Research on the Cultivation of Innovative Ability of College Physical Education Students Based on Data Mining Technology

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Abstract

Great progress has been made in mass sports and national fitness in China, leading to an increasing demand for innovative talents majoring in physical education. Curriculum reform is crucial for implementing innovative education. Curriculum is the heart of education, and curriculum reform is the core of education reform. This research, based on data mining technology, utilizes methods such as literature review, questionnaire surveys, mathematical analysis, and logical analysis. Through research, the following conclusions are drawn: (1) The innovative ability of students majoring in physical education should include both innovative thinking ability and innovative practice ability. Innovative thinking ability comprises general innovative thinking ability and special innovative thinking ability. (2) The constituent elements of the innovative ability of physical education (PE) majors mainly include five primary indicators (innovative thinking, innovative thinking ability, innovative learning ability, innovative intelligence ability, and innovative practical activity ability) and eight secondary indicators. The extraction of the first-level indicators is closely related to the characteristics of PE majors and the connotation and essence of innovative ability. (3) Subjective factors that affect the innovation ability of students majoring in physical education in colleges and universities mainly include innovative consciousness, creative thinking, ideological concepts, innovative motivation, students' quality, and students' knowledge. Objective factors include teaching content, school attention, innovation environment, teaching evaluation, teaching environment, and incentive mechanism.

Keywords

Data mining, College physical education, Cultivation of innovative ability

1. Introduction

In the era of the knowledge economy, innovation determines the comprehensive strength and competitiveness of a country and a nation. Innovation can't be separated from talent, and the competition in the 21st century is the competition of talents. The duty of higher education is to train high-quality creative talents for our country and serve social development and economic construction. The implementation of innovative education must be considered, comprehensively designed and gradually promoted (Fuchu Song, 2022). The curriculum is composed of certain educational goals, basic cultural achievements, and learning activities, which are used to guide the planning of school education and guide students to know the world, know themselves, and improve their media. It is of great practical significance to make them aggressive
and brave in opening up in a fiercely competitive society.

2. Research object and research method

2.1 Research object

This research studies the practical teaching of physical education majors in colleges and universities from the perspective of cultivating innovative ability. In order to cultivate the innovative ability of students majoring in physical education in colleges and universities, the practical teaching of physical education is the breakthrough point (JiaBei Tang & Bo Li, 2023).

2.2 Research method

2.2.1 Literature data method

Make full use of the literature materials provided by the school library, the national library, and the electronic literature retrieval system, look up and collect the research results of innovation ability at home and abroad in recent years, and provide a sufficient theoretical basis for successfully completing the writing of this thesis.

2.2.2 Questionnaire survey method

According to the needs of this study, a questionnaire was designed. A total of 300 copies were distributed to 300 students majoring in physical education at physical education institutes of universities. Finally, 283 questionnaires were successfully obtained, the returned questionnaires were carefully sorted out, and the questionnaires that could not participate in the research were removed. There were 271 qualified questionnaires in total, accounting for 95.76%.

2.2.3 Logical analysis method

This paper mainly adopts the method of logical reasoning and argumentation to analyze the basic categories of innovative ability, which paves the way for analyzing the elements of innovative ability of physical education students under the present conditions and the training countermeasures (Weimei Peng, 2021).

2.2.4 Mathematical statistics

The collected questionnaire data are sorted and analyzed by Excel and SPSS software.

3. Data mining

3.1 The main tasks of data mining

The task of data mining refers to the pattern type to be found in the task of data mining. Data mining tasks can generally be described and predicted in two categories. The descriptive mining task describes the general characteristics of data in the database.

Data mining can solve a large number of business problems. Based on the nature of these business problems, these problems are divided into the following main tasks of data mining:

3.1.1 Data classification

Data classification is one of the most common data mining tasks. Data classification refers to the process of finding the same attributes of a group of objects in the database and classifying them into different categories according to the classification model. Data classification is to analyze the data in the training set, make an accurate description for each category, establish a classification model, and then use this classification model to classify the records of other unknown categories (Zhang J, Chu L, & Guo C, 2021).

3.1.2 Cluster analysis

Clustering analysis is a process of dividing a group of objects into a series of meaningful subsets according to attribute values. The input of clustering is a group of unlabeled data, which is divided according to the distance or similarity of data itself. The principle of classification is to keep the maximum similarity within groups and the minimum similarity between groups, that is, to make the data in different clusters as different as possible, while the data in the same cluster as similar as possible.

3.1.3 Association rule

Association rules transform numerical target attribute values into discrete values by domain division, describe the
properties of target attributes by testing conditional attributes, and predict the values of target attributes by rules. Association rule is a common technique used in shopping basket analysis because it can find potential interesting product combinations.

### 3.1.4 Deviation analysis

There may be some data objects in the database, which are inconsistent with the general behavior or model of data. These data objects are isolated points, so deviation analysis is also called isolated point detection. The deviation-based method identifies isolated points by examining the differences in the main features of a group of objects, instead of using statistics or distance measurement. Deviation analysis can find credit card cheating, and the fraudulent use of credit cards can be found by detecting that a given account number is particularly large compared with normal payment. The outlier value can also be detected by shopping place and type, or shopping frequency.

### 3.2 Data preprocessing

This problem is a typical classification problem, so it is proposed to adopt a more commonly used classification algorithm—decision tree algorithm. College physical education has its own uniqueness, which emphasizes the cultivation of students' practical skills. Therefore, when establishing the evaluation system, we should consider students as the main body of evaluation. On this basis, we should establish a multi-evaluation system with classroom teaching evaluation as the main body, supplemented by teachers' self-evaluation, teaching and research section evaluation, and subject group evaluation (Qian Qian, 2020).

Taking colleges and universities as an example, the evaluation index system can be divided into student evaluation, teacher self-evaluation, teaching and research section evaluation, and subject group evaluation, including teaching attitude, teaching content, teaching means, teaching methods, teaching effect, and overall evaluation. It is divided into several items, including E1 (teaching attitude), E2 (overall evaluation of students), E3 (teaching creativity), E4 (teaching means and methods), E5 (professional teaching content), and E6 (overall evaluation result) to construct the sample data and training set of teaching evaluation in colleges and universities.

Data attributes are discretized, in which E2 (teaching attitude) is directly taken from students' evaluation of teaching, which can be directly converted into ABC without discretization. Four evaluation indexes, E2 (overall evaluation of students), E3 (teaching creativity), E4 (teaching means and methods), and E5 (specialty of teaching content), are divided into three grades, namely (1) A:90-100; (2) B:70-89; (3) C:0-69. E6 (overall evaluation result) is also divided into three grades, namely, (1) Excellent: 85-100; (2) Good: 65-85; (3) Average: 40-65. After the above steps, the following teaching evaluation data of university teachers are obtained, and some data are randomly intercepted as training samples.

### 3.3 Establish decision tree model

Because there are many attributes in the students' achievement table used for mining, this paper chooses three attributes, that are closely related to the achievement attributes of data structure theory, namely, sports achievement, teaching method, and fear of difficulties, as the basis for establishing the decision tree model of achievement classification. When establishing the decision tree model of whether the data structure scores are excellent or not, the attribute of whether the data structure theory scores fail is taken as the classification attribute.

### 3.4 Implementation of data mining

ID3 algorithm proposed by J.R. Quinlan is the earliest and most famous decision tree induction algorithm. Given a set of non-category attributes $C_1, C_2, \ldots, C_n$, category attributes, and a recorded training set $S$, a decision tree can be constructed by ID3 algorithm. Decision tree induction algorithm ID3 algorithm is described as follows:

```cpp
//Returns a decision tree
Function ID3 (R : A collection of non-class attributes, C : Class properties, S : A training set)

Begin

If S is empty, and a single node with a value of Failure is returned;
If S is composed of records whose values are all the same category attribute values, and returns a single node with this value;
If S is empty, and a single node is returned, whose value is the category attribute value with the highest frequency found in the record of S;
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The attribute with the largest \( \text{gain}(D,S) \) value among the attributes \( R \) is assigned to \( D \);
Assign the value of an attribute \( D \) to \( \{d_j | j=1,2,\ldots,m\} \);
Assign a subset \( S \) composed of records corresponding to \( D \) whose value is \( d_j \) to \( \{s_j | j=1,2,\ldots,m\} \), and return a tree whose root is marked as \( D \) and branch is marked as \( d_1, d_2, \ldots, d_m \);
Then construct the following trees respectively:
\[
\text{ID3}(R-\{D\},C,S_1), \text{ID3}(R-\{D\},C,S_2), \ldots, \text{ID3}(R-\{D\},C,S_m);
\]
End ID3

ID3 algorithm constructs a decision tree according to a set of given data rows or data objects (whose class attributes are known) and then uses the decision tree to classify data of unknown class. ID3 algorithm uses the parameter of “information gain” to evaluate the importance of attributes. The attribute with the largest information gain is considered as the attribute with the largest resolution in the current data set.

4. Result analysis

4.1 Analysis of the structure of innovation ability of physical education major in colleges and universities

According to the literature review of innovative thinking, the thinking elements of innovative thinking ability are obtained, and a questionnaire survey on innovative thinking ability of students majoring in physical education is conducted among excellent physical education teachers in colleges and universities.

Through the statistics of the questionnaire results of physical education teachers, it can be found that creative thinking, divergent thinking, open thinking, etc., which physical education teachers think should be possessed by students majoring in physical education, have a higher proportion. Innovative thinking ability refers to the activity of putting forward new viewpoints and ideas and thinking about problems from different angles. Divergent thinking is also very important for the cultivation of innovative thinking. It is more conducive to the development of new things to think about practical problems from different angles, different levels and different breakthrough points without sticking to a single way of thinking.

4.2 In creative thinking, students majoring in physical education need to cultivate their thinking most

Table 1. Investigation results on the situation that students majoring in physical education need to cultivate their thinking most (n=300)

<table>
<thead>
<tr>
<th>Way of thinking</th>
<th>Total number of people</th>
<th>Percentage</th>
<th>Sort</th>
</tr>
</thead>
<tbody>
<tr>
<td>Divergent thinking</td>
<td>183</td>
<td>61%</td>
<td>1</td>
</tr>
<tr>
<td>Thinking in images</td>
<td>67</td>
<td>22.33%</td>
<td>2</td>
</tr>
<tr>
<td>Intuitive thinking</td>
<td>36</td>
<td>12%</td>
<td>3</td>
</tr>
<tr>
<td>Logical thinking</td>
<td>14</td>
<td>4.67%</td>
<td>4</td>
</tr>
</tbody>
</table>

From Table 1, it can be seen that students majoring in physical education think that divergent thinking is the most important way to cultivate, followed by figurative thinking, with intuitive thinking and logical thinking accounting for a small percentage. This shows that in the creative thinking mode, divergent thinking and figurative thinking are very lacking for students majoring in physical education. Meanwhile, it also suggests that physical education teachers should focus on divergent thinking and figurative thinking when cultivating creative thinking mode for students majoring in physical education.

4.3 Analysis of influencing factors on innovation ability of physical education major in colleges and universities

Because of the wide range of innovative abilities, 16 indicators affecting the cultivation of innovative ability are summarized through literature and interviews with college physical education teachers and experts, and the dimensions of 16 indicators are reduced. Principal component analysis (PCA) was used for factor analysis of survey data, and KMO and
Barlett ball tests proved that there was a strong correlation between observed variables (See Table 2 for specific inspection results).

<table>
<thead>
<tr>
<th>Table 2. KMO and Barlett sphericity test results</th>
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</thead>
<tbody>
<tr>
<td><strong>KMO value</strong></td>
</tr>
<tr>
<td><strong>Bartlett spherical test</strong></td>
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The results of the KMO and Barlett spherical test are shown in Table 2. The KMO value in this study is 0.881>0.8 and less than the significant level of 0.01. According to the determination standard, the investigation results are suitable for factor analysis.

4.4 Decision tree analysis of student achievement

Using EXCEL's screening function shows that there are 4 records of failing long-distance running and passing sprints. This shows that: long-distance running failed, and sprinting basically failed. Once again, the screening function of EXCEL can be used to show the records of passing the long-distance running and hurdles, and the statistical results show that 28 people passed the sprint and 8 people failed the sprint. In the same way, it shows the records of passing the long-distance race and failing the hurdle race. The statistical results show that 24 people failed the sprint and 4 people passed the sprint.

We can also describe it like this: the student's learning level of long-distance running will directly affect their learning effect of the sprint. The study of hurdles also has a certain influence on the study of sprints. Therefore, teachers should consider students' long-distance running foundation when teaching sprints. Students with better long-distance running and average sprinting should pay more attention to the study of hurdles.

5. Conclusion and suggestion

5.1 Conclusion

(1) The research suggests that the innovative ability of students majoring in physical education should include innovative thinking ability and innovative practice ability, among which innovative thinking ability includes general innovative thinking ability and special innovative thinking ability.

(2) The constituent elements of the innovative ability of PE majors mainly include five first-level indicators (innovative thinking, innovative thinking ability, innovative learning ability, innovative intelligence ability, and innovative practical activity ability) and eight second-level indicators. The extraction of the first-level indicators is closely related to the characteristics of PE majors and the connotation and essence of innovative ability.

(3) Subjective factors that affect the innovation ability of students majoring in physical education in colleges and universities mainly include innovative consciousness, creative thinking, ideological concepts, innovative motivation, students' quality, students' knowledge, and so on; Objective factors: teaching content, school attention, innovation environment, teaching evaluation, teaching environment, incentive mechanism, etc.

5.2 Suggestion

(1) Stimulate students' innovative consciousness

Stimulating students' innovative consciousness is the premise of cultivating students' innovative ability, and developing students' innovative thinking is the core of cultivating students' innovative ability. First of all, the relevant leaders of colleges and universities should attach great importance to and strengthen the innovative consciousness of students majoring in physical education; Secondly, colleges and universities should provide all kinds of opportunities for students majoring in physical education to participate in innovative activities, so that students can feel the understanding, thinking and enlightenment brought by innovation in the process of participating in innovative activities, and provide students with an innovative platform and create an innovative environment. Finally, we should strengthen the students majoring in physical education in colleges and universities to understand the important role of innovative thinking, attach importance to the core position of innovative thinking in innovative ability, and continuously strengthen their study in this area.
(2) Change the backward teaching concept

Training teachers can change the current situation of teachers' backward teaching concepts, improve their understanding of the cultivation of innovative ability in practical teaching, make them fully understand the important role of practical teaching oriented to the cultivation of innovative ability in the process of training applied talents, and use innovative teaching methods reasonably in course teaching.

(3) Construct an innovative evaluation system of innovation ability

When establishing the evaluation system of cultivating the innovative ability of PE majors, we must pay close attention to the purpose of improving teaching quality and talent training quality, organically combine students' academic evaluation with teachers' teaching evaluation, and form a diversified, scientific, and fair evaluation mechanism. According to the goals and requirements of cultivating innovative talents put forward by society to higher education, scientific evaluation methods are used to make objective division and effective value judgments on students' innovative spirit, innovative ability, innovative thinking, and innovative practice.

References


