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Exploration and practice of assessment mode reform in hydraulic experiment course

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Abstract: *The hydraulic experiment course aims to help students understand and master the principles of hydraulics through practical operations, but the existing assessment methods have issues such as being too singular and not comprehensive. This paper discusses the problems with hydraulic experiment assessments and proposes corresponding reform plans. It introduces a combined assessment reform plan of formative and summative evaluations, aiming to comprehensively assess students' experimental skills, theoretical application ability, and innovation capacity. This plan has been implemented in the major of hydraulic and hydropower engineering at Nanchang Institute of Technology and has achieved good results. The reform aims to improve the quality of hydraulic experiment teaching and cultivate students' experimental skills and scientific research abilities.*

Keywords: *hydraulic experiment, assessment reform, formative evaluation, summative evaluation, teaching quality*

1. Introduction

The Hydraulic Experiment course is a practical course for majors in hydraulic engineering. It aims to help students understand and master the basic principles and techniques of hydraulics through a series of experimental activities. This course, through a series of carefully designed experimental activities, allows students to deeply understand and master the core principles and technical methods of hydraulics through hands-on operations. Through these experimental operations, students not only learn how to apply the basic concepts of hydraulics, but also cultivate their experimental operation skills and scientific exploration spirit. This lays a solid theoretical and technical foundation for students who hope to engage in engineering design and scientific research in key fields such as water conservancy, environment, and energy in the future.

At present, there are clear deficiencies in the assessment system of the hydraulic experiment course. The main problem lies in the excessive emphasis on the single score of the experimental report, while neglecting a comprehensive assessment of students' observational skills, thinking abilities, and problem-solving capabilities during the experiment [1]. In light of this, this article delves into the innovation path of hydraulic experiment assessment and proposes a comprehensive assessment reform plan. The plan aims to establish a more perfect and scientific evaluation system to comprehensively enhance the quality of hydraulic experiment teaching. This scheme has been implemented in the major of hydraulic and hydropower engineering at Nanchang Institute of Technology and has achieved remarkable results. The ultimate goal of this reform is not only to improve students' experimental skills but also to focus on cultivating their scientific research abilities, thereby laying a solid foundation for their future academic and professional careers.

2. The problems in the assessment of hydraulics experiment course

2.1 The assessment methods are too simplistic

The assessment model for hydraulic experiments is overly dependent on written reports, a method that struggles to provide a comprehensive evaluation of students' practical operational skills and in-depth understanding. The quality of the experimental reports is likely to be constrained by the students' writing skills, which may not accurately reflect their mastery of the experimental content or their ability to apply

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theoretical knowledge. The essence of experimental course lies in guiding students to thoroughly grasp the core principles through hands-on practice. However, if the assessment approach is monotonous and relies solely on textual reports, neglecting the examination of hands-on skills, it cannot fully ensure that students have truly acquired the necessary experimental capabilities [2].

2.2 The assessment content is not comprehensive

During the assessment process of hydraulic experiments, the evaluation of the application of theoretical knowledge is often overlooked. The main objective of hydraulic experiments is to help students gain a deeper understanding and mastery of the theoretical knowledge of hydraulics. However, the current assessment content tends to neglect the evaluation of students' ability to apply theoretical knowledge. For instance, whether students can integrate experimental results with theoretical knowledge, and whether they can provide in-depth explanations and analyses of theoretical concepts based on experimental outcomes, are crucial aspects that are easily disregarded in current assessments.

The assessment process of hydraulic experiments often overlooks the evaluation of students' innovative abilities. In today's society, the importance of innovation is self-evident. However, the current assessment content of hydraulic experiments often neglects the evaluation of students' innovative abilities. For instance, whether students can propose novel experimental designs, or whether they can solve practical problems through experiments, are important aspects that are easily overlooked in current assessments.

2.3 The assessment of examination results is unscientific

The assessment criteria for hydraulic experiments are not clearly defined. If the scoring criteria are vague or overly subjective, students may not clearly understand how to achieve the expected learning objectives, which may lead to inconsistent or unfair scoring results. Currently, the grades for hydraulic experiments overly rely on the experimental report, which may overlook key factors such as students' performance during the experimental operation, the accuracy of data collection, and the ability to explain experimental phenomena. In addition, the process of experimental operation itself is equally important, but it is often overlooked in the existing assessment system. Experimental skills, compliance with safety regulations, and the ability to solve problems on the spot are all important evaluation indicators that should be included in the assessment system.

3. The reform of the assessment for the hydraulics experiment course

Hydraulic experiment is an integral part of hydraulic engineering education, with the primary goal of helping students gain a thorough understanding and mastery of the fundamental principles and experimental skills of hydraulics. In order to further enhance students' experimental abilities and cultivate their innovative spirit, it is necessary to reform the assessment methods used for hydraulic experiments. This article will take the hydraulic experiment course offered by the Hydraulic and Hydropower Engineering program at Nanchang Engineering College as an example, discussing the specific implementation plan of this assessment reform.

3.1 Hydraulic experiment content

The present hydraulics experiment course comprises eight meticulously designed experimental projects: the hydrostatics experiment, energy equation experiment, momentum equation experiment, reynolds experiment, head loss along the path experiment, local head loss experiment, Venturi experiment, as well as the orifice and nozzle experiment. Each of these projects has been allotted a duration of 2 class hours, amounting to a total of 16 class hours, which equates to 1.0 credit. This allocation ensures that students have sufficient time to delve into each experiment, fostering a deeper understanding of hydraulics principles.

3.2 Formative assessment

The process-oriented evaluation of the hydraulics experiment course primarily aims to comprehensively assess students' performance throughout the learning process, rather than focusing solely on the final experimental results. This evaluation method helps teachers to fully understand

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students' learning progress, encourages students to actively participate in experimental activities, and provides timely feedback during the experimental process. In the total score of the hydraulics experiment course, the process-oriented evaluation accounts for 30%, of which online learning, classroom performance, and experimental operation each account for 10%. The details of hydraulics experiment projects and their allocated class hours are shown in table 1.

Table 1: Hydraulic experiment course projects and their allocated class hours

Numble	Experimental projects	Types of experiments	Class hours
1	Hydrostatics experiment	Verification experiment	2
2	Energy equation experiment	Verification experiment	2
3	Momentum equation experiment	Verification experiment	2
4	Reynolds experiment	Verification experiment	2
5	Head loss along the path experiment	Comprehensive experiment	2
6	Local head loss experiment	Comprehensive experiment	2
7	Venturi experiment	Comprehensive experiment	2
8	Orifice and nozzle xxperiment	Comprehensive experiment	2

The score for online learning is based on students' performance in watching online videos and completing simulation experiment assignments. The teacher has set up a hydraulics experiment course on the Chaoxing Learning Platform, and each experimental project is equipped with detailed videos explaining the experimental principles and operation steps. After watching the videos, students need to conduct online virtual simulation experiments and submit simulation experiment assignments. Chaoxing Learning Platform records the completion rate of students watching videos, and students can get corresponding scores after completing the viewing. The teacher will promptly correct the simulation assignments submitted by students and score them based on the quality of the completed assignments [3].

The score for classroom performance is determined based on students' performance in answering questions in class and the completion of in-class quizzes (Chaoxing Learning Platform). When explaining the theoretical knowledge and operation steps of the experimental project, the teacher will ask questions in class, and students who answer correctly will be given extra points. After the explanation, we will post in-class quizzes on Chaoxing Learning Platform, and students can get corresponding scores after completion.

The score for experimental operation is determined based on the performance of students' group experiments. Before the start of the experimental class, we will group the students, usually 2-4 people per group. During the experimental operation, we mainly focus on students' performance in equipment use, data recording, and group cooperation. In terms of equipment use, we observe whether students can correctly use and maintain experimental equipment, including the switch, adjustment, cleaning, and storage of equipment; In terms of data recording, we observe whether students can accurately record experimental data, including observed phenomena, measurement results and key variables in the experiment, which require the format to be neat, clear, and easy to read. In terms of group cooperation, we observe whether students can cooperate well with teammates, effectively divide work, and jointly advance the experimental process [4].

3.3 Summative assessment

The summative assessment for the hydraulics experiment is a comprehensive evaluation of the students' overall performance conducted after the experiment has concluded. This assessment aims to evaluate the learning outcomes and experimental capabilities of the students during the experiment and to provide feedback and suggestions for improvement for subsequent teaching. The summative assessment of the hydraulics experiment course accounts for 70% of the total grade, with the experimental knowledge test comprising 20%, the experimental operation test 30%, and the experiment report 20%.

The experimental knowledge test mainly examines knowledge in basic hydraulic theory, experimental principles and methods, operation of experimental equipment, and data processing and analysis. Basic hydraulic theory typically includes knowledge on hydrostatics, continuity equation, energy equation, and momentum equation. Experimental principles and methods cover knowledge on measuring flow velocity, pressure, discharge, and head loss. Operation of experimental equipment mainly assesses students' mastery of various hydraulics experiment equipment, such as flowmeters and pressure gauges. Data processing and analysis evaluate the students' ability to organize, process, and analyze experimental data, and to understand and manage the sources and methods of dealing with

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experimental errors.

The hydraulic experiment operation exam is primarily aimed at evaluating students' practical operational skills within the experiment. Students in each group draw lots to decide on the experimental operation exam project and complete the exam collaboratively [5]. The exam assesses students' proficiency and correctness in operating various hydraulic experimental equipment, such as velocimeters, pressure gauges, and flow meters. It also evaluates whether students can accurately execute the experimental steps according to the instructions in the experiment manual. In terms of data collection and recording, the exam checks if students can accurately and completely gather and log experimental data. Regarding the analysis of experimental results, it assesses whether students are capable of performing correct analysis and interpretation based on the experimental data. Throughout the exam, each student's operational steps are observed and graded to ensure that they have truly mastered the skills required for experimental operations.

The experiment report score is determined based on the quality of the students' analysis of experimental data and their answers to reflection questions. Regarding data accuracy, it examines whether the data collected by students is error-free and whether all necessary information has been correctly recorded, including experimental conditions, observations, and measurements. In data processing, it assesses whether students have appropriately processed the data, such as calculating averages, standard deviations, error analysis, and whether they can reasonably use charts and graphs to represent data. In terms of depth of analysis, it reviews whether students can deeply analyze the data to identify trends, patterns, and anomalies and provide reasonable explanations for these findings.

4. Analysis of implementation effect

4.1 The learning effect has been significantly improved

The assessment reform encourages students to apply theoretical knowledge to experimental operations, deepening their understanding of hydraulic principles in practice. The introduction of formative assessment keeps students highly engaged throughout the learning cycle. Students realize that their performance in the lab and their experimental operations will also affect their final grades, so they participate more actively in class discussions and experimental operations. The summative assessment, which includes an experimental operation exam, requires students to independently complete the experiment and analyze the data. This forces students to master operational skills proficiently. Under this pressure and motivation, students' hands-on abilities have significantly improved. The assessment reform of the hydraulics laboratory course has significantly improved learning outcomes by motivating students to participate more actively in experimental activities, reinforcing the learning of experimental skills, promoting deep understanding and application of knowledge, and developing the ability to solve problems independently.

4.2 The enthusiasm of learning has been significantly improved

The introduction of the experimental operation exam has made students place greater emphasis on learning experimental operations since they know it will directly impact their final grades. This has not only improved their practical skills but also their enthusiasm and eagerness for experiments. The new assessment method encourages students to think deeply about the experiments and even to engage in innovative designs. This process of exploration and innovation leads to more active student participation in the experiments and increased eagerness to learn. Formative assessment allows teachers to provide timely feedback and guidance during the experiment, helping students correct mistakes and improve their experimental skills. This immediate feedback and guidance make students feel that their learning process is valued, thereby boosting their eagerness to learn. Through the reform of course assessments, students' eagerness to learn has significantly increased. They are more proactive and attentive to practical operations during the experimental process, more willing to explore and innovate, and they place greater importance on self-assessment and reflection.

4.3 The comprehensive ability has been significantly improved

The assessment reform emphasizes the importance of experimental operations, and through practical operation exams and formative evaluation, students must master the use of experimental instruments, the accurate recording and processing of experimental data, and the analysis of experimental results. These requirements have enhanced the students' experimental skills. In the experimental process, various unexpected situations inevitably arise, and the assessment reform requires students to think and solve

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problems independently when faced with these situations, enhancing their adaptability [6]. The reformed evaluation system encourages teamwork; students need to exchange ideas with teammates and coordinate operations, which helps to improve their team collaboration and communication skills. Through the assessment reform in the hydraulics experiment course, students have not only mastered professional hydraulic knowledge and experimental skills but, more importantly, their comprehensive abilities have been significantly improved, laying a solid foundation for their future academic research or career development.

5. Conclusions

The assessment reform emphasizes the importance of experimental operations. Through practical operation exams and formative evaluations, students are required to proficiently master the use of experimental instruments, the accurate recording and processing of experimental data, and the analysis of experimental results. These requirements have enhanced the students' experimental skills. Inevitably, various unexpected situations will arise during the experimental process. The assessment reform requires students to think independently and solve problems when faced with these situations, thereby enhancing their adaptability. The reformed evaluation system encourages teamwork. Students need to exchange ideas with teammates and coordinate operations, which helps improving their team collaboration and communication skills. In the assessment reform of the hydraulics experiment course, students have not only mastered professional hydraulic knowledge and experimental skills, but more importantly, their comprehensive abilities have significantly improved, laying a solid foundation for their future academic research or career development.

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