

The Preliminary Study on The Efficiency of Physical Education in Colleges and Universities Using Data Envelopment Analysis

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Abstract: The data envelopment analysis (DEA) model is an efficiency analysis model based on linear programming, which can evaluate the comprehensive efficiency of multi-input and multi-output systems. In college physical education classes, to cultivate students' physical exercise habits, improve students' physical education classroom efficiency, and promote the continuous development of students' lifelong physical education ability, college physical education teachers must implement effective teaching methods in the teaching process. This goal is to use the literature and logical analysis method to summarize the relevant Research on the application of the DEA model in sports performance evaluation in China and abroad and put forward some suggestions for the further application of the DEA model in sports performance evaluation in the future. This research prospect data envelopment analysis method should be combined with theoretical and empirical Research in the field of physical education teaching evaluation in colleges and universities to provide a method to improve the efficiency of physical education in colleges and universities in this paper.

Keywords: Data envelope, Colleges and universities, Physical education training, Efficiency.

1. Introduction

Before carrying out physical education teaching, teachers should first understand the definition of habits to cultivate students' physical exercise habits effectively. The so-called habit is a person's specific application of the same thing over a long time, resulting in unchangeable behaviors, tendencies, or social customs. Physical exercise is a behavioral habit gradually formed through the active participation of human beings in physical training in the later stage, which can also be called a solidified behavioral pattern. Therefore, it can also be said that sports habits have the characteristics of self-discipline, consciousness, stability, behavior, etc. It must ensure a particular exercise intensity within a particular frequency to effectively exert its effect[1].

2. Characteristics of Physical Education Teaching in Colleges and Universities

Physical education is a general term for the corresponding

activities and teaching methods used by teachers in order to achieve the teaching goals of physical education. Compared with traditional knowledge-based teaching, physical education has the characteristics of solid operability and high utilization ability. Its teaching focuses on cultivating students' mental and physical abilities, and other disciplines cannot replace the specific role of physical education. Therefore, in the process of physical education teaching in colleges and universities, teachers should fully realize this point and ensure that students can actively participate in the physical education process to effectively improve their physical quality of students. At the same time, in explaining sports knowledge, the critical part of the explanation should be sports technology and operational knowledge[2]. However, on the premise of digging deeply into the students' own sports qualities, it can be effectively adapted to other sports to ensure that students can choose to appropriate The teaching content, combined with the related sports technology, to the greatest extent to complete their own sports practice[3], see Figure 1.

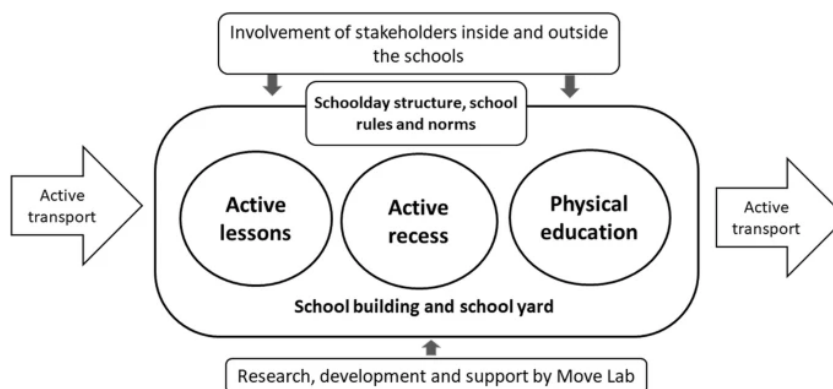


Figure 1. Analysis on the Factors of Improving Students' Efficiency and Subjective Initiative in Physical Training

3. Analysis of Factors That Improve Students' Efficiency and Subjective Initiative in Physical Exercise

3.1. The Needs of The Students Themselves

Ordinary college students have significant development both physically and psychologically. They are no longer just interested in doing things but are rational to a large extent. They engage in learning and exercise according to the requirements of the school and society and formulate goals for their development to generate an excellent internal motivation emotionally, meet their needs, and produce a positive emotional experience[4].

3.2. Students Have A Strong Interest in the Physical Exercise They Are Engaged In

Interest is the source of motivation. With a certain interest, students will actively participate in exercises and develop their potential. Many surveys show that students have a strong, deepening understanding of the sports they are interested in and the need to expand the scope of understanding and effectively devote themselves to these sports.

4. The Ways to improve the efficiency of physical education

4.1. Improve students' awareness of physical exercise and cultivate students' physical awareness

Students in ordinary colleges and universities have a high level of logical thinking, observation, imagination, memory, etc. By imparting certain theoretical knowledge and physical education, students will understand the scientific basis and role of physical education in enhancing physical fitness and the effects of physical exercise on physical fitness. The importance of their own development is to have positive and affirmative emotions, enhance the consciousness of physical exercise and produce a virtuous circle in teaching.

4.2. Improve students' sports technical level and aesthetic, and emotional experience

In teaching, if the content of the teaching material is poor, monotonous, or simply repeated, it will often cause students to be bored and even disgusted with negative emotions due to the lack of attractiveness of technology. Movement technique is the foundation of physical exercise. It is difficult for people without certain sports skills to appreciate sports fun. Therefore, in selecting teaching materials, there must be certain knowledge, skills, and the effectiveness of enhancing physical fitness to facilitate the attraction of technology and make students interested. In physical exercise, a beautiful flight, a mighty force, and a fast-paced movement will give people the enjoyment of beauty. Attention should be paid to cultivating students' aesthetic ability of sports techniques and skills in physical exercise, cultivating aesthetic expressiveness and self-appreciation ability of movement process to generate aesthetic, emotional experience, and improve students' enthusiasm for learning.

4.3. Vigorously Develop Sports Clubs To Allow More Students to Participate in Physical Training

College students are active and energetic and have a strong sense of participation in all kinds of meaningful activities before leaving society. Athletic clubs are undoubtedly the better campus groups, built on the foundation of sports silver chain and competition, allowing students to manage their emerging activity groups. It can effectively make use of students' spare time and allow them to participate in physical exercise in a planned, purposeful, and developed way so that they can not only strengthen their physique and cultivate their sentiments but also strengthen the connection between students, which is quite beneficial to student's physical and mental development. Favorable. Sports clubs create a good sports environment for students to actively participate in physical exercise and have more profound significance for students to exert their subjective initiative, see Figure 2.



Figure 2. Ways to improve the efficiency of physical training

5. The Necessity of Using Data Envelopment to Analyze The Efficiency of Physical Education in Colleges and Universities

Most of the traditional sports evaluation methods are to evaluate a single input and output target. Since the evaluation cannot only look at one indicator, there is difficulty in evaluating each other between multiple indicators. When it comes to the problem of indicator weights, the traditional Sports evaluation methods are easy to make the evaluation results have large errors. Using the DEA rule can effectively solve the problem of multiple inputs and multiple outputs in evaluation. From the analysis of the existing Chinese and foreign documents in this paper, the application of the DEA method in the sports field has experienced continuous development, and the problems it solves mainly cover the following aspects.

6. Application of DEA Method to Evaluate the Operational Efficiency of The Sports Industry

From the literature in recent years, the application and Research of the DEA method in the field of sports in China are mostly focused on evaluating the efficiency and operation efficiency of physical education in colleges and universities. The efficiency of Physical Education in Colleges and Universities") to evaluate the operational efficiency and their application level of the DEA method and model has also been improved to a certain extent. Among them, based on the CCR and BCC models, DEA-Malmquist, the total factor productivity index, is used to evaluate the efficient operation efficiency of physical education in some colleges and universities; this method decomposes the in total factor productivity into technological progress and technological efficiency changes. On this basis, the technical efficiency changes are further decomposed into scale efficiency changes and pure technical efficiency changes. Through the DEA-Malmquist analysis of the efficiency input-output data of physical exercise in these colleges and universities, the changes in production efficiency are finally effectively measured. Based on DEA-Malmquist, Zhang Hongwei used the window analysis method to dynamically evaluate the efficiency and operation efficiency of physical education in colleges and universities, which changed the static evaluation of enterprise efficiency in the past, to better observe the impact of enterprise resource investment on future production. However, the above DEA method still belongs to the traditional DEA one-step method, ignoring the information contained in the slack variables in the input and output, especially the influence of environmental factors. Efficiency evaluation of exercise efficiency: firstly, the relative

efficiency of these enterprises are evaluated by using the BCC model; secondly, the SFA model is used to distinguish the slack variables generated by the DEA model in the previous stage, namely management inefficiency, environmental impact and random noise. This method excludes the influence of environmental and error factors so that the DMU efficiency value reflects the technical efficiency more objectively, thus reflecting the state of the enterprise more realistically.

6.1. Data Envelope Analysis (DEA)

Data Envelope Analysis is a non-parametric evaluation method based on the concept of relative efficiency, which aims to solve the problem of the relative effectiveness of multiple input and multiple output variables in a set of decision-making units (DMUs). This method uses the index weight coefficients of DMU input and output as variables, and a comprehensive evaluation operation is performed to determine the effective production frontier. And according to the distance between each DMU and the effective production frontier, it is determined whether each DMU is DEA effective. The DEA model is an efficiency analysis model based on linear programming theory, and the optimal efficiency frontier formed by it can improve the performance objectives of the evaluation unit. Since the DEA model operation does not require pre-estimation of parameters, the subjectivity caused by human factors in determining the weight of each index is avoided. Therefore, DEA has advantages that cannot be underestimated in avoiding the influence of subjective factors, simplifying operations, and reducing errors. In recent years, DEA theory and methods have been widely used in various fields. In the field of sports involving multi-objective comprehensive evaluation, DEA is a more effective evaluation method.

7. Application of the Traditional DEA Model in the Performance Evaluation of Physical Education in Colleges and Universities

7.1. The Application of the CCR Model in the Performance Evaluation of Physical Education in Colleges and Universities

DEA models are divided into two forms: linear programming and fractional programming. These two forms are equivalent, the former is obtained based on a series of production axiom assumptions, and the latter is obtained through the ratio definition. The CCR model is the first DEA model formally proposed by Charnes, Cooper, and Rhodes in 1978. The model is based on the assumption of fixed returns to scale, assuming constant returns to scale (Constant Rhodes to Scale, referred to as CRS), and mainly evaluates the overall efficiency of decision-making units—technical efficiency. The CCR model can be expressed as, see Figure 3.

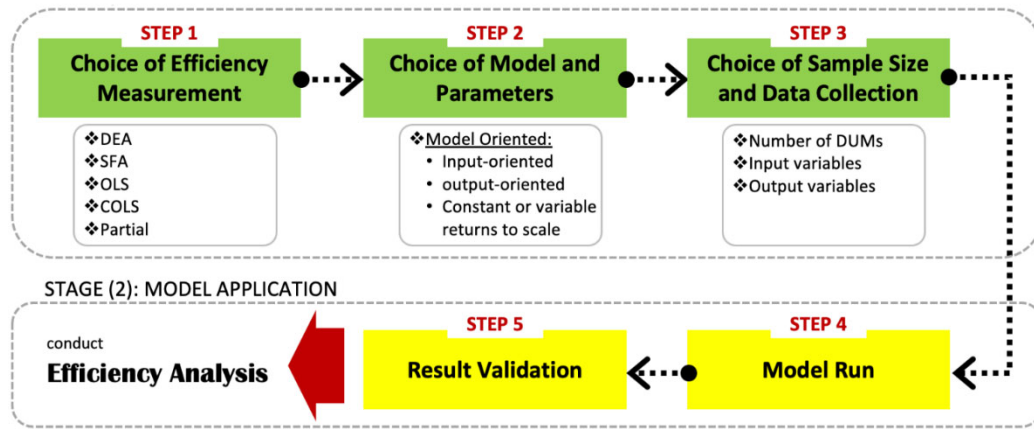


Figure 3. Applying DEA Method to Evaluate the Running Efficiency of Sports Industry

From the existing literature, most Chinese scholars use the CCR model to evaluate sports performance. Through the evaluation of the effectiveness of the input and output of sports in various provinces and cities in this country in 2012, The business operation capability of the Olympic Organizing Committee has a significant impact on the Olympic economy. Based on this, the study puts forward policy recommendations for the preparation of the Beijing Olympic Games.

7.2. The Application of the BCC Model in the Performance Evaluation of Physical Education in Colleges and Universities

Since the CCR model assumes that the return to scale is constant, when using the CCR model, it is necessary to satisfy all DMUs to produce at the optimal scale. When this condition cannot be met, the efficiency values of some DMUs may change, thus leading to Bias in the evaluation results. In 1984, Banker et al. improved the CCR model and proposed the BCC model's assumption of variable returns to scale. Since the CCR model cannot simply evaluate the technical effectiveness of the DMU model has higher applicability than the CCR model. BCC model with non-Archimedes infinitesimal ϵ :

$$\begin{aligned} & \min \theta \\ & \text{s.t. } \sum_{j=1}^n X_j \lambda_j + S_i^- = \theta X_{j0} \\ & \sum_{j=1}^n y_j \lambda_j - S_r^+ = \theta Y_{j0} \\ & \lambda_j \geq 0, S_i^- \geq 0, S_r^+ \geq 0 \end{aligned}$$

The BCC model has carried out a practical DEA evaluation on the short-term economic impact of the recent seven Olympic Games and found that the 2014 and 2018 Olympics reached DEA effectively. The study believes that the government's investment plan determines the short-term economic effects of the Olympic Games; the number of tourists, the number of employment, the profit and loss of the Olympic Organizing Committee, and the growth rate of GDP per capita are essential factors for the short-term economic growth of the Olympic Games. KIM et al. used the BCC model to evaluate the technical effectiveness of players in the English Football League and found the unbalanced technical efficiency of athletes. Further analysis of the model provided seven technical benchmarks for non-technically influential

athletes.

8. Discussion and Outlook

The application of the DEA model to sports performance evaluation in this country started late. Compared with other foreign fields, there is still a significant gap in the depth and breadth of the model application. In the application of the DEA model, most scholars still choose the traditional CCR, and There is still a significant gap in the application of the non-radial DEA model, the application of the multi-stage DEA model, and the construction of the targeted DEA model in BCC model for sports performance evaluation. This paper still needs Research and improvement in the following aspects.

8.1. Application of Non-radial DEA Model

According to the expression of the objective function, DEA models can be divided into radial DEA models and non-radial DEA models. The radial DEA model is represented by the CCR and BCC models. Since cannot change the ratio of each input and output, it can easily cause errors in the evaluation results. The SBM model represents the non-radial DEA model, and the meaning of its objective function is the total difference (Slack) between the evaluated DMU and the production frontier. The non-radial DEA model assumes that the input and output ratio of the DMU can be adjusted, thus fundamentally solving the difference problem and making the evaluation results more accurate; in addition, the non-radial DEA model can not only distinguish whether the evaluated DMU is effective but also more critical The purpose is to provide the degree of the ineffectiveness of the decision-making unit and at the same time provide the basis for the further improvement of the sports performance evaluation problem.

8.2. Application of the Multi-stage DEA Model

Most of the DEA models used in sports performance evaluation in this paper are single-stage and single-objective programming models. Researchers often regard the entire evaluation system as a "black box," usually only considering the initial input and final output, and ignore other influencing factors in the evaluation process, so it is difficult to solve the problems in the Research effectively. , resulting in an inevitable error in the evaluation results. In this regard, this paper should refine the research procedures and effectively solve this problem using the multi-stage, multi-objective planning DEA model to make the research results more

objective and scientific.

8.3. Building a Targeted DEA Model

Chinese sports performance evaluation mainly uses existing models such as traditional CCR and BCC. However, performance evaluation in sports has its characteristics and many uncertainties. Therefore, the traditional DEA model is unsuitable for targeted sports performance evaluation. Aiming at the specific sports performance evaluation problem, this paper needs to build a new DEA model suitable for the characteristics of the sports field. Therefore, improving the selection and application of existing DEA models and creating, developing, and developing specific DEA models for different types and characteristics of sports performance evaluation objects will be the future research direction of this paper.

9. Conclusion

In order to ensure that college students can improve the effect of exercise, teachers should focus on the teaching process of physical education to help students improve the efficiency of corresponding physical exercise so that students have an excellent emotional experience of physical exercise to stimulate students to participate in physical education. Interest in exercise. The data envelopment analysis method has certain scientificity, effectiveness, convenience, and quickness not only in the data analysis method and the

selection of decision-making cells but also in optimizing the physical education process. Based on grasping the existing research hotspots steadily, this paper should shift the research focus to the potential research hotspots, namely: using the data envelopment analysis method to carry out the Research on the efficiency evaluation of physical education in colleges and universities.

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