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Exploration of the Reform of the Sedimentary Petrology Laboratory Course Assessment System from Pre-class to Post-class

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Abstract— *This paper addresses the challenges associated with assessing sedimentary petrology laboratory courses. To tackle these issues, digital technology was integrated to establish a comprehensive assessment system, which evaluates pre-class preparation, in-class participation and operation, group work, and laboratory reports. Through the use of intelligent teaching platforms and wireless digital microscopes, students' learning process is comprehensively monitored and assessed. The findings of this study provide a valuable reference for experimental teaching assessment in geology-related disciplines.*

Keywords— ***Laboratory Course; Comprehensive assessment; Diversification; Sedimentary Petrology.***

I. INTRODUCTION

Depositional rocks are formed through a series of geological processes such as transportation, deposition, and consolidation. They are one of the three major types of rocks that make up the Earth's lithosphere. These rocks are primarily distributed in the upper part of the lithosphere and the surface layer of the Earth's crust, accounting for75% of the the exposed surface area on Earth. Depositional rocks harbor the vast majority of the world's mineral resources, including energy sources like petroleum, natural gas, and coal, as well as a large number of non-metallic, metallic, and rare element minerals, and paleontological fossils [1]. Sedimentary petrology is a core basic course for undergraduate majors such as geology, resource exploration engineering, and exploration technology and engineering in colleges of geology and mineral resources, and petroleum, It is crucial for workers in the related industries [2]. The course includes both theoretical and experimental content. The theoretical part mainly explains the concepts and basic principles related to sedimentary rocks and sedimentary processes. the experimental class deepens students' understanding of the macro characteristics and microstructure and structural characteristics of sed rocks through their observation of sedimentary rock hand specimens and rock thin sections, which is of great significance for improving teaching quality and cultivating students' abilities [3]. It is widely acknowledged that assessment is a crucial component of teaching, and the effectiveness of teaching largely hinges on the assessment methods [4]. However, due to the factors such as the singleness and fragmentation of the assessment methods for laboratory courses, the assessment results may not be able to objectively evaluate the effects of students' practical learning. Therefore, based on a systematic analysis of the existing problems in the assessment of the laboratory Course in Sedimentary Petrology, this paper proposes a comprehensive assessment system that covers the entire process from pre-class preparation, in-class activities to the submission of experimental reports.

With the help of the wireless digital interactive microscope experimental platform for monitoring and real-time evaluation, the course goal of scientific assessment of experimental teaching for cultivating applied technical talents with integrated learning, thinking and application, and first-class comprehensive quality is ultimately achieved.

II. THE CURRENT STATUS OF THE ASSESSMENT SYSTEM FOR SEDIMENTARY ROCK EXPERIMENTAL COURSES

2.1 Lack of Pre-class Preview Assessment

Laboratory courses are important teaching links to consolidate and deepen students' theoretical knowledge, stimulate their interest in learning, cultivate their innovative consciousness and the ability to connect theory with practice. The practicality and rationality of the assessment methods play a crucial role in the selection and training of various types of talents [5]. However, in the current teaching of sedimentary petrology experimental courses, some students have obvious deficiencies in the pre-class preview stage. For example, when teachers ask questions such as the macroscopic identification characteristics of feldspar and how to distinguish calcite from dolomite under the microscope, students' answers are often vague and inaccurate. After entering the experimental stage, these students are at a loss, with only a superficial understanding of the operating procedures and precautions of the microscope, which reflects that they have not seriously previewed the experimental content before class. This problem of insufficient preview seriously affects the progress and accuracy of the experiment.

2.2 Coarse Assessment in Laboratory Experiments

In the current sedimentary petrology laboratory teaching, there is a problem of coarse assessment in experiments. Under normal circumstances, teachers mainly evaluate students through class attendance and experimental operation performance. However, class attendance can only reflect whether students are present in class, and cannot reflect their actual performance and ability level during the experimental process. On the other hand, due to the limited energy of teachers, it is often impossible to fully record and accurately evaluate the operational details of each student. Therefore, the evaluation of experimental operation performance can only rely on subjective impressions for scoring. In this case, students' participation in classroom interaction, practical ability, problem-solving ability, and innovative thinking have not been fully assessed [6].

2.3 Simplification of Experimental Course Grades

At present, the assessment of experimental courses in most domestic colleges and universities is mostly focused on the learning outcomes, while neglecting the learning process. The assessment methods are relatively singular and subjective, and the composition of experimental grades is relatively simple. In most universities, the grades of sedimentary rock experimental courses are composed of class attendance and the evaluation of experimental reports according to a certain proportion. Some even use the evaluation of experimental reports as the final grade, lacking a unified assessment standard and a reasonable assessment method.

III. CONSTRUCTING A NEW TYPE OF DIVERSIFIED ASSESSMENT SYSTEM FOR SEDIMENTARY PETROLOGY LABORATORY COURSES

The laboratory course of sedimentary petrology covers two aspects: hand specimens and thin sections. The identification of hand specimens is the foundation, which mainly involves preliminary identification of the color, lithology, structure, and texture of sedimentary rocks, as well as their genetic markers, to lay the foundation for subsequent research. The identification of thin sections, on the other hand, involves observing and analyzing sedimentary rocks at the microscopic level with the aid of a microscope. It is an extension and deepening of fieldwork and a crucial step in verifying the correctness of preliminary understandings [7].

With the establishment of smart laboratories and the widespread application of intelligent teaching systems such as Yu Classroom and Learning Through, a new intelligent teaching model for laboratory courses has gradually taken shape. Against this backdrop, the establishment of a diversified experimental performance assessment system can comprehensively, multi-dimensionally, and throughout the entire process examine students' learning engagement and outcomes, thereby effectively promoting students' self

- directed learning and enhancing their internal motivation for learning [8].

3.1 Pre-class Assessment

The purpose of pre-class preview is to enable students to master the identification characteristics of the main rock-forming minerals of sedimentary rocks. To this end, we have used tools such as the Fanya Classroom to build an online preview management platform that meets the course requirements. The platform provides a variety of preview materials, such as videos and documents. After completing the preview content, students must pass the test on the preview platform before entering the laboratory to start the experiment. The AI teaching assistant will record each student's test score, which will be used as the score for pre-class preview.

3.2 In-class Assessment

3.2.1 Class Attendance

Class attendance is an important means for teachers to grasp students' attendance information, and the main purpose is to urge students to attend classes on time [9]. Teachers import an Excel file containing information such as student ID, name, and class into the system through the class management function of NowLab and set the effective sign-in time to 15 minutes before class. A sign-in dialog box will pop up on the student's end, and students need to enter their student ID and name to complete the sign-in. Students who sign in after the effective time will be considered late. After the sign-in is completed, the teacher will compare the students' sign-in information with the student list and export the Excel file for storage as the students' attendance score.

3.2.2 Experimental Operation

In class, students are divided into groups using the wireless interactive teaching platform, and experiments are conducted on a group basis. The experimental content includes two major categories: clastic rocks and carbonate rocks. The teacher first explains and demonstrates the experimental content, and then the students operate independently. Throughout the experimental process, teachers should shift from the "main role" to the "supporting role," allowing more time to students to explore on their own. This not only provides the teacher with more time to assess the students' operational performance but also fully stimulates the students' initiative and self-learning abilities. During this period, the teacher closely monitors each student's experimental situation through classroom monitoring, provides timely guidance and assistance, promotes interaction between teachers and students as well as among students, answer questions, and evaluates students' operational performance.

3.2.3 Group Assessment

Group assessment aims to enhance students' team collaboration ability and sense of responsibility, and to include team scores in the total score. The initial score of team members is based on the benchmark score and is assessed according to the team's contribution value [10]. Although the wireless digital microscope teaching platform can achieve real-time interaction between students and teachers, given the limited class time, the group leader is given management authority. Group members can feedback their observation results and questions to the group leader and discuss within the group. The group leader needs to promptly summarize the group members' experimental achievements and collect the problems that have not been solved in the experiment.

Before the experimental course assessment, a group presentation and answering questions session is scheduled. The judges, composed of excellent students with a solid professional foundations, group leaders, and professional teachers, will score each group's presentation. After discarding the highest and the lowest scores, the average score will be taken as the group's score. The group leader will then score the group members based on the group's score and the members' contributions to the presentation, and this score will be counted towards the regular grade.The answering questions session aims to solve the problems students encounter in the course learning and help them better complete the course learning.

3.3 Experimental Report Assessment

The experimental report primarily evaluates students' proficiency in writing standardized identification reports for rock hand specimens and thin sections, as well as their comprehensive analytical skills for sedimentary rocks. Students randomly draw numbered sedimentary rock hand specimens and thin sections, then independently complete two integrated identification reports within the allotted time. Instructors review the reports, and the scores contribute to the final experimental report grade. This assessment method

not only ensures students' engagement but also eliminates any temptation to plagiarize.

3.4 Composition of Experimental Grades

Assessment not only serves as a test of the effectiveness of experimental teaching by instructors but also provides a comprehensive evaluation of students' experimental attitudes, practical skills, and their ability to apply learned knowledge to solve real-world problems [11]. In reforming the assessment methods for sedimentary petrology experiments, it is essential to fully engage students' enthusiasm and initiative while avoiding mechanical or rote learning (Fig 1).

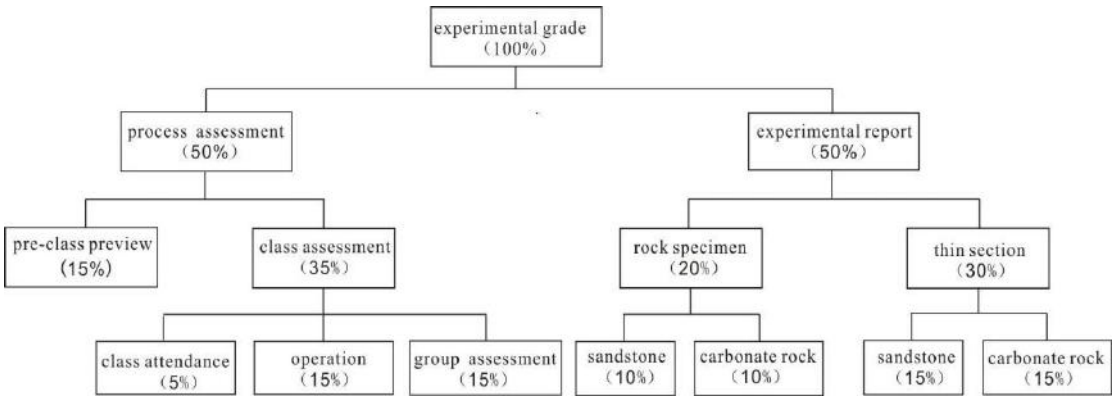

Fig.1 Composition of Experimental Grades

After five years of pedagogical practice and alignment with professional training plans and relevant institutional requirements, we have increased the proportion of process assessment scores and determined that the course grade is composed of 50% process assessment scores and 50% experimental report scores. Process assessment scores cover pre-class preview, class attendance, experimental operation, and group assessment. The experimental report grade is composed of two parts: hand specimen identification report and thin section identification report. The experimental course grade of each student is calculated according to the corresponding proportion. Students who neglect pre-class preparation or fail to diligently observe and record experimental data during class will struggle with group presentations and cannot produce high-quality reports. This approach ensures a fairer, more objective evaluation of experimental performance.

IV. CONCLUSION

Sedimentology experiments are a core course in the mineral resource exploration major of university geology and mining programs. It mainly assesses students' ability to comprehensively identify sedimentary rock hand specimens and thin sections, and is a highly practical experimental course. With the development of digitalization and the continuous improvement of the school's online teaching platform, this paper explores the assessment methods for sedimentology experiments and initially establishes a diversified course assessment system to comprehensively, objectively, and fairly evaluate students' learning outcomes.

The reform of assessment methods for experimental courses is a long and intricate endeavor, requiring instructors to continuously learn and innovate through teaching practice. This process is constrained by multiple subjective and objective factors, including students' foundational knowledge and learning initiative, laboratory infrastructure and management, the completeness of rock specimen collections, and allocated class hours. By establishing a comprehensive, multi-dimensional, and process-oriented diversified assessment system, we have not only stimulated students' interest and enhanced classroom engagement but also strengthened their practical skills, critical thinking, and problem-solving abilities. These improvements have elevated the teaching effectiveness of sedimentology experiments and cultivated more high-caliber talents with innovative spirit and practical competence.

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