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# *Exploration of Curriculum Construction and Teaching Methods for Sedimentary Basin Analysis: A Case Study of Resource Exploration Engineering at Shandong University of Petrochemical Technology*

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

*School of Earth Science and Engineering, Shandong Institute of Petroleum and Chemical Technology, Dongying City, China*
*[a]yw3019@foxmail.com, [b]896221370@qq.com, [c]93680706@qq.com*
**Corresponding author: Jiao Wang*

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***Abstract:*** Taking the Resource Exploration Engineering major at Shandong University of Petrochemical Technology as an example, this paper explores the construction and teaching methods of the course "Sedimentary Basin Analysis". As a core elective course, "Sedimentary Basin Analysis" has problems such as complex teaching content, abstract knowledge points, weak practical application, and outdated textbooks.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 is increasingly prominent. As an important discipline for cultivating talents in mineral resource exploration and development, the teaching quality of resource exploration engineering is directly related to national resource security and economic development. In the curriculum system of resource exploration engineering, "Sedimentary Basin Analysis" is a core elective course that not only undertakes the responsibility of imparting basic theories of sedimentary basin analysis to students, but also shoulders the mission of cultivating students' ability to solve practical mineral problems.

However, under the traditional teaching mode, the course of "Sedimentary Basin Analysis" often faces many challenges. The teaching content is diverse and the knowledge system is complex, and there are many repetitions with "Sedimentology" and "Petroleum and Natural Gas Geology", which makes it difficult for students to quickly master; Some knowledge points are abstract and difficult to understand, which can easily cause students to develop a fear of learning difficulties; The weak practical teaching link leads to a disconnect between theory and practice; Meanwhile, with the

continuous deepening of sedimentary basin analysis research and the emergence of new technologies and methods, traditional textbooks have obvious shortcomings in keeping up with the latest developments in the discipline.

Therefore, it is imperative to reform the teaching of the course "Sedimentary Basin Analysis". This article will take Shandong University of Petrochemical Technology as an example to explore how to optimize the teaching of the course "Sedimentary Basin Analysis" from the aspects of teaching content, teaching methods, and assessment methods, in order to stimulate students' learning interest and motivation, improve teaching quality and effectiveness, and contribute to the cultivation of resource exploration engineering professionals with solid theoretical foundations and strong practical abilities.

## 2. Basic Course Content and Learning Situation

Sedimentary Basin Analysis is an elective course for third year students majoring in Resource Exploration Engineering. It mainly introduces various research tasks and methods related to mineral resources and sedimentary basin analysis. The textbook we use is the classic work "Principles and Applications of Sedimentary Basin Analysis" jointly written by Professor Lin Changsong from China University of Geosciences (Beijing) and experts from various universities[1]. The course of sedimentary basin analysis in our school is scheduled for the fifth semester, with a total of 32 class hours, including 4 experimental class hours. Through the study of the course, students will master the basic types and structural backgrounds of sedimentary basins, formation mechanisms, sedimentary systems and filling styles, stratigraphic structures and controlling factors, analysis of organic matter evolution in subsidence history, and analysis applications. The focus of this major is on the formation mechanisms and subsidence history analysis of extensional basins, foreland basins, strike slip basins, and craton basins[1]. It plays an important role in students' understanding and recognition of various sedimentary basins, laying a 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 "Analysis of Sedimentary Basins" comprehensively covers the basic theories of sedimentary basin analysis and deeply analyzes the characteristics and genesis mechanisms of various sedimentary basins. 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 extensional basins, students need to master various types of extensional basin formation, extensional modes, extensional mechanisms, extensional mode calculations, and the calculation and analysis of extensional coefficients. 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 "Analysis of Sedimentary Basins" 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, there are both similarities and significant differences in the parameter calculation, sequence stratigraphy evolution, and sedimentary system domain analysis of different types of sedimentary basins, which makes it easy for students to confuse different knowledge points together when learning.

### 3.3. Insufficient Emphasis on Practical Teaching

The textbook "Sedimentary Basin Analysis" focuses on the basic concepts, fundamental theories, and detailed explanations of various sedimentary basins in terms of content, 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 application of sedimentary basin analysis through limited cases.

There are fewer experimental and internship activities: compared to the detailed theoretical chapters, there is less specific guidance on experimental and internship activities 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 the education of sedimentary basin analysis. It can not only help students consolidate theoretical knowledge, but also enhance their practical ability and innovative thinking. However, the shortcomings of the textbook "Sedimentary Basin Analysis" in practical teaching 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 "Analysis of Sedimentary Basins" was in 2016, and it has been 10 years since then [1]. 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 sedimentary basin analysis have been greatly enriched and improved. The emergence of these new technologies and methods not only broadens the research perspective of sedimentary basin analysis, but also profoundly changes our understanding of sedimentary basin analysis and exploration strategies.

In recent years, new perspectives in the field of sedimentary basin analysis have been breaking

through towards deep dynamic mechanisms, micro interface interactions, and coupling of Earth system layers, breaking the traditional single factor analysis framework and providing a new perspective for oil and gas exploration and mineral enrichment research. In the exploration of the genesis mechanism of sedimentary basins, although this textbook has covered various mineralization theories and models, more advanced research methods and techniques may still be needed for in-depth analysis in the face of complex and variable geological phenomena.

## 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, formation mechanism, sedimentary evolution, and analytical application. The basic theoretical module mainly introduces the basic concepts, types, and structural backgrounds of sedimentary basin analysis; The formation mechanism module elaborates on the characteristics and formation mechanisms of various sedimentary basins in detail; The sedimentary evolution module explores the sedimentary systems, sequence characteristics, subsidence, and evolution of various basins; The analysis application module introduces the application scenarios of sedimentary basin analysis and the latest research methods and technologies [2].

#### 4.1.2. Strengthen Practical Content

Sedimentary basin analysis 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 field investigations in order to understand the actual formation and exploration processes of sedimentary basins; In the laboratory, through simulation experiments, students can clarify various evolutionary processes and sedimentary basin analysis methods [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 sedimentary basin analysis can be carefully planned, allowing students to independently choose according to their personal interests and professional directions, thus exploring 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 "Sedimentary Basin Analysis", 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 sedimentary basin analysis 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. In the field internship, students will enter the interior of the basin, witness the formation and evolution of sedimentary basins, and personally touch the masterpieces of nature. 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 analytical techniques of the basin. 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 research techniques and analytical methods. In carefully designed experimental projects, students will personally operate various advanced experimental 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 "Sedimentary Basin Analysis". 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 "Sedimentary Basin Analysis", 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 sedimentary basin analysis 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 "Sedimentary Basin Analysis" 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 sedimentary basin analysis 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, formation mechanisms, sedimentary evolution, and analytical applications of sedimentary basin analysis, 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 sedimentary basin analysis courses, and contribute more wisdom and strength to the country's resource exploration cause.

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