve athletes' cardiorespiratory function. In addition, orienteering requires athletes to perform cross-country running in the wild without the same path or field. This requires them to break the existing rhythm of middle-distance running and establish a new rhythm while considering cross-country ability. After theoretical research and practice, the physical training of the orienteering team at Harbin Engineering University mainly includes five aspects.

##### (1) Endurance quality training

Endurance quality is the physical foundation of orienteering. The complexity of the competition field and particularity of technical requirements determine that orienteering is a variable-speed running sport dominated by endurance. Long- and middle-distance orienteering competitions are long-term and long-distance aerobic endurance sports, while anaerobic endurance is the key in 100-meter and short-distance competitions. In aerobic endurance training [25], continuous running (with total distance above 10 km and total duration more than 60 min), variable speed running, repeated running, and cross-country running (with distance and length half that of continuous running) are the main training methods. In anaerobic endurance training, intermittent running (100 m full-speed running, 2 min break, 100 m full-speed running, 4 min break, 100 m full-speed running) and variable speed running (100 m fast running, 100 m jogging, 100 m fast running, 100 m jogging) are the main training methods [26].

##### (2) Speed quality training

Speed quality refers to an athlete's rapid movement ability. In orienteering, it mainly relates to reaction, action, and movement speed in finding the checkpoint. In orienteering competitions, endurance is the foundation and speed is the key. Speed quality is particularly important in 100 m, short-distance, and



point races. Training methods can be variable speed running, intermittent high-leg lift in situ, repeated acceleration running, high-leg lift with acceleration, back kick, 100–400 m time run, etc.

### *(3) Strength quality training*

Strength quality training is used mainly to adapt to the complexity and cross-country nature of orienteering. In the training, natural conditions are fully utilized, and uphill and downhill running are undertaken for resistance exercise. Training ground such as sand or grass is used to improve lower limb strength. In addition, there is some strength training for upper limbs, waist, and lower limbs, which is similar to track and field training, such as push-ups; back, abdominal, and waist muscle exercises; and one-leg squats.

### *(4) Sensitivity training*

To adapt to the variable terrain features and complex path selection in orienteering, the athlete's nervous system should have good coordination with muscle movement. Sensitivity is particularly important, especially in 100 m and short-distance relay races, etc. In actual training, it is possible to use the short-distance and 100 m race training platform to gradually train athletes' sensitivity by gradually increasing the complexity of the terrain and route.

As is the case at most universities in China, orienteering players at Harbin Engineering University are not PE majors or specially enrolled PE students, but ordinary college students enrolled via the college entrance examination. Learning is their first task. In seasons appropriate for training, the orienteering team chooses to organize collective training from 16:00 to 17:00, Monday to Saturday. Players receive physical training three times a week when they have no classes. Orienteering simulation competitions are generally organized at Harbin colleges and parks every two weeks on Sunday. Intensive orienteering training is arranged at Erlong Mountain during May Day holiday and summer vacations. Near the end of the semester, the training is reduced or stopped at the end of June, early July, end of December, and early January, so that students can prepare for final exams.

After the systematic physical, theoretical, and map identification training, the orienteering team achieved good training results. In the past three years, at school sports meets of Harbin Engineering University, more than 70% of the top eight winners of all 800 m and longer track events were from the orienteering team; the team won a silver medal in the women's point race of undergraduate group A at the 2017 National Student Orienteering Championships; and in the National Demonstration-Map Identification and Use Competition in 2017 and 2018, the orienteering team won first and second place in the country. In addition, in physical tests of college students over the years, orienteering players have achieved excellent results.

### *4.3. Orienteering events*

Orienteering events are necessary to enrich course content, strengthen organizational construction, enhance cohesion of associations, test training results, and improve players' actual competitive experience. It is also an indispensable practical link to comprehensively improve the development level of orienteering. Table 5 shows the events the Harbin Engineering University orienteering team held and participated in throughout the year.

Given sufficient funds, professional orienteering equipment should be used in training for events at all levels to achieve better results. Due to the relatively high price of professional equipment for orienteering events, in case of insufficient funds, a variety of methods such as copying symbols can be adopted at association-level orienteering events to replace orienteering equipment, while professional orienteering equipment must be used for higher-level orienteering events.

Table 5  
List of annual orienteering events of Harbin Engineering University orienteering team

Event level	Event items	Event effect
Association	Campus, park, and mountain simulation events	Twice a month, strengthen organizational construction, promote orienteering, and train players
School	At the school: orienteering contest Intercollegiate: Harbin and Changchun college exchange contest	Popularize and promote orienteering Five times a year, exchange and discuss experience, improve players' level, and enrich practical experience
Provincial	Heilongjiang Student Orienteering Championship	About once a year, exchange with provincial teams
National	National Student Orienteering Championship National Demonstration-Map Identification and Use Competition	Annually, have a competition with national elite team, comprehensively test the training results of the year, seek deficiencies, and make improvements

## 5. Discussion

Over the years, orienteering in China has had little popularity. The main reason is the lack of teaching resources. There are few professional orienteering teachers, training institutions, and teaching materials in China. In addition, the development of orienteering requires professional equipment, such as large-scale topographic maps, orienteering punches, north arrows, paper cards, and software systems. There are few domestic manufacturers of such equipment, and the high price makes many companies decline. Moreover, orienteering lacks publicity. As a result, it is a popular movement among all kinds of people in the West, but is rarely known in China, and little known by young college and middle school students.

In view of this, this paper constructs a four-in-one orienteering development model including theory course, society, teams, and events. Orienteering courses are the theoretical and teaching basis for developing the sport, and colleges and universities must establish a curriculum development system for orienteering. Social organizations such as associations that focus on promoting orienteering with no threshold set for membership are designed to popularize the sport, as well as basic organizations for teams. Orienteering and other competitive players are selected from elite members of orienteering associations to form teams that enhance the competitive level of the sport. Comprehensive events fully expand the influence of orienteering, improve the level of athletes, and test the sport's development level. The research results have practical significance for engaging in orienteering.

Fortunately, although orienteering in China is at a relatively low level, it has demonstrated a rapid development trend in recent years. With the steady growth of China's economy, more orienteering mapping and equipment companies have emerged, providing equipment support for orienteering development. Also, there are more domestic professional training and academic exchanges, and more university teachers and social personnel have become professional orienteering teachers. Orienteering has gradually entered the college classroom, and more middle school students have started to participate as well. Domestic professional competitions are increasing year by year, gradually showing economic and cultural social benefits [27]. There are also more orienteering clubs, which increases publicity and enhances teaching resources. In addition, China has many favorable conditions for the development of orienteering. Its vast territory and diverse terrain are conducive to the development of various types of orienteering. The spirit of harmonious union between people and nature and self-improvement embodied in orienteering conform to the traditional Chinese ideology, which helps attract the participation of more Chinese adolescents. Orienteering is thus developing toward becoming a popular mass fitness movement in China.

## 6. Conclusions

Combining the climate and economic characteristics of northeast China and the practice of orienteering

at Harbin Engineering University, this paper conducts theoretical analysis and practical research on the development of orienteering at colleges and universities in northeast China considering the aspects of course teaching, organization publicity and construction, daily training of teams, and organization of events. The exploratory experience also has certain reference significance for universities and other social organizations around the world engaging in orienteering, especially in areas where it is poorly developed. With the progress of society and people's growing demand for new healthy sports activities, China and other countries with a late start on orienteering are bound to move toward embracing it, and it will become more popular in the world.

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### Conflict of interest

None to report.

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