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Original Paper

Discussion on the Evaluation Method of University Physics Experiment Assessment Based on "4C" Ability Cultivation

Nan Wang[1*], Yu Sun[1], LianPeng Song[1] & JinSong Liu[1]

[1] Dept. of Basic Sciences, Dalian Naval Academy, Dalian 116018, China

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Abstract

Education evaluation concerns the direction of education development, what use evaluation command bar, what kind of school orientation. To develop students abilities in Creativity and Innovation, Critical-thinking and Problem-solving, Communication, Collaboration. From the general idea of "Improve the evaluation of results, strengthen the process evaluation, explore value-added evaluation and make full use of information technology". Study of University Physical Experimental Assessment Methodology, divided the assessment evaluation into formative and final examination two parts, and explored formative assessment methods and final evaluation methods. The formative evaluation methods, including "pre-class preparation, class performance, experimental results" are proposed for most of the three, and the final evaluation of many forms of the examination, such as "written exam, work, virtual simulation, innovative physical work display, group reporting and replies".

Keywords

Evaluation, Experiment, Ability

1. Introduction

College Physics Laboratory is a basic science laboratory course for higher education, the forerunner of science experiments, embodying the commonality of most science experiments. It is the beginning for undergraduates to receive systematic experimental methods and experimental skills training. Its content covers a wide range of experimental ideas, methods and means, and in the process of learning, it can cultivate students' in Creativity and Innovation, Critical-thinking and Problem-solving, Communication, Collaboration. In October 2020, the Central Committee of the Communist Party of China and the State Council printed the "Overall Plan for Deepening Education Evaluation Reform in the New Era," which improves the system and mechanism for establishing moral character, and reverses the unscientific orientation of education evaluation. Educational evaluation is related to the direction of educational

development, what kind of evaluation baton is used, what kind of schooling orientation is there. At present, for the theoretical courses of educational assessment and evaluation of the research is more, practical courses assessment means relatively single. Among them, the university physics laboratory courses are mostly in accordance with the average score of each experiment, or the weighted average of the experiment score and the final written examination score as the final grade of the university physics laboratory courses. But overall the evaluation method is difficult to stimulate students' learning interest, promote learning enthusiasm and students' innovation ability, thinking ability and so on. Thus, we insist on the university physics experiment assessment and evaluation method to carry out continuous research, which is conducive to the cultivation of students' "4C" ability.

2. University Physics Experiment Assessment and Evaluation Methods

University physics experiment assessment, follow the overall idea of improving result evaluation, strengthening process evaluation, strengthening process evaluation, exploring value-added evaluation, and making full use of information technology.

The assessment and evaluation include two parts: formative assessment and summative assessment. The evaluation results use the weighted average of all experimental achievements, to strengthen the evaluation of the process, accounting for the total achievement ratio of 70%. To increase the diversity of the experimental contents, of which the comprehensive, research or design experiment weight is 60%. To highlight the characteristics of the course, improve the results evaluation, take the implementation examination as the final examination content, and account for 30% of the total scores, the accomplishments are not equal, the curriculum results are recorded as equal. As a practical course, to encourage students to actively innovate, the university biology experiment innovation competition as well as innovative works, etc., as value-added evaluation content. At the same time, in the assessment of the results, the use of rain classroom, university physics experiment virtual simulation experiment system, online collaboration platform, and other information technology tools, to empower the University Physics experiment examination, thereby improving the scientific, professional and objectivity of evaluation education.

3. Formative Assessment Evaluation and Rating Criteria

Formative evaluation achievements account for 70 per cent of the total achievement. The evaluation process can be roughly divided into "pre-class preparation, class performance, experimental results" three parts, representing "15%, 50% and 35% of the formative examination achievements respectively.

3.1 Pre-class Preparation

Pre-class training in university physics experiments is a key link in improving the efficiency of classroom learning, and is conducive to developing students' ability to learn independently, critical thinking and problem solving. Pre-class preparation is mainly through Internet informatization means, experimental manual learning, fill in the experimental report content, pre-class design experimental

program design preparation and so on. In terms of Internet information methods, mainly rely on teachers before class in the rain classroom to publish experimental principle explanation video, instrument use of attention matters video and experimental operation video, etc. Through research findings, rather than filling in the experimental preparatory report, students prefer to pre-training by looking at video science knowledge, answering questions and doing tests.

3.2 Classroom Performance

Classroom performance consists of listening, interaction, and practice. The interaction is divided into pre-reporting and in-class questions. In order to guarantee the fairness of achievements, the operations are carried out by one person in a group in the course of the practice, and the attention is not allowed without the permission of the teacher. At the same time, it is required to be able to carefully adjust, observe, encounter frustrations and difficulties positive improvement, to cultivate students' critical thinking and problem solving ability. Through the layout of the assignments in the classroom, the students are encouraged to organize collaborative discussions and design solutions, thereby developing the students' ability to communicate and cooperate. After the measurement is completed, the data must be organized into a data sheet, and the teacher must check the signature and register it. Classroom achievements are given by the completion of the class and the accuracy of the results.

3.3 Experimental Results

The results of experiments generally include the experimental reports of the experiments learned, the production of innovative works, as well as the design program and research reports. The purpose of the report is to examine the conclusions given after data processing, the experiment report is written to peers, so it must fully reflect their work harvest and results, reflecting their own characteristics. Excellent reports should be concise, clear, elaborate, insightful. So the necessary parts of writing the report are: fill in the table of measurement data, the calculation of the data process, in individual cases also need supporting charts, experimental ideas, error analysis and conclusions. Reporting achievements are given by measuring the accuracy of the results and the writing process of the series, or by factors such as the systematic innovativity of research reports and the production of innovative works.

In summary, the University Physics Experimental Assessment mainly consists of "rain classroom learning, design experimental program design, classroom interaction, basic content completion, extended content completed, experimental report, production class innovative work or research report" seven sub-section, of which "rain classroom learning, classroom interactions, basic contents completion report" mainly focused on basic, comprehensive experimental project assessment, focusing examiner on achieving the curriculum learning objectives to play a critical role in the contents of mastery. while "design experimental programme design, extension completion contents, production of finished product or study report" is mainly oriented to design, other experimental expansion tasks exhibition or innovation works competition.

4. Final Assessment Evaluation and Rating Criteria

Final evaluation achievements accounted for 30 per cent of the total achievement. Evaluation can be done using written tests, works, virtual simulations, creative works, sub-group reports and answers. Each of these methods has its advantages and disadvantages, and can be selected according to different schools' circumstances and needs.

4.1 Written Examination

Written test results are usually determined by scores. As the most traditional test method, the advantages of the written test form are obvious. It can minimize the impact of factors such as space restrictions on the site, instrument number restrictions, staff time restrictions and rating subjectivity. The contents of the examination can cover theoretical knowledge, methodological steps, data processing, attention matters, results analysis, etc. At the same time, selecting, filling empty, short answers, calculations and other methods can be carried out, which can reflect the diversity of the theme. But the disadvantage is that the lack of practical lessons characteristics, some high-rated students may present the phenomenon of high-ranking, written test can not detect the student's practical operational ability, lack of real warfare.

4.2 Implementation

The performance score is determined by the operating score given by the faculty examination and the results of the experimental report, combined with a comprehensive decision. The examination is conducted by a lottery, determining the contents of the student's examination, providing each person with a set of experimental instruments, guaranteeing the individual to complete the operation independently. In the examination, the teacher examines and gives practical operating scores through the students on the operation of the experimental instrument, the use of experimental methods, the recording of the experiments data, etc. The experimental report scores are given through the compilation, calculation, pictorial production, data analysis and so on. The exam can examine the student's practical operational ability, analytical thinking ability, etc., is very suitable for experimental courses. But the disadvantage is that the number of experimental instruments and the size of the classroom space are limited, and it is difficult for a large number of students to complete the examination at the same time.

4.3 Virtual Simulation

In recent years, with the development of science and technology, university physical virtual simulation experiments are becoming more mature, and the coverage is increasingly wide. Virtual simulation test scores, which are given automatically to the errors of the operation through the examination. A virtual simulation test can be conducted remotely, with some of the advantages of both a written and a conducted exam. However, it is easy for students to write down operational scores in advance, which does not guarantee a full reflection of the student's real level.

4.4 Innovative Forms of Display of Physical Works

Innovative physical work display scores are scored by the integrity of the experimental work, the realization of the function, the degree of innovation and so on. The advantages are that students' practical, operational, innovative and problem-solving abilities can be fully examined. The disadvantage is that some students are unable to make innovative physical work or the results are relatively simple, the material is not completed, etc. Achievements can easily be divided into two levels.

4.5 Sub-group Reporting and Response Form

The test scores in the form of group reports and replies are given by the teacher based on the content of the report and the conclusions of the replies. The advantages are that it can be personalized to grasp the student situation, examine the student's expression ability, cooperation ability, problem-encountered reflection ability and problem-solving ability, etc. The disadvantage is that the exam is limited by the number of teachers, while being more subjective.

5. Conclusions

Education evaluation concerns the direction of education development, what use evaluation command bar, what kind of school orientation. To develop students' abilities in Creativity and Innovation, Critical-thinking and Problem-solving, Communication, Collaboration. The University Physics Experimental Assessment Methodology follows the general idea of "improving the evaluation of results, strengthening process evaluation, exploring value-added evaluation and making full use of information technology". The evaluation evaluation was divided into two parts: the formative evaluation and the final evaluation, and the ratio of 70% and 30% was defined. The formative examination includes most of the three "pre-class preparation, class performance, experimental results", while the final examination explores "written examination, work, virtual simulation, innovative physical work display, group reporting and replies" multiple forms of examination. A number of methods are provided for reference in the form of examinations for the implementation of the course.

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