Applied Mathematics and Nonlinear Sciences

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Informationisation of teaching model for track and field education based on finite element higher-order fractional differential equation

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Submission Info

Communicated by Juan Luis García Guirao

Received June 17th 2021

Accepted September 24th 2021

Available online November 22nd 2021

Abstract

In order to study the informationised teaching model of track and field education, this paper uses the finite element higher-order fractional differential equation to simulate, to provide high-quality, strong resistance to pressure, physical and mental health talents for the development of the country, through the study of the higher-order fraction of the finite element and track and field course intended to strengthen the application in the innovation of track and field course. The results show that based on the finite element theory of higher-order fractional differential equation, a new teaching model is constructed to solve the current difficulties faced by track and field. Starting from the teaching end, pay attention to the quality of output so as to achieve the purpose of training qualified personnel. Conclusion: In the course of track and field classroom practice based on finite element high-order fractional differential equation, students' enthusiasm is mobilised, and they take the initiative to learn knowledge and master skills.

Keywords: finite element, differential equation, track and field education, information-based teaching**AMS 2010 codes:** 97B10

1 Introduction

Education informatisation is in the 1990s, with the construction of the information highway and, refers to computer technology, network technology, virtual reality, artificial intelligence and communication technology and other modern information technologies in the education of comprehensive application, with the modern information technology to construct a network, the combination of digital and intelligent education environment. The essence of school education informationisation is to use modern information technology and modern

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education theory to build the school into an environment full of information, convenient for learners to obtain information and cultivate innovative talents [1]. With the improvement of the degree of educational information, the modern teaching material system is also gradually integrated and serialised, so that people can effectively choose the corresponding learning resources according to different conditions, purposes and stages [2].

Through the innovation of track and field courses, train outstanding track and field talents. Innovate classroom teaching mode, cultivate students' innovation ability, cooperation ability and language expression ability. Through the innovation of the class, increase the interest of the class, make the students actively involved in the track and field learning, cultivate a group of high-quality students who are interested in track and field and are willing to promote the development of track and field. The ultimate aim is to cultivate students' interest in physical exercise and establish their consciousness of life-long exercise through the innovation of college physical education class.

Regarding the research of track and field, our country has been carrying out, more than half a century, track and field events, which is the mother of sports, and the research of track and field is also paid attention to [3]. In the China National Knowledge Network (CNKI) with track and field as the keyword search, you can retrieve 20,879 items, mainly in the research of track and field sports, sports workers, athletes, track and field teaching, and coaches. Among them, there are 2171 track and field teaching, and the earliest research on track and field teaching is Wang Deping and Xu Xiaoying, in 20 September 1997, published in the sports research [4].

The main research is to overcome the psychological barriers in track and field teaching of high-altitude sports speciality. Peng Yihai and Liu Yuan, on 18 November 1997, published in the fifth national sports science conference abstract compilation, which involved mainly research of junior high school track and field teaching development of students' personality [5]. The 'Analysis of Current Situation and Reform of College Athletics and Track Course' written by Xu Bo starts from the value of college track and field course through the analysis of current situation of track and field teaching course [6].

The value of track and field classes is that there are few restrictions and most events can be done outdoors. Track and field is the mother of sports, and from the track and field class one can understand the scientific training methods, hard-working spirit and team cooperation ability. It is also the best way to keep fit. But at the same time, the current situation of track and field courses in colleges and universities also exists. The number of sports facilities is limited, which cannot meet the needs of teachers and students. Second, some students' physical quality is very poor: some being the only child, spoiling and unhealthy lifestyle lead to the poor quality of students. This makes teaching more difficult. The teaching mode is backward, and the teachers in colleges and universities still adhere to the traditional teaching methods and models, which cannot meet the requirements of the recent times. It is necessary to break the routine, innovate the classroom, constantly improve students' interest in track and field, cultivate good sports habits and improve their physical quality [7].

Liu Qingfeng wrote 'analysis of the current situation of track and field teaching in ordinary colleges and universities and reform countermeasures' on the current stage of track and field teaching problems were studied, and the article highlighted the current problems as (1) teaching facilities are not perfect, students cannot enjoy quality sports facilities and the enthusiasm of students will be greatly reduced. Also, the teaching will be affected and they will not be able to complete their teaching tasks. (2) No strong professional teaching. The quality of college teachers is not high, and there is a lack of basic professional knowledge, which cannot give students professional guidance. (3) Insufficient teaching time. Ordinary colleges and universities' track and field teaching time is insufficient, and even a lot of universities have cancelled track and field classes. The serious lack of teaching time makes it difficult for students to learn real track and field knowledge to form long-term muscle memory and to form movement stereotypes, leading to unscientific sports practice [8].

The Teaching Reform and Innovation of Track and Field General Course based on the Background of Applied Talents written by Zhao Yanyan reflects the necessity of track and field course reform through the description of the historical background, with the deepening of curriculum reform in China, in order to meet the needs. The Times, track and field, as a major educational discipline, plays a vital role in the cultivation of students' comprehensive quality. Strengthening track and field teaching is conducive to cultivating applied talents

in sports, assisting other disciplines, jointly cultivating talents with balanced development of moral, intellectual, physical, aesthetic and labour, and providing high-quality applied talents for the society [9].

There are abundant research on the teaching reform and evaluation system of track and field in China, which expound the basic function of track and field from many aspects. There is a systematic summary of perfect countermeasures, but these countermeasures have not been put into action and only empty talk countermeasures. In the practical application process, or in following the traditional teaching methods and traditional evaluation system, the curriculum innovation has not been put into practice.

In recent years, fractional differential equations have been widely used in various scientific fields: for example, mechanics (viscoelastic and viscoplastic theory), biochemistry (polymer and protein models), electrical engineering (ultrasonic propagation), medicine (human tissue models under mechanical loads), etc. Several classics also emerged: for example, Oldham and Spanier, Samko, Kilbas and Marichev, Miller and Ross, and Podlubny on the theory of fractional-order calculus. Hilfer's 'Applications of Fractional Calculus in Physics', Mainardi's 'Linear Viscoelastic Fractional Calculus and Fluctuations: An Introduction to Mathematical Models', Tarasov's 'Fractional Dynamic Systems: Particles,' Application of Fractional Calculus for Fields and Media, and Klafter and Sokolov's discussion of the continuous time random walk model with power-law waiting time distribution [10]. Stochastic Models of Fractional Calculus by Meerschaert and Sikorskii and Applications of Fractional Calculus in Mechanics by Atanacković et al. are derived. It includes 'Modeling Fractional Derivatives for Mechanics and Engineering Problems' written by Chinese scholar Professor Chen Wen et al. and 'Fractional Partial Differential Equations and Their Numerical Solutions' written by Academician Guo Bailing et al.

The innovation of this paper based on the finite element theory of higher-order fractional differential equation, a new teaching model, is constructed to solve the current difficulties faced by track and field.

2 Research methods

The construction of a healthy China cannot be separated from the help of sports. Mass sports are carried out in full swing, but the popularity is low, the participation scope is narrow and the participation group is relatively single. Investigating its reasons has the following three points: (1) sports infrastructure is not perfect, (2) lack of health management awareness, physical exercise awareness needs to be strengthened and (3) lack of professional social sports instructors. In the past 40 years, with the deepening of reform and opening up, people's material living standards have improved significantly. It is no longer a problem for people to have enough to eat and warm clothes. People continue to pursue a high-quality life and pay more attention to their health. Health comes from two aspects, one is a healthy diet and healthy work and rest rules; second, physical exercises after meals. In this context, sports talents are particularly critical. Through what I have learned, I can drive the upsurge of physical exercise around me, pass on correct exercise methods, give scientific physical guidance and create a good atmosphere of mass physical exercise.

2.1 Current track and field curriculum setting and operation mechanism

The traditional evaluation method consists of technical courses, theoretical courses and ordinary grades, with technical courses accounting for 50%, theoretical courses for 30% and ordinary grades for 20%. The whole track and field course is concentrated in the freshman year, with a total of 144 class hours, which are divided into two semesters. According to Table 1, we can see that technical exams occupy a large proportion of class hours and final scores. The scores of technical courses are determined by students' specific scores. Those students with good physical fitness can run fast, jump high and throw far. By virtue of their physical quality they can get high marks. Students who work hard and make big progress tend to get lower grades. Theory courses lack innovation and the allocation of class hours is relatively small. Theoretical courses are single and lack courses corresponding to social needs. The ultimate goal of training students by school is to adapt to the society and

post needs. That is, to achieve success. Usually the result mainly comes from the student's attendance, the lack of the students' classroom discipline, the effort, the interaction between teachers and students, and students and other comprehensive inspection. In the process of the final set of ordinary grades, teachers' personal emotional factors are mixed; even less can reflect the specific actual situation. In the whole learning process, there is lack of monitoring and adjustment of the learning process and the lack of evaluation of the learning process. These are the courses that need to be revised in the process of reform and according to the actual operation and social needs to make corresponding adjustments.

Table 1 Assessment index of current track and field technical course

Technical courses 50% of the exam	Theory course examination 30%	Usual score 20%
Technical course assessment content: shot-put, high jump, hurdles, etc. pass line 60 points	Technical principle of running jump shot, track and field judging method and field specification, theory examination pass line 60 points	Usually the result is mainly for the attendance record, and the teacher's subjectivity is strong

With the changes in the times and environment, the training mode of track and field talents has been reformed. What follows is the reform of teaching methods and the transformation of traditional teaching methods. On the one hand, it advocates students' active and independent learning, changing the past to passively accept the knowledge. Arouse students' enthusiasm and make students participate in the whole teaching activity. On the other hand, we should change the educational concept of teachers. In the past, we paid attention to curriculum and teaching, but now we pay attention to students and ability – from the instillation of teaching mode to guide students to improve themselves and the knowledge exploration of endogenous motivation. This teaching method can not only put students in the central position but also stimulate students' interest in learning so that the interest in learning can be better transformed into the improvement of learning ability and the acquisition of knowledge.

A four-order precision approximation scheme for spatial fractional derivatives is established, which is called the weighted and shifted Lubich difference operator (WSLD). Then, the spatial fractional diffusion equations of one and two dimensions are solved, the unconditional stability and convergence of the scheme are proved theoretically, and the teaching model of track and field is determined. By using the fractional order linear multistep method, Lubich obtained the L-order precision approximation scheme ($L \leq 6$) for the α -order derivative ($\alpha >$) or integral ($\alpha < 0$) by analysing the coefficients of the generating function $\Delta\alpha(\zeta)$, in which:

$$\delta^\alpha(\zeta) = \left(\sum_{i=1}^L \frac{1}{i} (1 - \zeta)^i \right) \quad (1)$$

When $\alpha = 1$, the scheme degenerates to the classical backward difference formula of $(L + 1)$ point. When $L = 1$, the scheme is transformed into the generating function of the discrete coefficients of the standard α -order Grünwald derivative of the first-order precision. Fortunately, Meerschaert and Tadjeran succeeded in overcoming this difficulty and established the so-called Grünwald formula for displacement.

When $L = 2$, Cuesta et al. discussed the time discrete fractional wave equation. However, when the discrete scheme is applied to the fractional derivative of $\alpha \in (1, 2)$ space, it is unstable for the evolution equation because the eigenvalue of the matrix corresponding to the discrete operator is > 1 . On the other hand, if Lubich's formula of displacement is applied to this formula, it will be reduced to the first-order precision format. Next, we will establish Lubich's operator of weighting and displacement and obtain a class of fourth-order discrete schemes with precision, which will be effectively used to solve the fractional order development equation problem. Then,

we will use the fourth-order scheme to solve the two-dimensional fractional order diffusion equation as follows:

$$\begin{aligned} \frac{\partial u(x,y,t)}{\partial t} &= d_+(x,y) {}_{xL}D_x^\alpha u(x,y,t) + d_-(x,y) {}_{xR}D_x^\alpha u(x,y,t) + e_+(x,y) {}_{yL}D_y^\beta u(x,y,t) + e_-(x,y) {}_{yR}D_y^\beta u(x,y,t) \quad (2) \\ u(x,y,0) &= u_0(x,y) \quad (x,y) \in \Omega \\ u(x,y,t) &= 0 \quad (x,y,t) \in \partial\Omega \cdot (0,T] \end{aligned}$$

The bounded region $\Omega = (x_L, x_R) \times (y_L, y_R)$, $0 < t \leq T$, 0 . The left, $1 < \alpha, \beta < 2$, Riemann-Liouville fractional derivative and the right Riemann-Liouville fractional derivative are defined.

3 Research results

Numerical results further show the correctness of the above theoretical analysis, including the stability and convergence of the numerical values, in which the L^∞ norm is used to measure the numerical errors.

3.1 One-dimensional numerical results

A one-dimensional fractional diffusion equation is considered in which the bounded region 0 the initial value of $u(x,0) = \sin(1)(2_-) \times 4 \times 4$ computer, the boundary conditions of $u(0,t) = u(1,t) = 0$ and the exact solution for $u(x,t) = \sin(t+1)(2_-) \times 4 \times 4$ computer. Table 2 shows the maximum error of $t = 1$, $\tau = h^2$, and the numerical results show the convergence order $O(\tau^2 + h^4)$. The maximum error and convergence order of the numerical scheme, where $t = 1$, $\tau = h^2$.

Table 2 Maximum error and convergence order of one dimension

$(p, q, r, s, \bar{p}, \bar{q}, \bar{r}, \bar{s})$	h	$a = 1.1$	convergence orde	$a = 1.9$	convergence orde
(1, 2, 1, 0, 1, 2, 1, -2)	1/10	4.7842e-03		5.8264e-03	
	1/20	2.5436e-04	4.2333	5.9999e-04	3.2796
	1/40	1.9662e-05	3.6934	4.6242e-05	3.6977
	1/60	4.1748e-06	3.8218	9.7725e-06	3.8334
(1, 2, 1, -3, 1, 2, 1, -2)	1/10	8.5475e-03		5.5003e-03	
	1/20	4.9722e-04	4.1035	5.7476e-04	3.2585
	1/40	3.9559e-05	3.6518	4.4490e-05	3.6914
	1/60	8.6604e-06	3.7464	9.4148e-06	3.8301

3.2 Two-dimensional numerical results

Consider the two-dimensional fractional diffusion Eq. (2), where 0 variable coefficient $d_+(x,y) = x\alpha$, $d_-(x,y) = 2x(x,y) = \alpha$, $e_+(x,y) = y\beta$, $e_-(x,y) = 2y(y) = \beta$ and the initial value of zero boundary conditions for $u(x,y,0) = \sin(1)(2_-) \times 4 \times 4$ computer $y^4(2-y)^4$, the exact solution for $u(x,y,t) = \sin(t+1)(2_-) \times 4 \times 4$ computer $Y^4(2_-)y^4$. By these conditions, can get the source function $f(x,y,t)$.

Table 3 The maximum error of numerical format (2.56) and the order of convergence, the $t = 1$, $\tau = as(\delta) \times 2 = as(\delta y)^2$.

$(p, q, r, s, \bar{p}, \bar{q}, \bar{r}, \bar{s})$			convergence orde		convergence orde
(1, 2, 1, 0, 1, 2, 1, -2)	1/10	8.6154e-03		6.6647e-003	
	1/20	5.4115e-04	3.9928	4.5632e-004	3.8684
	1/30	1.2626e-04	3.5894	9.0006e-005	4.0036
	1/40	4.3328e-05	3.7177	2.8287e-005	4.0235

The numerical results in Table 3 show an order of convergence $O(\tau + (\Delta x)^4 + (\Delta y)^4)$.

4 Conclusion

The track and field course model based on the finite element high-order fractional differential equation meets the needs of the times, starts from the quality of output and comprehensively sets up various course contents, which can meet students' demands for ability and significantly improve students' satisfaction with the class. The comprehensive evaluation, such as process monitoring and evaluation, and final evaluation and personal progress, can stimulate students' interest in learning, mobilise their enthusiasm and guide students to change from passively accepting knowledge to actively acquiring it. In the process of setting learning goals, students can feel the expectations of teachers, the needs of society and self-motivation. Comprehensive measures ensure the quality of training output.

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