Research on the Teaching Reform of Flotation Reagent Course in Mineral Processing Engineering Major Based on BOPPPS Teaching Mode

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Abstract: The application of BOPPPS teaching mode in the flotation reagent course of mineral processing engineering can not only stimulate students' interest in learning, but also cultivate their engineering practical ability and improve teaching quality. This article elaborates on the application advantages of BOPPPS teaching mode in the teaching of flotation reagents in mineral processing engineering major, and explores the teaching reform strategy of flotation reagents in mineral processing engineering major based on BOPPPS according to the process of introducing situational problems, clarifying learning objectives, pre-test, participatory learning, post test, and summary. The aim is to provide some useful references, promote the teaching reform and innovation of flotation reagents in mineral processing engineering major, and cultivate talents in mineral processing engineering major.

Keywords: BOPPPS teaching mode; Mineral Processing Engineering major; Flotation reagent course

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Introduction

The continuous advancement of society and rapid economic development cannot be separated from the effective supply of resources. To achieve efficient exploitation and rational utilization of resources, relevant disciplines need to continuously develop and achieve innovative breakthroughs. Mineral processing engineering, as one of the important majors in the field of resource development and recycling, is a multidisciplinary and comprehensive major that mainly studies the efficient integration and recycling of natural mineral resources and secondary resources. At present, with the proposal of "promoting efficient utilization and green development of mineral resources" in the "14th Five Year Plan for the Development of Raw Material Industry", the demand for talent cultivation in mineral processing engineering in the field of resource development and recycling is gradually increasing. However, the traditional teaching mode is no longer sufficient to meet the needs of the current teaching reform of flotation reagents in mineral processing engineering, which makes it difficult for students to combine the mechanism of action of reagents with actual ore properties and process parameter optimization, and cannot meet the industry's demand for "innovative, composite, and application-oriented" engineering and technical talents. The application of BOPPPS teaching mode can break the limitations of traditional teaching mode, emphasizing student-centered, learning goal oriented, and continuous improvement as the core concept. By applying the BOPPPS teaching model, not only can students connect knowledge with practical applications, but it can also strengthen their practical abilities and improve their learning outcomes. This article takes the course of "Flotation Reagents" as the starting point and constructs a teaching reform strategy based on the BOPPPS model, aiming to provide a reference for the teaching reform of mineral processing engineering courses and cultivate high-quality technical talents in mineral processing engineering.

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1.The application advantages of BOPPPS teaching mode in the teaching of flotation reagents in mineral processing engineering major

1.1 Stimulating Learning Interest

Different from traditional teaching modes, BOPPPS teaching mode is a student-centered teaching mode guided by educational goals. This mode divides the teaching process into six stages: course introduction, learning objectives, pre-test, participatory learning, post test, and summary. The application of BOPPPS teaching mode in the teaching of flotation reagents in mineral processing engineering majors can attract students' attention by introducing scenario based problems or practical cases, making them aware of the importance of flotation reagents in actual production, and effectively combining theoretical knowledge of professional courses with practical experience, further stimulating students' desire to understand and explore related knowledge.

1.2 Cultivate Engineering Practice Ability

The BOPPPS teaching model emphasizes organizing students for participatory learning, allowing them to learn professional theoretical knowledge and master relevant professional skills through practical participation. For example, teachers can introduce virtual simulation technology in the participatory learning process, which simulates the flotation process under different reagent conditions, intuitively displays the influence of reagent concentration and pH value on recovery rate, and then guides students to group for practical operations. This helps deepen students' participation and immersive learning experience, allowing them to learn new knowledge and consolidate old knowledge through actual participation. It is also beneficial for students to connect knowledge with practice and strengthen their engineering practice ability.

1.3 Improving Teaching Quality

The BOPPPS teaching model emphasizes the importance of pre-test and post test. The fundamental purpose of pre-test is to evaluate students' knowledge reserves, mastery of learned content, and pre study situation, while also understanding students' interests in the course, helping them identify shortcomings, and strengthening their willingness to learn. Moreover, teachers can evaluate the depth and pace of teaching based on pre-test results, and adjust teaching content and methods appropriately. The fundamental purpose of post testing is to help teachers understand students' learning situation in this lesson, including their understanding and mastery of knowledge, their ability to apply knowledge to solve practical problems, etc., and then reflect on the shortcomings in teaching and adjust teaching strategies accordingly. Therefore, the application of BOPPPS teaching mode in the teaching of flotation reagents in mineral processing engineering majors can help improve the quality of teaching.

2.Teaching reform strategy for flotation reagents course in mineral processing engineering major based on BOPPPS teaching mode

2.1 Introduction of practical cases to stimulate learning interest

Before teaching the flotation reagent course in mineral processing engineering, teachers should first introduce practical cases related to the course knowledge, attract students' attention, and stimulate their thinking and exploration interest. For example, a teacher presented a video of a large copper ore beneficiation plant experiencing economic losses due to an unreasonable flotation reagent system, resulting in a copper recovery rate far below the industry average. The video presents in detail the production process of the beneficiation plant, the actual situation of the flotation workshop, and the confusion faced by technical personnel when facing problems. After watching, the teacher guides the students to review the basic knowledge they have learned about mineral properties, flotation principles, etc., and think about the relevance of these knowledge to the application of flotation reagents in the current case. In this process, students can think independently and discuss with other peers, which helps deepen their understanding and memory of the basic knowledge they have learned, and also stimulates their enthusiasm for learning, laying a foundation for subsequent teaching.

2.2 Clarify ability requirements and learning tasks and objectives

Clear ability requirements and learning tasks and goals are important prerequisites for students to engage in purposeful learning and practice. Firstly, before formal teaching, teachers should first search online to understand the latest developments and trends in resource development and recycling, and communicate through online meetings between schools and enterprises to understand the job requirements of enterprises. On this basis, teachers grasp the core competency elements from the organized materials, combine them with the school's professional education goals, and determine the overall teaching objectives, aiming to let students know which knowledge needs to be emphasized and what abilities they need to possess. Secondly, the teacher should clearly state the goals that students should achieve in terms of knowledge consolidation and practical application in this lesson. In terms of knowledge consolidation, students need to have a deep understanding of core knowledge points such as the classification, mechanism of action, and influencing factors of flotation reagents, and accurately explain the specific roles of different types of flotation reagents in the flotation process. In terms of practical application, students are able to design a reasonable flotation reagent system based on the given ore properties and process requirements; Be able to analyze the problems that arise during the actual flotation process and propose solutions based on flotation reagent adjustments. By setting clear learning goals, students can have a clear direction in the learning process, consolidate knowledge and enhance practical abilities in a targeted manner.

2.3 Diagnose students' prior knowledge and adjust teaching content

The main purpose of implementing this section is to help teachers understand students' mastery of the learned content and their pre reading situation, so that they can optimize the teaching content in a targeted manner based on the pre-test results. Before formal teaching, on the one hand, teachers can use educational platforms such as MOOCs and NetEase Cloud to organize students to participate in Q&A games. The game content includes the knowledge points of the previous class and the knowledge learned before, to understand the students' knowledge and ability situation, in order to further grasp the difficulty and progress of teaching. On the other hand, teachers can design written tests that include multiple-choice questions, fill in the blank questions, and short answer questions to test students' memory and understanding of basic concepts, classifications, and other fundamental knowledge of flotation reagents. At the same time, teachers set up some practical case analysis questions for students to analyze the problems and possible causes of the application of flotation reagents in the cases based on their learned knowledge, in order to evaluate their ability to apply knowledge to solve practical problems. After the implementation of the pre-test phase, teachers will accurately identify students' weak areas in knowledge mastery and practical application based on the test results, make targeted adjustments to the existing teaching content, optimize teaching methods, and meet students' learning needs.

2.4 Participatory learning to enhance knowledge understanding and engineering application abilities

After conducting pre class quizzes, teachers design interactive and participatory teaching activities for flotation reagents based on the test results, such as group discussions, simulated engineering design and practice, which are the core elements of the BOPPPS teaching model. Firstly, the teacher organizes group discussions with students, presenting relevant content about flotation reagent engineering cases through multimedia, allowing students to understand the background and basic content of the cases. For example, ores contain various valuable metals such as copper, lead, and zinc, and the sulfides of these metals are interwoven with each other. The composition of gangue is complex, and students are required to analyze how to choose the appropriate combination of flotation reagents in this case to achieve effective separation and recovery of various metals. Secondly, during the group discussion, students should apply their knowledge of flotation reagents, combined with the properties of ores and process requirements, to engage in in-depth thinking and communication. Teachers should provide touring guidance, guiding students to analyze problems from different perspectives and encouraging them to propose innovative solutions. Thirdly, teachers use virtual reality technology and augmented reality technology to simulate the construction of a new

beneficiation plant, requiring students to comprehensively consider factors such as ore properties, process flow, equipment selection, etc., and design a reasonable flotation reagent system. In the design process, students need to consult relevant materials, understand the application experience of flotation reagents for similar ores, and then combine their learned knowledge to carry out innovative designs. During this period, teachers should provide timely professional guidance to help students solve professional problems, guide students to think in the right direction, and correct students' erroneous behaviors in practical operations in a timely manner, standardizing students' practical operation behavior. In addition, teachers can also incorporate professional course knowledge and case studies into student designs to better help students connect knowledge with practice, allowing them to learn knowledge and exercise professional skills through participation in practice, achieving the goal of "learning by doing, learning by doing", and strengthening students' knowledge understanding and engineering application abilities.

2.5 Verify learning outcomes and provide immediate feedback

After the participatory teaching activity, teachers should conduct tests on students to understand their mastery of knowledge, and then provide feedback on the test results to guide students to reflect independently and make targeted improvements, strengthening their understanding and mastery of knowledge. Firstly, based on the content and objectives of this teaching session, the teacher designs a variety of test questions, including multiple-choice questions and short answer questions, covering the knowledge and skills learned by students in the classroom. At the same time, teachers will send test questions to students in electronic form, determine the deadline and submission method for test questions, such as email distribution, document sending, etc., and then organize the documents submitted by students to understand their understanding and mastery of flotation reagent course knowledge, score them, and provide reasons for scoring. In addition, teachers provide targeted feedback and guidance to individual students or the entire class based on their test results. They can evaluate students' answers through online annotations, comments, or face-to-face interviews, point out errors, and guide students to correct them. At the same time, they recognize students' progress and excellent performance in the test.

Secondly, in order to understand students' professional knowledge and practical abilities, and to test their achievements in participatory learning, teachers can also use various assessment methods such as experimental reports, case analysis reports, and on-site operation assessments to comprehensively evaluate students' knowledge of flotation reagents and engineering practical abilities mastered in this lesson. Among them, the assessment content not only includes students' understanding and mastery of theoretical knowledge, but also their performance in practical operations, problem-solving, teamwork, and other aspects. After the assessment is completed, the teacher points out the deficiencies in students' practical operations based on the post test results, guides students to correct them in a timely manner, strengthens students' correct understanding and application of knowledge, and conducts self reflection to continuously optimize the teaching mode and better cultivate professional talents in mineral processing engineering.

2.6 Emphasize teaching summary, sorting and consolidating knowledge

After the completion of the post test phase, teachers should summarize and reflect on the students' test results, teaching process, and feedback, including whether the teaching objectives have been achieved, whether the students' learning outcomes have met expectations, the effectiveness of teaching methods, and room for improvement. Teachers can write a teaching summary report, recording the experience and lessons learned from this teaching, and continuously adjusting and optimizing the teaching mode. Throughout the process, teachers should respect individual differences among students, be student-centered, pay attention to personalized learning needs and progress of each student, and motivate students to actively learn through appropriate feedback and guidance. At the same time, the teacher guides students to systematically sort out the knowledge of flotation reagents learned in this lesson. Through the use of mind maps, the classification, mechanism of action, influencing factors, application cases, and other knowledge points of flotation reagents are connected to help students form a clear knowledge framework and

construct a complete knowledge system. On this basis, the teacher emphasizes the importance of knowledge of flotation reagents in practical engineering applications, and analyzes the positive effects of correct flotation reagent system design on improving mineral recovery rate, reducing production costs, and minimizing environmental pollution, based on actual cases. In addition, teachers should constantly reflect, learn, and improve to enhance the teaching quality of flotation reagents in mineral processing engineering. In addition to summarizing, teachers should also introduce students to the latest technologies and development trends in the industry, and use methods such as pictures and videos to let students understand the cutting-edge dynamics in the field of flotation reagents, and stimulate their interest and enthusiasm for future engineering practices.

3.Conclusion

In summary, the application of BOPPPS teaching mode in the teaching of flotation reagents in mineral processing engineering is an important way to cultivate professional technical talents and improve teaching quality. This article elaborates on its advantages and proposes targeted teaching strategies: introducing practical cases to stimulate learning interest; Clear ability requirements and learning tasks and goals; Diagnose students' prior knowledge and adjust teaching content; Participatory learning enhances knowledge understanding and engineering application skills; Verify learning outcomes and provide immediate feedback; Pay attention to teaching summary, sorting and consolidating knowledge. In the future, we can try to introduce new technologies such as generative artificial intelligence, lower the threshold for course practice, allow more students to learn knowledge and master skills through practice, continuously cultivate high-quality engineering and technical talents, and help the high-quality development of China's mineral processing field.

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