

Mathematical Models to Study the Effect on Preschool Children Development of Adding Game Elements into Sports

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Abstract — Preschool stage plays an important development role, and also builds good foundation for future learning and working. Therefore, it is required to develop a sense of morality, intelligence, physique, aesthetics and labor in an all-around manner. Sport is an important mean to strengthen preschool children's physical quality, and game element occupies proportions in sports and make important contributions to the development of preschool children in physical, psychological and others aspects. The paper proposes mathematical models that can be used to study the effect of adding games elements to sport for preschool children.

Keywords - sports games; preschool children; physical and psychological health

I. INTRODUCTION

Preschool children are more intensely fond of games by comparing to sports due to immature psychology, however, games lack of safety and rationality by comparing to sports. Due to preschool children in games has not received scientific training on body but can cause damage to the body due to dangerous games, sports is necessary to preschool children [1-3].

The paper studies to include game element into sports, which not only trains preschool children physically and psychologically, but also greatly attracts preschool children to positively participate in sports [4].

As Table 1 shows, parents often play games with children, fewer families choose sports, so it is particularly important to combine games with sports that increase sports interest and also improve physical quality of preschool children [5-8].

TABLE 1. GAMES THAT PARENT AND CHILDREN OFTEN PLAY

Item	Number of Selection on the Sports	Percentage
Game	265	86.5
Bicycle riding	451	55.0
Rubber band skipping rope skipping	156	38.9
Scooter, skating	154	35.4
Do gymnastics	246	45.5
Swimming	106	22.6
Running	135	27.5
Kicking a ball	156	29.6
Play table tennis, badminton	55	14.3
Beating spinning top	65	15.2
Shuttlecock kicking	106	24.5
Martial Arts	32	5.6
Others	56	14.5

II. MODEL ESTABLISHMENTS

Analytic hierarchy process enables to organically combine qualitative analysis with quantitative analysis to make multiple-objective decision analysis. The approach is able to analyze factors that are included in a problem according to their occupied weight and divide a problem influence factors into different levels.

Humanistic education contains students' learning on humanity history and folk customs and culture. For students undertaking preschool children education, except for contacting with available learning courses in class, walk out of classroom and accept reasonable game education is an important link in cultivating preschool children fitness consciousness. The development of preschool children education is originated from continuous inspiration of students on learning, family and friends, only the enlightenment consciousness of children are strong enough then their ability to life can be continuously improved. For preschool children, different types of characters always decide students' future tendency, improvement of students' personality in school's learning is an important link in students' learning out of classroom.

A. Establishing Hierarchical Structure

The paper establishes a clear and well-organized structure for problems, and establishes three layers' relations. Classified layer number is related to complex degree and detail level of research objects. The paper utilizes analytic hierarchy process to make quantization on preschool children educational mode. Establish relations among target layer, Criterion layer and Scheme layer.

Target layer: Preschool children educational mode

Criterion layer: Scheme influence factors, C_1 is the consciousness of beauty building, C_2 is consciousness of

enlightenment, c_3 is perfection of character, c_4 is improvement of physical capacity.

Scheme layer: A_1 is sports games, A_2 is game, A_3 is sports.

It gets hierarchical structure, as Figure 1 shows.

B. Construct Each Layer Judgment Matrix

In criterion layer, each criterion target occupies different proportions, by researchers researching on criterion layer, and according to number 1~9 and its reciprocal to judge each criterion target occupied weights.

The paper takes Table 2 showed 1~9 scale table as evidence, it makes weight analysis.

TABLE 2. 1 TO 9 SCALE TABLE

Scale a_{ij}	Definition
1	factor i and factor j have equal importance
3	factor i is slightly more important than factor j
5	factor i is relative more important than factor j
7	factor i is extremely more important than factor j
9	factor i is absolute more important than factor j
2,4,6,8	Indicates middle state corresponding scale value of above judgments
Reciprocal	If factor i and factor j are relative weak, obtained judgment is reciprocal

At first, solve judgment matrix, according to above principle, reference 1~9 scale setting, and according to experts' experiences and refer to lots of documents, it can refer to Figure 1 scale figure of 1 to 9.

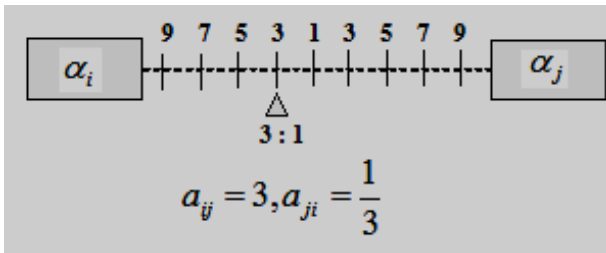


Figure 1. 1~9 scale figure

It gets paired comparison matrix that are respective as Table4-7.

Among them, Table 3 is comparison matrix between target layer and criterion layer, Table 4-7 are comparison matrixes between criterion layer and scheme layers.

TABLE 3. COMPARISON MATRIX G

G	c_1	c_2	c_3	c_4
c_1	1	1/3	3	3
c_2	31/8	1	5	5
c_3	1/3	1/5	1	1
c_4	1/3	1/5	1	1

TABLE 4. COMPARISON MATRIX c_1

c_1	A_1	A_2	A_3
A_1	1	1	1/3
A_2	1	1	1/3
A_3	3	3	1

TABLE 5. COMPARISON MATRIX c_2

c_2	A_1	A_2	A_3
A_1	1	8	7
A_2	1/8	1	5
A_3	1/7	1/5	1

TABLE 6. COMPARISON MATRIX c_3

c_3	A_1	A_2	A_3
A_1	1	5	8
A_2	1/5	1	5
A_3	1/8	1/5	1

TABLE 7. COMPARISON MATRIX c_4

c_4	A_1	A_2	A_3
A_1	1	3	8
A_2	1/3	1	5
A_3	1/8	1/5	1

C. Hierarchical Single Arrangement and Consistency Test

The use of consistency indicator to test: Set in comparison matrix, λ_{max} is maximum feature value is comparison matrix order:

$$CI = \frac{\lambda_{\max} - n}{n - 1}$$

CI Value gets smaller; it shows judgment matrix gets closer to completely consistent. CI gets bigger, it shows that known degree is lower.

D. Hierarchy Total Arrangement and its Consistency Test

$$A = \begin{pmatrix} 1 & 1/3 & 3 & 3 \\ 3 & 1 & 5 & 5 \\ 1/3 & 1/5 & 1 & 1 \\ 1/3 & 1/5 & 1 & 1 \end{pmatrix}$$

By column vector normalization \rightarrow $\begin{pmatrix} 0.224 & 0.152 & 0.37 & 0.25 \\ 0.074 & 0.568 & 0.54 & 0.4 \\ 0.131 & 0.125 & 0.05 & 0.07 \\ 0.181 & 0.125 & 0.14 & 0.05 \end{pmatrix}$

Solve sum by line \rightarrow $\begin{pmatrix} 1.56 \\ 2.12 \\ 0.326 \\ 0.314 \end{pmatrix}$

Normalization \rightarrow $\begin{pmatrix} 0.245 \\ 0.525 \\ 0.095 \\ 0.091 \end{pmatrix} = W^{(0)}$

It gets:

$$AW^{(0)} = \begin{pmatrix} 1 & 1/3 & 3 & 3 \\ 3 & 1 & 5 & 5 \\ 1/3 & 1/5 & 1 & 1 \\ 1/3 & 1/5 & 1 & 1 \end{pmatrix} \begin{pmatrix} 0.2684 \\ 0.554 \\ 0.0987 \\ 0.0524 \end{pmatrix} = \begin{pmatrix} 1.22 \\ 2.247 \\ 0.375 \\ 0.334 \end{pmatrix}$$

$$\lambda_{\max}^{(0)} = \frac{1}{4} \left(\frac{1.054}{0.257} + \frac{2.254}{0.786} + \frac{0.257}{0.045} + \frac{0.457}{0.078} \right) = 4.038$$

$$w^{(0)} = \begin{pmatrix} 0.274 \\ 0.551 \\ 0.042 \\ 0.036 \end{pmatrix}$$

Similarly, it can calculate judgment matrix:

$$B_1 = \begin{pmatrix} 1 & 1 & 1/3 \\ 2 & 1 & 1/3 \\ 3 & 6 & 1 \end{pmatrix}, B_2 = \begin{pmatrix} 1 & 5 & 5 \\ 1/5 & 1 & 2 \\ 1/5 & 1/5 & 1 \end{pmatrix},$$

$$B_3 = \begin{pmatrix} 1 & 6 & 8 \\ 1/5 & 1 & 5 \\ 1/8 & 1/5 & 1 \end{pmatrix}, B_4 = \begin{pmatrix} 1 & 8 & 8 \\ 1/5 & 1 & 5 \\ 1/8 & 1/5 & 1 \end{pmatrix}$$

By above, it is clear that the paper takes preschool children educational mode maximum feature value and feature vector as weights to analyze, and establishes weight hierarchical figure.

$$\lambda_{\max}^{(1)} = 3.31, \omega^{(1)}_1 = \begin{pmatrix} 0.252 \\ 0.089 \\ 0.66 \end{pmatrix}$$

$$\lambda_{\max}^{(2)} = 3.12, \omega^{(1)}_2 = \begin{pmatrix} 0.575 \\ 0.286 \\ 0.139 \end{pmatrix}$$

$$\lambda_{\max}^{(3)} = 3.30, \omega^{(1)}_3 = \begin{pmatrix} 0.624 \\ 0.240 \\ 0.136 \end{pmatrix}$$

$$\lambda_{\max}^{(4)} = 4.05, \omega^{(1)}_4 = \begin{pmatrix} 0.185 \\ 0.240 \\ 0.575 \end{pmatrix}$$

Use consistency indicator to test:

$$CI = \frac{\lambda_{\max} - n}{n - 1}, CR = \frac{CI}{RI}$$

See 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

It gets judgment matrix:

$$A, \lambda_{\max}^{(0)} = 4.073, RI = 0.9$$

$$CI = \frac{4.073 - 4}{4 - 1} = 0.24$$

$$CR = \frac{CI}{RI} = \frac{0.024}{0.90} = 0.027 < 0.1$$

It shows A inconsistency test is valid and moves within permissible range, it can use A feature vector to replace weight vector.

(2) Similarly, make consistency test on judgment matrix B_1, B_2, B_3, B_4 , it gets weight vectors.

Utilize hierarchical chart drawing out calculation results from target layer to scheme layer.

Calculation structure as following:

$$\omega^{(1)} = (\omega_1^{(1)}, \omega_2^{(1)}, \omega_3^{(1)}, \omega_4^{(1)})$$

$$= \begin{Bmatrix} 0.627 & 0.173 & 0.152 & 0.565 \\ 0.237 & 0.238 & 0.082 & 0.276 \\ 0.142 & 0.587 & 0.66 & 0.139 \end{Bmatrix}$$

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

$$= \begin{Bmatrix} 0.25 & 0.584 & 0.664 & 0.175 \\ 0.074 & 0.278 & 0.220 & 0.243 \\ 0.67 & 0.151 & 0.126 & 0.545 \end{Bmatrix} \begin{Bmatrix} 0.557 \\ 0.037 \\ 0.114 \\ 0.286 \end{Bmatrix}$$

$$= \begin{Bmatrix} 0.435 \\ 0.302 \\ 0.273 \end{Bmatrix}$$

The results are valid with regard to preschool children, with sports games having higher proportion at 43.5%.

III. CONCLUSION

Preschool stage plays an important enlightenment role, and should develop morality, intelligence, physique, aesthetics and labor in an all-around way, sports is an important mean to enhance preschool children physical

quality, the preschool children have a more intensely fond of games by comparing to sports due to immature psychology, but games lack of safety and rationality by comparing to sports. Therefore, integrate games and sports are very important.

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