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PROCEEDINGS ARTICLE

Research and Practice of Online–Offline Formative Evaluation With Effective Learning as a Criterion: Based on "Electrotechnics and Electronics Technology Basis" Course

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ABSTRACT

Students of sergeant vocational and technical education have a weak theoretical foundation, but have active minds and love hands-on operations. In order to examine the learning effect of students more comprehensively, based on the construction of online and offline blended "golden course", this article proposes to build a formative evaluation system based on the effective learning criterion for the course "Electrotechnics and Electronics Technology Basis". It discusses the formative evaluation of the course from the aspects of constructing a whole process assessment and evaluation system, proposing diversified assessments and evaluation schemes, establishing a learning process evaluation and feedback mechanism, and formulating reasonable process assessment standards and assessment organization methods, intending to provide a reference basis for relevant professional teaching staff.

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1. INTRODUCTION

Effective learning is defined as a participant spending less learning time to obtain better learning results under guidance of appropriate learning strategies [1].

It includes the effectiveness of the learning process and the effectiveness of the learning outcome, which is reflected in "grasping" during the learning process on one hand, and the high achievement of the learning outcome, i.e. "understanding" on the other hand.

The evaluation method of course assessment not only has the functions of detection, identification and selection, but also has the functions of feedback and motivation. The traditional summative evaluation, which is "to use one exam to determine the score", cannot reflect the whole process of students' learning comprehensively and cannot evaluate the learning effect of students and the teaching quality of the course comprehensively and reasonably.

Formative evaluation is an evaluation method that focuses on feedback and is oriented to the teaching process, which has a positive effect on improving the teaching quality of the course [2]. It has the following advantages: Firstly, it can dynamically know the learning effect of students; secondly, it can mobilize the enthusiasm and initiative of students; thirdly, it is conducive to the full display of students' talents.

In 2018, the document "Guidelines of the Ministry of Education on Accelerating the Development of High-Level Undergraduate Education and Comprehensively Improving the Ability to Train Personnel" also requires "strengthening the management of the learning process, strengthening the management of examinations, strictly evaluating the process, and increasing the proportion of the process evaluation results in the total grade of the course".

Although the "Electrotechnics and Electronics Technology Basis" course based on the sergeant vocational and technical education adopts the form of "regular assessment + final assessment of experiment + final assessment of theory", it still has the following shortcomings: (1) The proportion of formative evaluation is too low; (2) The formative evaluation

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mode is relatively single [3]; (3) The subject of formative evaluation is too limited; (4) The effect of formative evaluation on improving teaching is poor.

In summary, this article proposes to build a formative evaluation system based on the effective learning criterion according to the characteristics of sergeant students and relying on the construction of online and offline blended golden course" [4].

2. RESEARCH OBJECTIVES

It takes effective learning as the standard, aims at the needs of communication majors and jobs, optimizes and adjusts the assessment and evaluation mechanism, and builds a whole-process, diversified and all-round course evaluation system, in order to effectively improve teaching quality.

2.1. Constructing a Whole-Process Assessment and Evaluation System

It emphasizes the comprehensive assessment of the whole process of students' learning, reflects the results of the whole teaching process and learning process in terms of the comprehensive requirements for students' knowledge, ability and innovation in the pre-class-in-class-after-class [5] link, and establishes a sound diversified academic assessment and evaluation system with equal emphasis on ability and knowledge assessment.

2.2. Proposing a Diversified Assessment and Evaluation Scheme

Based on the online and offline blended teaching model [6], it integrates a variety of assessment forms to comprehensively evaluate learning performance of students. It specifies the composition, content, and the proportion of various forms of assessment of diversified assessment. It specifies the support of the assessment and evaluation system to the course objectives, and builds a focused, objective, reasonable, simple and easy-to-operate assessment and evaluation system to reduce the burden of teachers and students while achieving the course objectives.

2.3. Establishing a Learning Process Evaluation and Feedback Mechanism

It implements the evaluation of the students instantly, dynamically and several times during the teaching process. It provides real-time feedback on learning evaluation information to guide students to strengthen and continuously improve the learning process. Teachers are expected to continuously improve the teaching and learning process.

2.4. Developing Reasonable Process Assessment Criteria and Assessment Organization Forms

For different forms of process assessment, it researches and establishes fair and reasonable assessment and evaluation standards, the organization forms of assessment and the assessment methods of grades.

3. SPECIFIC IMPLEMENTATION METHODS

3.1. Building a Whole-Process Assessment and Evaluation System

This is to stimulate the learning interest and enthusiasm, improve the degree of recognition and participation, and improve the comprehensive quality and ability of the students in a real sense [7]. On the basis of the preliminary full research, the research group designs a diversified formative evaluation system in order to ensure the effect of process learning and to combine the learning ability and characteristics of the students.

For the formative evaluation, based on the Rain Classroom platform, a blended online and offline teaching model is adopted, and the classroom is extended to pre-class-in-class-after-class throughout the whole process of assessment.

3.2. Proposing a Diversified Assessment and Evaluation Scheme

- Diversification of Assessment Subjects [8], with the addition of online platform evaluation and student-student mutual evaluation links on the basis of teacher assessment.
- Diversification of assessment forms.

It includes watching pre-study videos, completing online exercises, group participation scores, after-class assignments, staged quiz scores, etc. According to different contents of theory and experiment courses, group discussion and group experiments are set in class respectively; after-class assignments are set as theory exercises and experiment reports (or simulation cases) respectively (Table 1).

Link \ Form	Theory	Experiment	Grading Method
Before class	SPOC video learning - online practice - discussion and exchange		Online platform generation
In class	Discussion	Group experiment	Offline student-student mutual assessment
	Classroom performance		Offline teacher evaluation
After class	Review and consolidate PPT		Online platform generation
	After-class exercise	Experiment report	Offline teacher evaluation
	Horizontal cutting of knowledge points, stage test		Offline teacher evaluation

Table 1. Formative evaluation components.

3.3. Using the Online Platform to Establish a Feedback Mechanism

The offline usual results can be regularly imported into the Rain Classroom, and information technology can be used to provide real-time dynamic feedback of the combined online and offline evaluation results.

- Diagnosing students and discover their own shortcomings so that they can identify problems early and take effective measures to solve them and make up for the shortcomings, thus enabling them to conduct effective learning and make continuous progress.
- Diagnosing teachers' teaching to find out the deficiencies of teaching and find out the root cause of the problems in the teaching process. Allowing teachers to adjust and refine their teaching activity plans in time to obtain a more optimal teaching program.
- Revising and improving the evaluation system in real time to ensure its applicability, effectiveness and development.

3.4. Developing Reasonable Process Assessment Criteria and Assessment Organization Forms

It refines and quantifies project indicators in a scientific and fair manner. Formative evaluation accounts for 50% of the total grade, including 10% before class, 20% during class, and 20% after class.

Before class:

Setting the percentage of each part score in the Rain Classroom platform, 3% for SPOC video learning and 7% for online practice.

In class:

① Dividing into discussion and group experiments according to the course content (15%)

Discussion class: Each small class is divided into several groups, with each group of 4-5 people. Each group conducts prior research and study on the topic selected by teachers in advance. During the discussion class, each group chooses a representative to give a lecture and other group members in the group are responsible for answering the questions raised by students in other groups. Each student must attend, and failure to attend will result in 0 points, and the full score is 100. Students who participate but don't say a word will receive 30 points, and students who give a speech regardless of right or wrong will receive at least 60 points.

The group experiment is carried out in pairs. Teachers give the group score based on the results of the experiment and the time spent on the experiment. The main test is whether the use of instruments is correct and standardized, whether the experimental steps are proficient, whether the data analysis is accurate, and whether the maintenance style is rigorous, etc.

② Classroom performance (5%): The benchmark score is 100 points; 10 points will be deducted for being tardy; 10 points will be deducted for changing

seats at will; 10 points will be deducted for copying experiment reports/assignments and reading extracurricular books in class.

After class:

① Rain Classroom viewing and reviewing PPT (3%)

② After-class homework completion (7%)

The benchmark score is 100 points, averaged over the number of assignments and scored based on question-answering thought/skill/correctness, etc. Points will be deducted for each assignment if the assignment is missed or copied once.

The experiment reports will be graded according to the completeness of the experimental purpose, principles, steps, the correctness of the analysis and discussion of the experimental results, and the rigor of the answers to the reflection questions.

③ Stage test (10%)

It includes horizontal cutting of knowledge points, and stage grading of students according to knowledge points. Taking the course evaluation of "Electrotechnics and Electronics Technology Basis" as an example, the horizontal cutting of knowledge points [9] is to cut the three major knowledge points of "Fundamentals of Electrotechnics / Fundamentals of Artificial Circuits / Fundamentals of Digital Circuits" and to grade the students in stages.

The Fundamentals of Electrotechnics section includes a theoretical test, while the Fundamentals of Artificial Circuits and Fundamentals of Digital Circuits section include a experimental test. The total score of the theoretical test is 100 points and the types of questions are multiple choice, fill-in-the-blank, judgment and analytical calculation. The experimental test is conducted with a single person as a single group and typical key experiments are selected for the test, and points are given according to the experimental results and experimental time.

Exploratory additional assessment [10]:

Only additional marks will be given, and no marks will be deducted. If you find errors in PPT and textbooks, 5 points for one place will be given; if you propose an innovative experimental idea and it is feasible, 10 points will be given. Points may be awarded if there are other rewarding behaviors.

Also, during the implementation process, the percentage of formative evaluation can be dynamically adjusted according to the class size. If the class size is large, with 50 to 60 students, the proportion of formative evaluation will be reduced appropriately; if the class size is small, with about 30 students, the proportion of formative evaluation will be increased appropriately.

4. REFORM EFFECTIVENESS OF THE COURSE FORMATIVE EVALUATION SYSTEM

4.1. Enriching Course Resources

Teachers develop the course resources in depth, mainly including the formative evaluation test bank, classroom quiz test bank and laboratory assessment test bank, which provide important guarantee for effectively improving the quality of course teaching.

4.2. Optimizing Teaching Contents and Cultivating Students' Ability of Independent Learning

Formative evaluation has a good promotion role in optimizing the content of "Electrotechnics and Electronics Technology Basis" course, which is determined by the characteristics of the course.

Knowledge of electronics is developing rapidly, and new research results are emerging and changing rapidly. These changes make it urgent for the course to be supplemented with new content in a timely manner. Therefore, for some cutting-edge advances in this field, teachers can lead the students to explore some research topics of interest on their own through the form of knowledge expansion short essays. At the same time, the course content is complicated and the knowledge points are scattered, so it is difficult to ensure the learning effect of the students within the limited classroom teaching time. For important knowledge points, teachers can assign part of the independent study to the students so that they can conduct in-depth exploration outside the classroom, which can well solve the problem of limited classroom teaching time. In this process, teachers' guiding role should be given full play to provide good guidance and answer questions.

During the discussion class, students earnestly fulfill their job duties of mutual evaluation, and there are often debates on the answer to a certain question; during the experimental operation assessment, they cooperate with each other to check and fill in the gaps, reflecting a good teamwork spirit.

4.3. Enhancing Teaching Reform Ability

The research group regularly conducts seminars to analyze and study the feedback from each stage of

formative evaluation and adjust teaching methods in a timely manner. At the same time, they expand assessment resources through various ways and drive the reform of teaching contents and teaching methods while adapting to the reform of assessment mode, in order to truly achieve the effect of promoting teaching by examination.

4.4. Improving Students' Final Examination Results

This evaluation scheme was adopted at the end of the first semester from 2021 to 2022, and a total of 397 students took the examination. There were 310 people with final scores of 60 or more, accounting for 78.09% of the total, with the highest score of 98, the lowest score of 38, and an average score of 68.3. After the reform of the formative evaluation system, the passing rate of the final examination improved by 37.65% compared with the previous term and the average score increased by 7.42 points. This reflects the increased initiative of students in learning and reflects the purpose of effective learning.

5. ISSUES THAT NEED ATTENTION

5.1. More Formative Evaluation Links and More Workload

Formative evaluation sets up several assessment links, and each link needs to assess the learning performance of all students. Not only the assessment contents are diverse, but also the workload generated by the need to record and file in a timely manner is relatively large. Teachers need to plan the course teaching in advance and do the assessment work of each link in stages and batches.

5.2. Developing Assessment Standards So Assessment Results Are Fair and Just

Teachers are responsible for setting the assessment criteria and need to reflect the expected learning objectives in each link. The assessment of "Electrotechnics and Electronics Technology Basis" course should reflect not only the learning attitude of the students, but also their mastery of knowledge, the application and expansion of electronics knowledge of the comprehensive assessment. The expected goals of formative evaluation are to play the role of assessment to guide learning, to bundle learning and examination together, to change the one-time assessment into multiple process learning supervision and examination, and to make the assessment results more objectively and fairly reflect the learning situation and personality differences of the students.

6. CONCLUSION

The change of the assessment method makes students' learning initiative obviously enhanced and they actively complete after-class assignments, and independently learn, report and extend short essays, and the learning effect is obviously improved, which can expand the teaching contents. For teachers, although the workload has increased and the assessment content has increased, their teaching plans of the course has been done well in advance to ensure that the assessment work of each link is completed efficiently in stages and batches.

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