

# Experimental Research and Data Analysis in Physics Education

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**ABSTRACT:** *In the practice of physics teaching, as the cornerstone of physics, physics experiments and experimental data analysis play an important role in physics teaching. However, in teaching practice, the update speed of physics teaching content is slow, some demonstration experiments or phenomena in textbooks are not obvious, or experimental data errors are large, and the design of some exploratory experiments is unreasonable, which lacks pertinence for improving students' inquiry ability, Is not conducive to the establishment of physical concepts and physical models for students. Based on this, this article studies the experimental research and data analysis in physics education. This article conducts questionnaire surveys and interviews on the experimental teaching situation of the sophomore teachers of the university, and the sophomore students on the experimental learning situation, in order to provide practical measures for effectively cultivating students' interest in physics experiment teaching in colleges. The statistical data of the survey shows that in college experimental teaching, there are some steps and some details that are useful to enhance students' interest in physics learning, and the teacher's educational concept will directly affect whether he can pay attention to these details and measures. It can be seen that improving the overall quality of laboratory teachers and educational concepts will play an important role in the experimental research of physics education.*

**KEYWORDS:** *Physics Teaching, Experimental Research, Survey Research, Data Analysis*

## 1. Introduction

Physics is the basic discipline of the natural sciences, used to study the basic structure, interaction and motion of matter. The curriculum requirements of physics education [1-2] clearly stipulate that the primary textbook for students and the formation and development of physics must be provided with compulsory education. In the study of physics, students must achieve four goals : (1) develop ideas of matter, movement and communication; (2) Have the awareness and ability to build models; (3) Conscious scientific problems; (4) Can accurately understand the nature of science.

Physical experiments [3-4] basically include four types of research: first, the use of experimental instruments and the use of measuring instruments. Secondly, students conduct verification tests and measurement tests on test objectives, test principles, test equipment, test procedures, test data and information system, error analysis, etc. Thirdly, questions and experiments were designed, questions were raised, experimental questionnaires were designed according to physical ideas, and experimental data were analyzed. Fourthly, the teacher carries out experimental teaching demonstration in the classroom [5], some simple experiments in textbooks. Under the guidance of the new curriculum standards, this paper aims to speed up the teaching design process by conducting experiments and data analysis [6-7] in physics education, improving students' scientific knowledge in class and developing students' various skills. Understand the fundamentals of physics more effectively, familiarize you with the basic concepts of the new curriculum, and promote the process of new system improvement. The research methods of this paper are literature review [8] and questionnaire survey [9]. Read books related to psychology and pedagogy, collect literature from educational experts and scholars in various journals, and understand the practical significance and promotion value of this subject research through questionnaire survey.

This paper discusses the experimental research and data analysis in physics. This paper provides Colleges teachers and Colleges students with research and interviews on experimental education, in order to provide practical measures for effectively cultivating students' interest in learning in Colleges physics experiment teaching, and effectively develop students' learning needs. The statistical analysis of the survey data shows that improving the overall quality and teaching concept [10] of laboratory teachers will play an important role in the experimental research of physical education.

## **2. Experimental Research and Data Analysis in Physics Education**

### ***2.1 Experimental Research in Physics Education***

The experiments of physics experiment teaching in senior Colleges can be divided into three categories: demonstration experiments carried out in the classroom, in-class experiments and multimedia assisted virtual experiments; generally to the laboratory to carry out the students in groups; extracurricular experiments and production outside the classroom. The characteristics and main functions of common demonstration experiments are as follows:

1. Introduce the subject to stimulate the desire to learn.
2. Provide necessary perceptual materials to help students revise pre-concepts establish correct concepts and recognize laws.
3. By actively selecting and designing the content and criteria of the experiment, the demonstration can train students' observation and thinking skills, and help students enhance and apply physics.

4. Demonstrate to students to develop good practical and experimental skills.

In order to play a better role of demonstration, experimental learning must follow some basic principles: (1) the experimental purpose must be clear. (2) The experimental equipment must be simple and clear, and the experimental phenomenon must be clear. (3) To ensure the safety and improve the success rate of the experiment. (4) To find out the truth from practice, there must be a rigorous and responsible scientific method for obtaining information.

## ***2.2 Data Analysis in Physics Education***

During the experiment, some relevant experimental data are often obtained. In order to determine the relationship between the various data, the information obtained in the experiment must be obtained in order to obtain the laws of physics. There are many methods for data processing. In general, there are the following methods for data processing.

### **1. Average method**

Obtaining accounting authorization is usually a data processing method used to reduce unexpected errors. Under the same measurement conditions, for a given number of physical conditions, the results of multiple measurements are usually not exactly the same, so the average value of multiple measurements can be taken as the final experimental result.

### **2. The formula method**

Formula method is based on the measured two or more groups of data into the formula to solve the problem, the application of the formula is to use complete data to take the average value or use two groups of data with large difference.

### **3. Listing method**

The information from the experiment is listed in the table. This information can briefly show the relationships between related physical quantities, which are useful for checking the accuracy of measurement and calculation, and for discovering and analyzing problems.

### **4. The graphic method**

By selecting appropriate independent variables, the relationship between each parameter can be drawn or reflected, the law of action between them can be understood, and the functional relationship of relevant Numbers can be determined. Graphic method is one of the most commonly used methods for experimental data processing.

### **3. Experimental Thinking and Design**

#### ***3.1 Experimental Ideas***

As a sophomore in my school, choose two basically the same classes, and use one as the control group and the other as the experimental group. In the experimental group, teaching was organized in the form of classroom teaching according to different teaching contents and subjects, while in the control group, teaching was conducted according to the usual teaching methods. After a period of experiment, the two parts are compared and analyzed. Through the understanding of physics knowledge, the improvement of thinking ability, the desire to learn physics, learning attitude and learning methods are analyzed to observe whether the students in the experimental class are better than those in the classroom.

#### ***3.2 Experimental Design***

Physical activity teaching based on students' activity and self-experience, make students experience the process of scientific research, to master the basic methods of scientific inquiry, trains the student to obtain and process information of students' innovative spirit and practice ability as the goal a kind of teaching method, therefore, the physics teaching is a kind of essential to realize the objective of the new curriculum to improve the teaching methods. This paper makes a comparative study on the application effect of experimental teaching concept in Colleges physics education.

In order to make the experiment science effective, this article selects the sophomore freshmen of our school as the experimental subjects, with the sophomore (1) as the experimental class and the sophomore (2) as the control class. Take the method of controlling variables. The independent variable is the teaching mode of activity teaching to organize the teaching, and the dependent variable is the student's physics performance, interest attitude, ability, subject consciousness and participation consciousness. The control variable is the two classes of the second year. After entering the school, they are divided into classes according to their grades. There is no obvious difference in the basic qualities of students between classes. In the experimental class, the strategy of active teaching is adopted, and the control class adopts the general conventional teaching methods. After a period of time, the research object is "post-tested", and data analysis is used to find that the active teaching has an effect on the students' physics learning performance and learning interest in the class. And the basic situation of whether the influence of thinking ability and cooperative consciousness is significant.

## 4. Discussion

### 4.1 Experimental Research and Data Analysis in Physics Education

Physics is a science based on experiment, which is closely related to the reality of production and life. In the process of solving physical problems, we should find a balanced and similar physical way to solve problems: mining the key physical conditions and checking whether the recovery process and mathematical results are consistent with the physical reality. Physics is difficult to learn is a problem generally recognized by students. Although many students put forward many problems in the process of learning physics, they always believe that "if you understand and read, you will do wrong". The root cause of this phenomenon is that students only pay attention to imitation in the process of learning. However, there is a lack of deep understanding of physical concepts and laws, and a lack of correct methods for the analysis of physical problems. The academic performance in physics education is closely related to two factors: one is the characteristics of students' cognitive mode, which is internal; the other is the characteristics of students' learning style, which is called external factors. The organic combination of these two factors greatly improves students' academic performance. In the teaching of physics education, many aspects can obtain useful information through quantitative research and draw some important conclusions, which can provide the basis for further development of education research. Through the comparative experiment of different teaching methods, we have a quantitative understanding of the teaching methods for students with different cognitive styles, so as to carry out the teaching reform according to their aptitude.

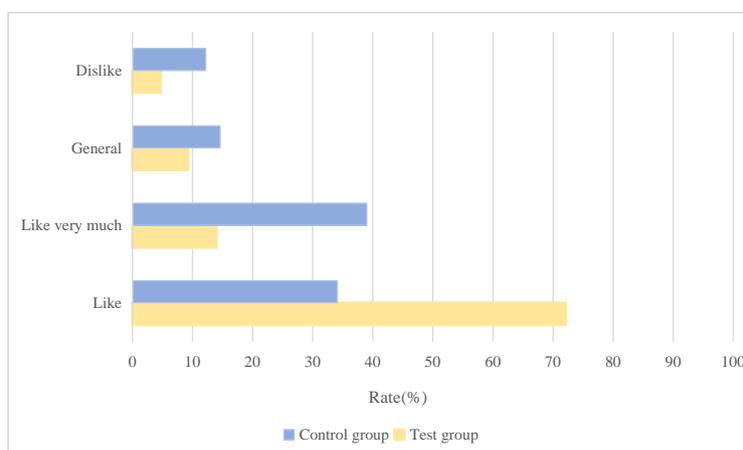


Figure 1. Comparison of the degree of interest in physics between the experimental class and the control class

After a semester of the development of the physics experiment teaching, the experimental class and compared to that in comparative classes, one of the most obvious is the degree of experimental classes of students interested in physics class is higher than that in comparative classes, in the implementation of teaching activities in the first two class interested in physics class has no obvious difference, at the end of the semester, have been conducted in the experimental classes and that in comparative classes students collective questionnaire investigation and statistics, as shown in Figure 1. According to the end of statistics, the students in the experimental class liked physics more than the control class after using classroom activities, and the number of students who liked physics was more than twice as much as that of the control class, while the number of students who did not like physics was also significantly lower than that of the control class.

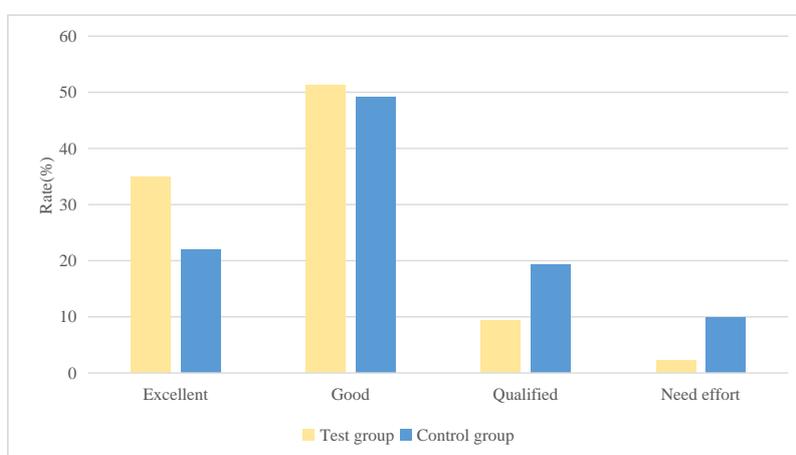


Figure 2. Comparison of cooperative attitude and cooperative consciousness after the experiment

As shown in Figure 2, the number of students who can take the initiative to cooperate and communicate with classmates in study and life has increased after physics experiment teaching, while the number of students with weak ability of solidarity and cooperation has decreased. The results show that the interaction between teachers and students in classroom activities can enhance students' awareness of cooperation and communication with teachers and students in study and life, improve students' communicative ability, improve interpersonal relations, and promote the integration and perfection of personality.

#### 4.2 Problems in Experimental Research in Physics Education

Physical experiment is a kind of scientific experiment, in which human beings can use tools and equipment purposefully in a planned way and use artificial

intelligence to replicate physical phenomena for observation, measurement and research. Physics is a natural science based on experiment. Physical experiment plays an important role in the formation and development of physics and is the only standard to test physical theory.

1. Physical education should be based on the experiment itself, which depends on the characteristics of experimental physics and its role in physical education.

2. The experiment has the characteristics of authenticity, clarity and clarity, which is very attractive to middle school students and can stimulate their curiosity and desire to learn physics.

3. Experiments can create a clear learning environment for students.

4. Experiments can improve students' ability of observation, cheating and analysis, and students are an effective way to grasp scientific methods.

5. It also helps students to establish a firm scientific attitude towards scientific knowledge and seeking truth from facts. In short, we need to understand the importance of experimental education in improving students' academic literacy and making it a foundation for their lifetime development. In the implementation of the new curriculum, we must respect the direction of experimental learning and strengthen experimental learning.

But at present, the school and teachers in the physics teaching has not reached the requirements of the national new curriculum reform, there are still some teachers in teaching is still stay in the experimental stage, especially in the larger part of the grade teachers, due to some objective factors, such as they are growing up poor material conditions, the experiment equipment does not reach the designated position, etc., lead to the physics experiment is not familiar with all the time, only stay in the outline of the scope of those who will do the experiments. In particular, they do not understand the importance of the experiment; think too much waste of time. So there's still the phenomenon of experimentation. At the same time, due to the different attitudes of teachers to experimental teaching, there are great differences in the practice of experimental teaching. On the other hand, physics is generally regarded by Colleges students as one of the most difficult subjects in Colleges. Especially at the present stage of China to cope with the college entrance examination of a large number of exercises teaching, let students back away. From the characteristics of physics, students' interest in learning has a great impact on the study of physics.

## 5. Conclusions

In the research on experimental research and data analysis in physics education, this paper discusses the importance of experimental research in physics education and the methods of data analysis. This article chooses two classes in the second year of the school that are basically the same. One is used as the experimental class and the other is used as the control class. In experimental classes, according to different teaching contents, and different class type, take the classroom activity teaching

forms of organization, in that in comparative classes according to the conventional teaching mode organization teaching, after a period of experiment, look at the experimental classes of students in improving their knowledge of physics, thinking ability, interest in learning physics, learning attitude and learning method is better than the control group of students, to take practical steps to effectively develop the students' physical experiment. The research shows that physics is a science based on experiment. Physical experiment plays an important role in the formation and development of physics, and experiment is the only standard to test physical theory.

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