Curriculum and Teaching Methodology (2024)
Clausius Scientific Press, Canada

DOI: 10.23977/curtm.2024.070621
ISSN 2616-2261 Vol. 7 Num. 6

Teaching Reform of Mineral Deposits Science in Resource Exploration Engineering: A Case Study of Shandong Institute of Petroleum and Chemical Technology

Wei Yu[a], Jiao Wang[b,*], Jie Chen[c]

College of Petroleum Enaineening, Shandong Institute of Petroleum and Chemical Technology, Dongying City, China
[a]yw3019@foxmail.com, [b]896221370@qq.com, [c]93680706@qq.com
[*]Corresponding author

Keywords: Resource Exploration Engineering, Mineral Deposits Science, Teaching Reform

Abstract: This article takes Shandong Institute of Petroleum and Chemical Technology as an example to explore the teaching reform of the "Mineral Deposit Science" course in the Resource Exploration Engineering major. As a core elective course in the field of "Mineral Deposit Science", there are problems such as complex teaching content, abstract knowledge points, weak practical application, and outdated textbooks. By optimizing teaching content, innovating teaching methods, and reforming assessment methods, the aim is to stimulate students' interest in learning, improve teaching quality and effectiveness, cultivate professional talents with solid theoretical foundations and strong practical abilities, and contribute to the country's resource security and economic development.

1. Introduction

With the rapid development of the global economy, the importance of mineral resources as a national strategic resource has become increasingly prominent. The Resource Exploration Engineering discipline plays a crucial role in training professionals for mineral resource exploration and development, and its teaching quality is directly related to national resource security and economic development. In the curriculum of the Resource Exploration Engineering program, "Mineral Deposit Science" serves as a core elective course that not only imparts the fundamental theories of mineral deposit science to students but also carries the mission of developing students' ability to solve practical mineral issues.

However, under traditional teaching models, the "Mineral Deposit Science" course often faces numerous challenges. The extensive content and complex knowledge system make it difficult for students to grasp quickly; some knowledge points are abstract and hard to understand, which can create a sense of intimidation among students; the weak practical teaching components lead to a disconnect between theory and practice; moreover, with the continuous advancement of mineralogy research and the emergence of new technologies and methods, traditional textbooks fall significantly short in keeping up with the latest developments in the field.

Therefore, it is imperative to implement teaching reforms in the "Mineral Deposit Science" course. This paper will take Shandong Institute of Petroleum and Chemical Technology as an example, exploring ways to optimize the teaching of "Mineral Deposit Science" in terms of teaching content, teaching methods, and assessment methods. The aim is to stimulate students' interest and motivation in learning, improve teaching quality and effectiveness, and contribute to training resource exploration engineering professionals with a solid theoretical foundation and strong practical abilities.

2. Basic Course Content and Learning Situation

Mineral Deposit Science is an elective course for third year students majoring in Resource Exploration Engineering. It mainly introduces various research tasks and methods of mineral resources and mineral deposit science. The textbook we use is the classic work "Mineral Deposit Studies" (Third Edition) jointly written by Academician Yusheng Zhai, Shuzhen Yao, Keqin Cai, and others[1]. Our school's Mineral Deposit Science course is scheduled for the fifth semester, with a total of 32 class hours. Through the study of the course, students will master the basic concepts of mineral deposits, mineralization processes, regional mineralization research, and comprehensive research on mineral deposits; This includes various mineral deposits such as magmatic deposits, pegmatite deposits, skarn deposits, hydrothermal deposits, volcanic deposits, weathered deposits, sedimentary deposits, biochemical energy deposits, and metamorphic deposits[1]. It plays an important role in students' understanding and recognition of various mineral deposits, laying the foundation for students to solve practical mineral problems after entering the workforce.

This type of course emphasizes theoretical teaching, and its traditional teaching model often focuses on imparting problem-solving skills, with teachers taking the lead and students easily falling into the dilemma of passive learning. In the classroom, students often exhibit phenomena such as lack of interest, scattered attention, low participation, and delayed response, which directly affect the effective achievement of teaching effectiveness.

3. Problems in the Teaching of Mineral Deposit Courses

3.1. Too much teaching content and too scattered knowledge system

The textbook "Mineral Deposit Science" comprehensively covers the basic theories of mineral deposit science, while deeply analyzing the geological characteristics, ore controlling factors, and genesis mechanisms of various types of mineral deposits. For beginners, facing such a vast knowledge system, it is often difficult to quickly establish a clear framework and context, which can easily lead to a sense of confusion in learning. For example, when studying magmatic deposits, students need to master knowledge in multiple aspects such as the formation conditions, mineralization mechanisms, deposit types, and characteristics of magmatic deposits. These knowledge points are interrelated and influence each other, forming a complex knowledge network[1].

3.2. Some Knowledge Points are Difficult to Understand and Easily Confused

The textbook "Mineral Deposit Science" covers a wide range of complex knowledge points, including some highly abstract and theoretical content. And there are often close connections and mutual influences between knowledge points, but this connection can also easily lead to confusion among students in the learning process. For example, different types of mineral deposits have both similarities and significant differences in their genesis, characteristics, and controlling factors. Students may easily confuse the characteristics of different types of mineral deposits when studying.

3.3. Insufficient Emphasis on Practical Teaching

The textbook "Mineral Deposit Science" focuses on the basic concepts, fundamental theories, and detailed explanations of various types of mineral deposits, providing students with a solid theoretical foundation. However, compared to the richness of theoretical knowledge, the section on practical teaching in textbooks appears relatively weak. This is mainly reflected in the following aspects:

The limitations of practical cases: Although there are many introductions and analyses of actual mineral deposit cases in textbooks, the number and types of these cases may not be sufficient to meet the needs of practical teaching. Students may find it difficult to fully understand the practical applications of mineral deposit studies through limited case studies.

Lack of experimental and internship components: Compared with the detailed theoretical chapters, there is less specific guidance on experimental and internship components in the textbook. This may lead to a lack of clear guidance and direction for students in the practical process, making it difficult to effectively transform theoretical knowledge into practical abilities.

The lack of systematicity in practical teaching: Practical teaching should be a systematic and coherent process that needs to be closely integrated with the theoretical knowledge learned by students. However, due to the lack of systematicity in the practical teaching section of the textbook, students may find it difficult to form a complete system of practical skills.

Practical teaching plays a crucial role in mineral deposit education. It can not only help students consolidate theoretical knowledge, but also enhance their practical ability and innovative thinking. However, the shortcomings in practical teaching of the textbook "Mineral Deposits Science" may have the following impacts and consequences:

The disconnect between theory and practice: Students may find it difficult to combine theoretical knowledge with practical application in the learning process, leading to the dilemma of "learning without usefulness".

Insufficient practical ability: Without sufficient practical teaching, students' practical ability may not be fully exercised and improved, which may affect their future career development.

Innovative thinking is limited: Practical teaching is an important way to cultivate students' innovative thinking. If the practical teaching part in the textbook is insufficient, it may limit the development of students' innovative thinking and innovation ability.

3.4. Lack of Follow-up on the Latest Developments in the Discipline

The publication of "Mineral Deposit Science" (Third Edition) was in 2011, and it has been more than ten years since then. With the continuous advancement of modern science and technology, especially breakthroughs in geological exploration technology, geophysical technology, geochemical technology, and isotope geochemistry, the research methods and means of mineral deposit science have been greatly enriched and improved. The emergence of these new technologies and methods not only broadens the research perspective of mineral deposit studies, but also profoundly changes our understanding of the genesis, distribution patterns, and exploration strategies of mineral deposits.

In recent years, new perspectives and hypotheses on the multi-source of ore-forming materials, the complexity of ore deposit formation processes, and the close relationship between ore deposits and geological structural environments have attracted widespread attention in the academic community. However, they may not have been fully reflected or deeply explored in this textbook. In the exploration of the genesis mechanism of mineral deposits, although this textbook has covered various mineralization theories and models, more advanced research methods and techniques may still be needed for in-depth analysis when facing complex and variable geological phenomena of mineral deposits.

4. Teaching Reform Content of Mineral Deposit Science Course

4.1. Teaching Content Reform

4.1.1. Optimize course structure

In terms of teaching content, the course structure should be further optimized to make the content more systematic and coherent. Specifically, the course content can be divided into four modules: basic theory, deposit types, mineralization laws, and exploration techniques. The basic theoretical module mainly introduces the basic concepts of mineral deposit science, the general theory of mineralization, etc; The deposit type module elaborates on the characteristics and genesis of various types of deposits in detail; Exploring the spatiotemporal distribution patterns of mineral deposits through the mineralization law module; The exploration technology module introduces the methods and techniques of modern mineral deposit exploration[2].

4.1.2. Strengthen practical content

Mineral deposit science is a highly practical discipline, therefore, practical content should be strengthened in the teaching process. By increasing field internships, laboratory experiments, case studies, and other methods, students can combine theoretical knowledge with practical applications. For example, students can be organized to conduct on-site investigations in mining areas to understand the actual formation process and exploration process of mineral deposits; In the laboratory, students can master various exploration techniques and analysis methods through simulation experiments[2].

4.2. Reform of Teaching Methods

4.2.1. Introducing research-based teaching

As a cutting-edge teaching philosophy, research-based teaching aims to stimulate students' subjectivity, encourage them to actively participate, explore independently, and practice the knowledge they have learned. In teaching practice, a series of research topics or projects closely related to mineral deposits can be carefully planned, allowing students to independently choose according to their personal interests and professional directions, and explore the unknown in real or simulated research environments. During this process, teachers need to transform into guides and partners, providing timely methodological guidance, assisting students in overcoming difficulties, and optimizing research paths. This teaching mode not only strengthens students' professional knowledge, but also invisibly hones their innovative thinking, critical thinking ability, and problem-solving ability, laying a solid foundation for future academic research and career[3].

4.2.2. Adopting diversified teaching methods

In order to improve the teaching effectiveness of the course "Mineral Deposit Science", we should actively adopt diversified teaching methods to enrich students' learning experience and deepen their understanding. In addition to traditional lecture based teaching, we should also cleverly integrate multiple modes such as multimedia teaching, online teaching, and interactive teaching. Multimedia teaching, with its vivid and intuitive advantages, presents complex mineral deposit forms and features to students through high-definition images, dynamic videos, and other media, making abstract concepts concrete. Interactive teaching emphasizes the subject status of students. Through interactive activities such as group discussions and role-playing, it not only enhances the fun of the classroom

and students' sense of participation, but also greatly stimulates their learning initiative and exploratory spirit, jointly promoting a significant improvement in teaching effectiveness[4].

4.2.3. Strengthen the practical teaching process

The importance of practical teaching as the core pillar of mineral deposit science course teaching is self-evident. Practical teaching should cover multiple dimensions, including but not limited to diverse activities such as field internships, laboratory experiments, and course design. During the field internship, students will personally visit the mineral deposit site, witness and touch the masterpieces of nature with their own hands. Through on-site observation and recording, they will gain a deep understanding of the actual formation process, geological structure background, and practical application of modern exploration technology of the mineral deposit. This process not only deepens students' understanding and memory of theoretical knowledge, but also cultivates their observation ability, analytical ability, and teamwork spirit[5].

Laboratory experiments are an important way for students to master exploration techniques and analytical methods. In carefully designed experimental projects, students will personally operate various advanced exploration instruments, learn and master the entire process of sample collection, processing, and analysis. Through repeated practice, their experimental skills and data processing abilities will be significantly improved.

4.3. Reform of Assessment Methods

4.3.1. Establish a diversified evaluation system

The traditional assessment method tends to rely solely on exam scores, which undoubtedly obscures the comprehensive examination of students' practical and innovative abilities. In order to build a more fair and comprehensive evaluation system, we urgently need to introduce diversified assessment standards to measure students' learning outcomes from multiple dimensions. Specifically, the evaluation system should be refined into three major sections: theoretical knowledge, practical ability, and innovation ability. Theoretical knowledge is tested through rigorous closed book exams to assess students' mastery level. Practical ability is comprehensively evaluated through on-site operations during field internships, precise execution of laboratory experiments, and innovative ideas in course design. And innovation ability encourages students to demonstrate their ability and achievements in independent thinking and innovative exploration through writing academic papers, submitting research reports, and other forms. This evaluation system not only promotes the comprehensive development of students, but also guides education towards a more practical and innovative direction[2].

4.3.2. Strengthen Process Evaluation

Process evaluation, as a comprehensive and in-depth evaluation method, has immeasurable value in enhancing the teaching quality and promoting the comprehensive development of students in the course of Mineral Deposit Science. This evaluation method not only focuses on students' final learning outcomes, but also looks at key elements such as their attitudes, methods, and teamwork throughout the entire learning process.

In the classroom of Mineral Deposit Science, teachers can evaluate students' positive learning attitudes by carefully observing their classroom performance, such as participation, questioning quality, note taking, etc. Meanwhile, encouraging students to participate in group discussions can not only enhance their understanding and application of mineral deposit knowledge, but also observe their communication skills, collaborative spirit, and critical thinking through interaction. In addition,

the completion status of homework is also an important component of process evaluation, which reflects students' abilities in independent learning, data collection, problem analysis, and problem-solving.

Through this series of procedural evaluation methods, teachers can promptly identify the difficulties and problems that students encounter in the learning process, and provide personalized guidance and assistance. This timely feedback mechanism helps students adjust their learning strategies in a timely manner, overcome learning barriers, and enhance their learning motivation[5].

5. Conclusions

In the teaching reform of "Mineral Deposit Science" in the field of resource exploration engineering, we deeply recognize the limitations of traditional teaching models and the necessity of reform. By optimizing the course structure, strengthening practical content, introducing research-based teaching and diversified teaching methods, we aim to stimulate students' interest in learning, enhance their practical abilities and innovative thinking.

As a highly comprehensive and practical discipline, the teaching reform of mineral deposit science studies is not only a reconstruction of students' knowledge system, but also a comprehensive improvement of their overall quality. We believe that through reform, students will be able to better grasp the basic theories, mineralization laws, and exploration techniques of mineral deposits, laying a solid foundation for their future careers. At the same time, we also realize that teaching reform is a continuous process that requires constant exploration and practice. We will continue to pay attention to the latest developments in the discipline, update teaching content, improve teaching methods, and strive to provide students with better educational resources and learning environments.

Looking ahead to the future, we hope to cultivate more resource exploration engineering talents with solid theoretical foundations, strong practical abilities, and innovative thinking through the reform of mineral deposit courses, and contribute more wisdom and strength to the country's resource exploration cause.

References

[1] Zhai, YS., Yao, SZ., and Cai, KQ. (2011) Mineral Deposit Science. Geological Publishing, Beijing.

[2] Zhao, ZH., Liang, SS., Zhou, JZ., Jing, ZY. (2022) Reform and Practice of Ideological and Political Education in Mineral Deposit Studies. Education and Teaching Forum, 43, 53-56.

[3] Li, Q., Zhao, SQ., Dong H. (2020) Reform and Practice of Research based Teaching in Mineral Deposit Science Course. University Education, 04, 68-70.

[4] Zhang, HH, Xue, XG., Huang, YB., Deng, XH. (2021) Research on Guiding Students to Actively Learn Methods: Taking Mineral Deposit Science Course as an Example. Journal of Changchun Institute of Technology (Social Sciences Edition), 22 (04), 70-73.

[5] Sun, HS., Zhao, LJ., Pi, DH., Yang, Z., Chen, ZJ., Jiang, MR. (2018) Reflections on the Teaching Reform of Mineral Deposit Science Course. Journal of Hebei University of Geosciences, 41 (06), 38-42.