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School physical education reformation institutionalization game analysis and structural reform trend research

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ABSTRACT

Young are strong, the country strong. As country's hope and future, teenager physical quality are particularly important, but in the society that is centered on economic construction, school sports system appears some loopholes that cause teenager sports activities cannot arrive at expected efficiency, in order to find out school sports reformation system form obstacles, the paper firstly solves government and school optimal strategies on solving school sports reformation institutionalization problems by game analysis and evolution game analysis. Then establish analytic hierarchy process model, solve school sports reformation system situation obstacles upmost factors when considering the enrollment rate, the sport construction funds, the school subject thought and the leadership system as well as other influence factors.

KEYWORDS

Game theory; Evolution game analysis; AHP; School physical education; System reformation.



INTRODUCTION

A country’s physical education cultural development level is an important standard to reflect whether the country is healthy or not. And among them, construction of teenager physical education system is even top priority. Because teenager is national precious treasure and hope. With Chinese rapidly development, historical task of building socialism society is still very arduous, which needs teenagers to make arduous efforts to build national future. However in the developed informational society, lots of teenagers keep indoors due to be addicted to network, which causes their physical qualities are sharply dropping, and teenagers exercises time and opportunities also become fewer and fewer, school’s physical exercising time becomes main parts of teenager training physique, but schools sports system has some loopholes that lead to teenager sports activities cannot arrive at expected efficiency, therefore it is necessary for country to reform school physical education system, help teenager to return to outdoors, and restore health. The paper will make researches and analysis of school physical education institutionalization and reform system existing form obstacle.

MODEL ESTABLISHMENT

School physical education reformation institutionalization game analysis

In the problem of school physical education reformation institutionalization, it takes government and schools as influence subjects, therefore below game analysis can roughly regard government and school as main parts of game, both their implemented strategies are two kinds, government strategy is coordination and don’t coordinate. Government and school game process is as Figure 1 shows.

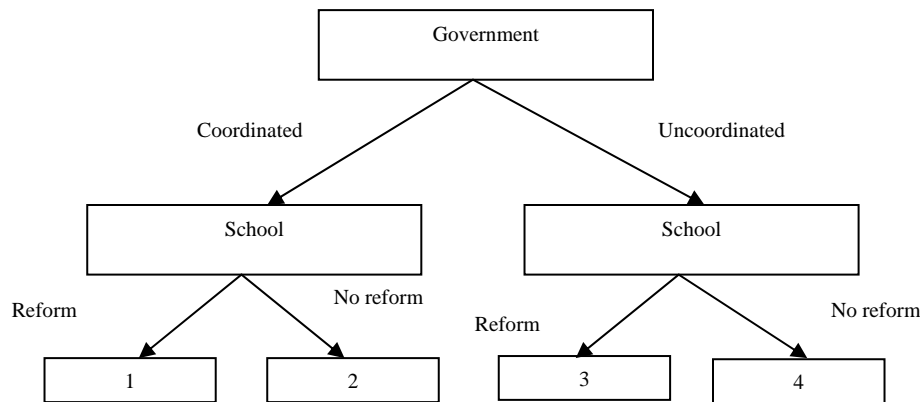


Figure 1 : Government and school game tree schematic diagram

Set in case government coordinates school physical education reformation while school doesn’t reform, government earnings is C_1 , school earnings is 0 ;on the contrary school takes physical education reformation while government doesn’t play coordination role, school earnings is C_1' ,government earnings is C_2 ,reason is though government don’t play coordination roles, but school reformation is beneficial to social development. When both government and school are with positive attitudes, government earnings is C ,school earnings is C' ;if both government and school are not positive, then the two earnings are 0 . TABLE 1 is government and school physical education reformation earnings matrix.

TABLE 1 : Government and school physical education reformation earnings matrix

		School	
		Reform	Don’t reform
Government	Coordinate	C, C'	$C_1, 0$

Don't coordinate	C_2, C_1'	0,0
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Among them, $C > C_1 > C_2$, but size of C', C_1' cannot define, therefore the paper will adopt evolution game analysis to analyze government and school physical education reformation institutionalization practices, and make respectively strategies adjustment.

School physical education reformation institutionalization evolution game analysis

Due to government and school positive and negative strategies selection in school physical education reformation is independent and random and can carry on repeated games. Therefore, set government support social organization probability to be p , probability that don't support is $1-p$; school reformation probability is q , probability that don't reform is $1-q$. According to Malthusian

theorem, it is clear that government strategies support times selection growth rate should be $\frac{\dot{p}}{p}$ that is difference between fitness $E_w T \{f, 1-q\}^T$ and average fitness $\{p, 1-p\} T \{q, 1-q\}^T$. $E_w = [1, 0]$, when government support probability is 1, its earnings matrix is:

$$T = \begin{bmatrix} C & C_1 \\ C_2 & 0 \end{bmatrix}$$

Simplify $\dot{p} = p(1-p)\{1, -1\} T \{q, 1-q\}^T$ and get: $\dot{p} = p(1-p)[(C - C_1 - C_2)q + C_1]$

Similarly, school strategy of selection construction times growth rate should be $\frac{\dot{q}}{q}$ that is difference between fitness $E_j F \{q, 1-q\}^T$ difference between fitness $\{q, 1-q\} F \{p, 1-p\}^T$. $E_j = [0, 1]$, When school reformation probability is 1, its earnings matrix is:

$$F = \begin{bmatrix} C' & 0 \\ C_1' & 0 \end{bmatrix}$$

Simplify $\dot{q} = q(1-q)\{-1, 1\} F \{p, 1-p\}^T$ and get:

$$\dot{q} = q(1-q)[C_1' + (C' - C_1')p]$$

Therefore when $\dot{p} = 0, \dot{q} = 0, (0,0), (0,1), (1,0), (1,1)$ are school physical education reformation institutionalization balance points. According to matrix stability, analyze these balance points partial stability, solve partial derivatives of \dot{p} to p , and partial derivatives of \dot{q} to q , matrix is:

$$R = \begin{bmatrix} \frac{\partial \dot{p}}{\partial p} & \frac{\partial \dot{p}}{\partial q} \\ \frac{\partial \dot{q}}{\partial p} & \frac{\partial \dot{q}}{\partial q} \end{bmatrix} = \begin{bmatrix} (1-2p)[(C - C_1 - C_2)q + C_1] & p(1-p)(C - C_1 - C_2) \\ q(1-q)(C' - C_1') & (1-2q)p \end{bmatrix}$$

Among them:

$$\det R = (1-2p)(1-2q)[(C - C_1 - C_2)q + C_1][C_1' + (C' - C_1')p] - pq(1-p)(1-q)(C - C_1 - C_2)(C' - C_1')$$

$$trR = (1-2p)[(C - C_1 - C_2)q + C_1] + (1-2q)[C_1' + (C' - C_1')p]$$

TABLE 2 is balance point partial stability.

TABLE 2: Balance point partial stability

Balance point (p, q)	det R		trR		Stability
(0,0)	$C_1 \bullet C_1'$	+	$C_1 + C_1'$	+	unstable point
(0,1)	$-(C - C_2) \bullet C_1'$	-	$C - C_2 - C_1'$	Unknown	Saddle point
(1,0)	$-C_1 \bullet C'$	-	$C' - C_1$	Unknown	Saddle point
(1,1)	$(C - C_2) \bullet C'$	+	$-(C - C_2 + C')$	-	Stable point

By above TABLE 2, it is clear (0,0) point is unstable point, (0,1) and (1,0) are saddle points, evolution stable point is(1,1). Therefore government and school optimal strategy on school physical education reformation institutionalization is school should positive carry on physical education reformation, and government also should positive carry on coordination, it had better let state education commission and national sports commission to joint solve school physical education reformation institutionalization’s coordination problems.

Construct hierarchical structure

In order to analyze school physical education reformation institutionalization main forms obstacle, it should find out school physical education reformation institutionalization main forms obstacle, and find out each unit contribution degree, therefore the paper first bases on analytic hierarchy process, make quantization on school physical education reformation institutionalization main forms obstacle sources. Establish target layer, criterion layer and scheme layer relations.

Target layer: The mains obstacle to reform school physical education.

Criterion layer: Scheme influence factors, c_1 is the enrollment rate , c_2 is the sport construction funds, c_3 is the school subject thought, c_4 is leadership system.

Scheme layer: a_1 is the lack of sports equipment. a_2 is pursue the one sided develop, a_3 is the lack of overall thought, it gets hierarchical structure as Figure2 shows.

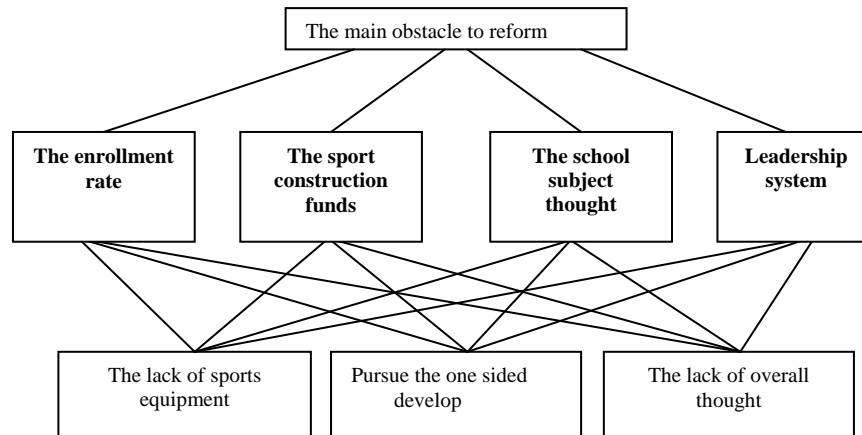


Figure 2 : Hierarchical structure

Construct judgment matrix

According to lots of experts experiences and referencing lots of documents as well as 1~9 scale setting, it gets paired comparison matrix that is judgment matrix as TABLE 3-7.

TABLE 3 : Comparison matrix G

G	c_1	c_2	c_3	c_4
c_1	1	1/4	5	6
c_2	4	1	8	5
c_3	1/5	1/8	1	1
c_4	1/6	1/5	1	1

TABLE 4 : Comparison matrix c_1

c_1	a_1	a_2	a_3
a_1	1	1	1/5
a_2	1	1	1/4
a_3	5	4	1

TABLE 5 : Comparison matrix c_2

c_2	a_1	a_2	a_3
a_1	1	4	5
a_2	1/4	1	6
a_3	1/5	1/6	1

TABLE 6 : Comparison matrix c_3

c_3	a_1	a_2	a_3
a_1	1	6	6
a_2	1/6	1	7
a_3	1/6	1/7	1

TABLE 7 : Comparison matrix c_4

c_4	a_1	a_2	a_3
a_1	1	5	7
a_2	1/5	1	5
a_3	1/7	1/5	1

Consistency test

Use consistency test formula as: $CI = \frac{\lambda_{\max} - n}{n - 1}$. Among them, λ_{\max} is maximum feature root value of comparison matrix, n is comparison matrix order. It is clear that judgment matrix and CI value are in inverse proportion.

$$C = \begin{Bmatrix} 1 & 1/4 & 5 & 6 \\ 4 & 1 & 8 & 5 \\ 1/5 & 1/8 & 1 & 1 \\ 1/6 & 1/5 & 1 & 1 \end{Bmatrix}$$

$$\begin{array}{l} \text{Column vector normalization} \end{array} \rightarrow \begin{Bmatrix} 0.233 & 0.192 & 0.5 & 0.4 \\ 0.066 & 0.557 & 0.3 & 0.2 \\ 0.142 & 0.123 & 0.1 & 0.2 \\ 0.221 & 0.115 & 0.2 & 0.1 \end{Bmatrix}$$

$$\begin{array}{l} \text{Solve sum by line} \end{array} \rightarrow \begin{Bmatrix} 1.186 \\ 2.42 \\ 0.386 \\ 0.3098 \end{Bmatrix}$$

$$\begin{array}{l} \text{Normalization} \end{array} \rightarrow \begin{Bmatrix} 0.4240 \\ 0.4202 \\ 0.0935 \\ 0.0838 \end{Bmatrix} = U^{(0)}$$

$$CU^{(0)} = \begin{Bmatrix} 1 & 1/4 & 5 & 6 \\ 4 & 1 & 8 & 5 \\ 1/5 & 1/8 & 1 & 1 \\ 1/6 & 1/5 & 1 & 1 \end{Bmatrix} \begin{Bmatrix} 0.4240 \\ 0.4202 \\ 0.0935 \\ 0.0838 \end{Bmatrix} = \begin{Bmatrix} 2.448 \\ 3.521 \\ 1.423 \\ 1.840 \end{Bmatrix}$$

$$\lambda_{\max}^{(0)} = \frac{1}{4} \left(\frac{2.448}{0.4202} + \frac{3.521}{0.4240} + \frac{1.423}{0.0935} + \frac{1.840}{0.0838} \right) = 4.33$$

$$u^{(0)} = \begin{Bmatrix} 0.233 \\ 0.425 \\ 0.115 \\ 0.227 \end{Bmatrix}$$

Judgment matrix is:

$$C_1 = \begin{Bmatrix} 1 & 1 & 1/4 \\ 1 & 1 & 1/4 \\ 4 & 4 & 1 \end{Bmatrix}, C_2 = \begin{Bmatrix} 1 & 3 & 3 \\ 1/3 & 1 & 5 \\ 1/3 & 1/5 & 1 \end{Bmatrix}, C_3 = \begin{Bmatrix} 1 & 6 & 7 \\ 1/6 & 1 & 5 \\ 1/7 & 1/5 & 1 \end{Bmatrix}, C_4 = \begin{Bmatrix} 1 & 4 & 5 \\ 1/4 & 1 & 5 \\ 1/5 & 1/5 & 1 \end{Bmatrix}$$

Corresponding maximum feature value and feature vector are in order as:

$$\lambda_{\max}^{(1)} = 3.84, u_{11}^{(1)} = \begin{Bmatrix} 0.346 \\ 0.346 \\ 0.472 \end{Bmatrix} \lambda_{\max}^{(2)} = 3.47, u_{22}^{(1)} = \begin{Bmatrix} 0.547 \\ 0.256 \\ 0.096 \end{Bmatrix}$$

$$\lambda_{\max}^{(3)} = 2.43, u_{33}^{(1)} = \begin{Bmatrix} 0.520 \\ 0.243 \\ 0.158 \end{Bmatrix} \lambda_{\max}^{(4)} = 3.41, u_{44}^{(1)} = \begin{Bmatrix} 0.576 \\ 0.342 \\ 0.256 \end{Bmatrix}$$

According to $CI = \frac{\lambda_{\max} - n}{n - 1}$ it gets RI value that can refer to TABLE 8.

TABLE 8 : RI value

n	1	2	3	4	5	6	7	8	9	10	11
RI	0	0	0.58	0.90	1.12	1.24	1.32	1.41	1.45	1.49	1.51

For judgment matrix C , $\lambda_{\max}^{(0)} = 3.84, RI = 0.81$

$$RI = \frac{3.84 - 3}{3 - 1} = 0.042$$

$$CR = \frac{CI}{RI} = \frac{0.42}{0.81} = 0.05 < 0.1$$

It represents C inconsistency extent is within permissible range, now it can use C feature vector to replace weight vector.

Similarly, to judgment matrix C_1, C_2, C_3, C_4 , utilize above principle, all pass consistency test. Therefore target layer to scheme layer computational result can refer to Figure 3.

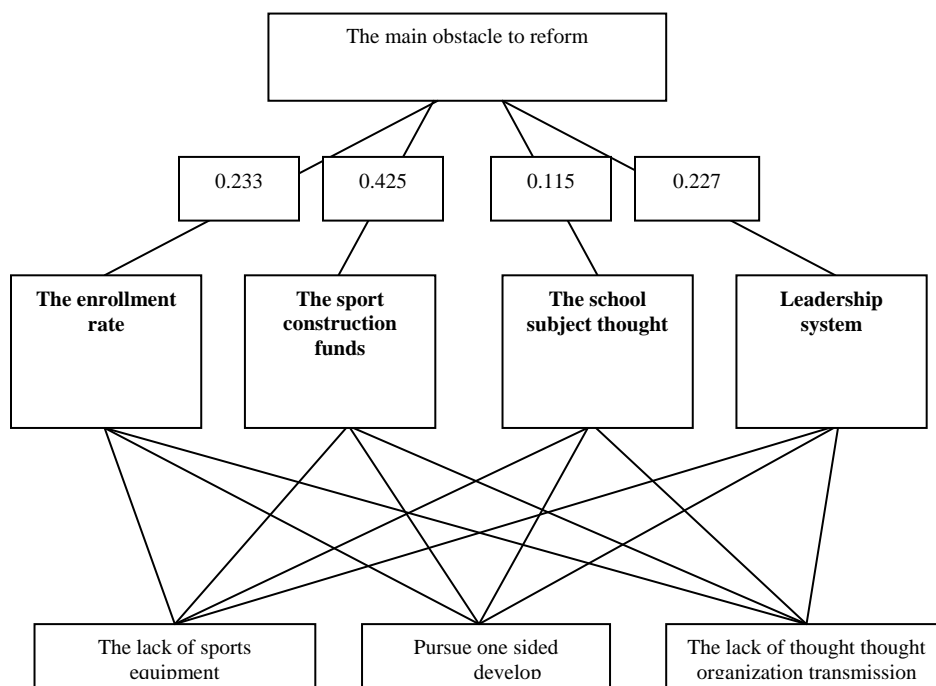


Figure 3 : Target layer to Scheme layer calculation result

$$\left\{ \begin{matrix} 0.346 \\ 0.346 \\ 0.472 \end{matrix} \right\}, \left\{ \begin{matrix} 0.547 \\ 0.256 \\ 0.096 \end{matrix} \right\}, \left\{ \begin{matrix} 0.520 \\ 0.243 \\ 0.158 \end{matrix} \right\}, \left\{ \begin{matrix} 0.576 \\ 0.342 \\ 0.256 \end{matrix} \right\}$$

Calculation structure is as following:

$$u^{(1)} = (u_1^{(1)}, u_2^{(1)}, u_3^{(1)}, u_4^{(1)})$$

$$= \left\{ \begin{matrix} 0.346 & 0.547 & 0.520 & 0.576 \\ 0.346 & 0.256 & 0.243 & 0.342 \\ 0.472 & 0.096 & 0.158 & 0.256 \end{matrix} \right\}$$

$$u = u^{(1)} u^{(0)}$$

$$= \left\{ \begin{matrix} 0.346 & 0.547 & 0.520 & 0.576 \\ 0.346 & 0.256 & 0.243 & 0.342 \\ 0.472 & 0.096 & 0.158 & 0.256 \end{matrix} \right\} \left\{ \begin{matrix} 0.233 \\ 0.425 \\ 0.115 \\ 0.227 \end{matrix} \right\}$$

$$= \left\{ \begin{matrix} 0.272 \\ 0.454 \\ 0.284 \end{matrix} \right\}$$

By above formula, it can get that in school physical education reformation system situation obstacle, the lack of sports equipment, pursue the one sided develop, and the lack of overall thought respective occupied proportions are 0.272, 0.454 and 0.284.

CONCLUSION

The paper firstly uses game analysis and evolution game analysis, it solves government and school optimal strategy on solving school physical education reformation institutionalization problem is school should positive carry on physical education reformation, and government also should positive carry on coordination, it had better let state education commission and national sports commission to joint solve school physical education reformation institutionalization's coordination problems. Then it establishes analytic hierarchy process model, solves school sports reformation system situation obstacles' the lack of sports equipment, pursue the one sided develop, and the lack of overall thought respective occupied proportions are 0.272, 0.454 and 0.284 when considering the enrollment rate, the sport construction funds, the school subject thought and the leadership system and other influence factors. It finds out school physical education reformation system situation obstacle upmost factors.

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