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

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>
<thead>
<tr>
<th>Scale ( a_j )</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>factor i and factor j have equal importance</td>
</tr>
<tr>
<td>3</td>
<td>factor i is slightly more important than factor j</td>
</tr>
<tr>
<td>5</td>
<td>factor i is relative more important than factor j</td>
</tr>
<tr>
<td>7</td>
<td>factor i is extremely more important than factor j</td>
</tr>
<tr>
<td>9</td>
<td>factor i is absolute more important than factor j</td>
</tr>
<tr>
<td>2,4,6,8</td>
<td>Indicates middle state corresponding scale value of above judgments</td>
</tr>
<tr>
<td>Reciprocal</td>
<td>If factor i and factor j are relative weak, obtained judgment is reciprocal</td>
</tr>
</tbody>
</table>

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 1to 9.

![Figure 1. 1–9 scale figure](image)

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.

C. Hierarchical Single Arrangement and Consistency Test

The use of consistency indicator to test: Set in comparison matrix, \( \lambda_{max} \) is maximum feature value is comparison matrix order:
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\[ CI = \frac{\lambda_{\text{max}} - n}{n-1} \]

- **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**

\[
A = \begin{bmatrix}
1 & 1/3 & 3 & 3 \\
3 & 1 & 5 & 5 \\
1/3 & 1/5 & 1 & 1 \\
1/3 & 1/5 & 1 & 1
\end{bmatrix}
\]

By column vector normalization

\[
\begin{align*}
W^{(0)} &= \begin{bmatrix} 0.252 \\ 0.089 \\ 0.575 \\ 0.139 \\ 0.624 \\ 0.240 \\ 0.136 \\ 0.185 \\ 0.240 \\ 0.575 \end{bmatrix} \\
\lambda_{\text{max}} &= 3.31, \omega^{(1)} = \begin{bmatrix} 0.252 \\ 0.089 \end{bmatrix}
\end{align*}
\]

Use consistency indicator to test:

\[ CI = \frac{\lambda_{\text{max}} - n}{n-1}, \quad CR = \frac{CI}{RI} \]

See Table 8.

**TABLE 8. RI VALUE**

<table>
<thead>
<tr>
<th>n</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
</tr>
</thead>
<tbody>
<tr>
<td>RI</td>
<td>0</td>
<td>0</td>
<td>0.58</td>
<td>0.90</td>
<td>1.12</td>
<td>1.24</td>
<td>1.32</td>
<td>1.41</td>
<td>1.45</td>
<td>1.49</td>
<td>1.51</td>
</tr>
</tbody>
</table>

It gets judgment matrix:

\[ A^{(0)} = 4.073, RI = 0.9 \]

\[ CI = \frac{4.073 - 4}{4 - 1} = 0.24 \]

\[ CR = \frac{CI}{RI} = 0.024, 0.027 < 0.1 \]

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

\[
\omega^{(1)} = (\omega_1^{(1)}, \omega_2^{(1)}, \omega_3^{(1)}, \omega_4^{(1)}) = \begin{pmatrix} 0.627 & 0.173 & 0.152 & 0.565 \\ 0.237 & 0.238 & 0.082 & 0.276 \\ 0.142 & 0.587 & 0.66 & 0.139 \end{pmatrix}
\]

\[
\omega^{(0)} = \begin{pmatrix} 0.25 & 0.584 & 0.664 & 0.175 \\ 0.074 & 0.278 & 0.220 & 0.243 \\ 0.67 & 0.151 & 0.126 & 0.545 \end{pmatrix}
\]

\[
W = \frac{\omega^{(1)}}{\omega^{(0)}} = \begin{pmatrix} 0.557 \\ 0.037 \\ 0.114 \\ 0.286 \end{pmatrix}
\]

\[
= \begin{pmatrix} 0.435 \\ 0.302 \\ 0.273 \end{pmatrix}
\]

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.

**REFERENCES**


