

Teaching Reform of International Course on Seismic Data Interpretation in Universities under the Background of Big Data

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Abstract: With the development of computer capabilities and oilfield development, traditional industries such as petroleum enterprises are gradually undergoing big data transformation. Traditional international seismic data interpretation courses cannot meet the talent needs of the modern petroleum industry. Under the Background of big data, this article analyzes the reform path and methods of international teaching of seismic data interpretation in university from multiple aspects such as the construction of a three-dimensional textbook system, the construction of diversified teaching models, the construction of domestic and foreign online teaching platforms, and comprehensive teaching assessment methods, in order to achieve students' open development, diversified education, and improve their practical operational abilities.

Keywords: International Course; Big Data; Teaching Reform; Seismic Data; Data Interpretation

1. Introduction

With the deepening of reform and opening up and rapid economic development, the demand for oil and natural gas in China is increasing day by day [1-2]. In 2007, the domestic dependence on oil imports was 49.8%, officially entering the threshold of oil "danger", while in 2022, the external dependence on crude oil reached 71.2%. China has become the world's largest importer of crude oil. According to predictions from relevant international institutions, China's overseas dependence on oil may reach 80% by 2030, while the overseas dependence on natural gas may reach 50%. The continuous increase in dependence on crude oil and natural gas poses significant risks and challenges to national oil security. In order to ensure the country's

energy security, it is urgent to carry out in-depth oil and gas exploration, improve domestic crude oil supply, and resist the risk of external imports. Seismic exploration, as the most widely used and effective geophysical exploration method to solve oil and gas exploration problems, is the main technical means for oil and gas discovery, storage and production increase [3]. It has the characteristics of low cost and high accuracy and occupies an absolute dominant position in oil and gas exploration. Therefore, improving the quality of seismic data interpretation courses and cultivating high-quality oil and gas seismic exploration talents is of great significance for the country's energy security.

2. The Importance of International Course Teaching Reform in Seismic Data Interpretation in Higher Education Institutions under the Background of Big Data

Yulin is located in the northern part of the Ordos Basin and is an important national energy and chemical industry base and a modern coal chemical industry demonstration zone. Large oil fields such as Yanchang Petroleum Group and Petro China Changqing Oilfield have settled in Yulin, requiring a large number of petroleum exploration and application personnel every year. Seismic exploration personnel are highly practical and diverse professions with strong practical skills. With the development of computer capabilities and oilfield development, traditional industries such as petroleum enterprises are gradually undergoing digital transformation [4-5]. The oilfield collects and processes a large amount of geological, geophysical, geochemical, and engineering data through big data technology. Efficient storage, management, and analysis of these data can be achieved, providing more accurate and comprehensive data support for oilfield exploration and development. The

oilfield generates detailed geological models by analyzing a large amount of geological and seismic data, revealing the distribution, properties, and scale of oil and gas reservoirs. This helps oilfield exploration and development personnel make wiser decisions, choose appropriate drilling locations and development strategies, improve the success rate of exploration and development, and increase the oilfield's production capacity and recovery rate.

Russia has abundant marine sedimentary oil and gas resources, as well as rich theories and technologies for oil and gas exploration and development [6]. Seismic data interpretation, as a core course in petroleum engineering (Sino foreign cooperation) exploration, is the main means of conducting petroleum exploration both domestically and internationally. Improving students' abilities in seismic exploration lays the foundation for enhancing their international, comprehensive, and application abilities. Therefore, the teaching effectiveness of seismic data interpretation will greatly affect the interest of petroleum engineering students in learning other professional courses in the later stage, as well as their international and comprehensive qualities.

In short, introducing big data into petroleum engineering education is a multi-dimensional requirement to serve major national needs, support regional economic and social development, enhance the ability of schools to serve local areas, and strengthen the comprehensive quality of students.

3. The Current Situation of Seismic Data Interpretation Teaching

3.1 Poor Teaching Effectiveness of Traditional Teaching Modes

Seismic data interpretation has the characteristics of having multiple theoretical concepts, complex content, high difficulty, requiring a wide range of knowledge, and fast professional updates. This course involves a large number of abstract, difficult to understand, or easily confused concepts. In this new form, China's undergraduate education still uses a one-way classroom teaching method dominated by teacher lectures, which has led to prominent contradictions in current undergraduate education: the

contradiction between increasingly rich teaching content and the effectiveness of traditional teaching methods; The contradiction between students' passive learning methods and complex and diverse knowledge points. In response to the two prominent contradictions encountered in undergraduate teaching of the course mentioned above, it is necessary to change the traditional teaching method of seismic data interpretation, which focuses on imparting knowledge through full classroom teaching.

3.2 Insufficient Practical Experience of Students on Site

Seismic data interpretation is a subject with strong on-site application, and for students, it is crucial to apply theory to the field. However, current teaching focuses on analyzing and understanding seism theory knowledge among students, lacking improvement in their on-site application level. Teaching content such as on-site cases and practical tasks should be introduced to cultivate students' ability to apply theory to practical seismic exploration work.

3.3 Student Assessment Methods are too Single

The current assessment indicators often tend to focus on quantitative theoretical knowledge testing, neglecting the performance of students in practical aspects such as seismic exploration experiments and on-site problem-solving [7]. This assessment method cannot comprehensively evaluate the practical ability and mastery of practical operation skills of students. Meanwhile, seismic data interpretation is a discipline that involves interdisciplinary knowledge and requires students to have the ability to comprehensively analyze and solve problems. However, most current assessment indicators only focus on detecting students' knowledge points, lacking evaluation of their comprehensive application of knowledge. We should consider increasing the assessment methods for students to comprehensively apply seismic knowledge to solve practical problems, such as actual seismic profile analysis, seismic survey line layout, etc.

4. The Content of Teaching Reform in the Internationalization Course of Seismic Data

Interpretation in Higher Education Institutions under the Background of Big Data

4.1 Construction of a Three-dimensional Textbook System

In response to the application needs of big data in seismic data interpretation, a teaching outline is formulated and a three-dimensional teaching material system is established based on actual situations. By integrating knowledge from the fields of seismology, geophysics, and big data analysis, a three-dimensional teaching material is constructed, including written textbooks, electronic textbooks, online courseware, and case analysis, to meet the theoretical and practical needs of students in seismic exploration under the background of big data. Integrate seismic exploration cases and analysis experiences from different countries or regions into the course, allowing students to understand seismic exploration application work in different cultural backgrounds, and compare and exchange ideas [8].

4.2 Construction of Diversified Teaching Models

By combining the application scenarios of big data technology in seismic exploration, diversified teaching methods such as combining theory with practice, group cooperative learning, internship and training opportunities, information technology assistance, and multidisciplinary integration are adopted. Collaborating with universities or companies from other countries to carry out projects such as seism detection and data analysis can provide students with comprehensive improvement in theoretical learning, practical operation, team cooperation, and information technology application, cultivating excellent talents with solid professional knowledge and practical operation abilities.

4.3 Construction of Domestic and Foreign Online Teaching Platforms

We are building an online teaching platform tailored for big data seismic exploration, where educational resources will be uploaded and shared collaboratively with other universities and industry professionals both domestically and internationally. Through a

mechanism of shared development, the platform's resources will be continuously optimized to meet students' needs for off-campus learning. Additionally, this initiative will foster resource sharing and cooperation between universities and industries.

The online teaching platform aims to provide a comprehensive repository of educational materials, including lectures, tutorials, case studies, and research papers. These resources will be regularly updated and expanded to keep pace with the latest advancements in seismic exploration technologies and methodologies. By leveraging cloud-based technologies, the platform will offer seamless access to high-quality educational content, enabling students to learn at their own pace and according to their individual schedules.

Furthermore, the collaborative nature of the platform will encourage academic and professional exchanges between institutions and industry practitioners worldwide. Workshops, webinars, and virtual seminars can be organized to facilitate knowledge sharing and discussion on cutting-edge topics in seismic data interpretation and big data applications. This will not only enhance the learning experience for students but also contribute to their professional development by exposing them to a global network of experts and peers.

The shared development mechanism will also include feedback loops where users—students, educators, and industry professionals—can provide input on the quality and relevance of the platform's resources. This feedback will be instrumental in the continuous improvement process, ensuring that the platform remains responsive to the evolving needs of its users.

By promoting innovation and development in the teaching of seismic data interpretation through big data, the online teaching platform will serve as a cornerstone for advancing education in this field. It will support a dynamic and interconnected educational ecosystem that bridges the gap between theoretical knowledge and practical application, ultimately preparing students to excel in an increasingly data-driven world [9].

4.4 Comprehensive Teaching Assessment Methods

In response to the practical nature of big data

in international seismic exploration education, we have redefined and optimized our assessment methods. These new assessment methods include, but are not limited to, the following:

Firstly, there is the assessment of international case studies. By introducing classic or recent seismic exploration cases from around the world, students are required to conduct detailed analysis and interpretation. This not only helps students understand complex real-world situations but also cultivates their ability to solve practical problems.

Secondly, there is the assessment of completing foreign language projects. In the context of globalization, proficiency in a foreign language has become a fundamental requirement for engaging in seismic exploration work. Therefore, we have incorporated the assessment of language skills into the overall evaluation system. Students need to complete project reports or deliver presentations in a foreign language, evaluating their communication and collaboration abilities in an international professional environment.

Additionally, we have implemented on-site assessments of both domestic and international applications. By organizing field exploration activities under different geological conditions, we examine students' ability to apply theoretical knowledge to solve practical problems. This assessment method goes beyond technical operations and includes evaluating their cross-cultural teamwork skills. These comprehensive assessment methods aim to evaluate students' practical abilities and learning outcomes in international seismic data interpretation education comprehensively and fairly. This ensures that they possess the necessary holistic qualities and professional skills to engage in seismic exploration work on a global scale [10].

5. The Path of Teaching Reform for the Internationalization of Seismic Data Interpretation in Higher Education Institutions under the Background of Big Data

5.1 Analysis of the Current Situation, Problems, and Causes of Seismic Data Interpretation Teaching, and Formation of Research Reports

By conducting research on the establishment of seismic data interpretation courses in domestic and foreign universities, as well as the demand for big data application talents in the seismic exploration industry, we aim to understand the current teaching status of seismic data interpretation courses, analyze existing problems and causes, and form a research report to lay a solid foundation for the later promotion of the project.

5.2 The System has Organized Knowledge Units and Constructed a New Curriculum System for Seismic Data Interpretation

Through preliminary research, project team members collected information, reorganized the key knowledge units of current domestic and foreign seismic exploration courses, and constructed a curriculum system that meets the international teaching needs of seismic data interpretation in the context of big data [11].

5.3 Optimize Course Content Based on Industry Talent Needs and Course Certification Needs

Based on the demand for big data application talents in the seismic exploration industry both domestically and internationally, as well as the need for course certification, the course content has been further optimized and improved within the existing knowledge unit structure, ensuring that the teaching content closely meets the market demand of big data in seismic exploration both domestically and internationally [12].

5.4 Develop a Teaching Outline, Improve Relevant Teaching Materials, and Build an Online Teaching Platform

Complete the construction of a first-class three-dimensional teaching material system consisting of teaching syllabus, online courseware, case analysis, question bank, teaching videos, and experimental guides, record teaching videos, and upload relevant materials to the online platform to meet the needs of students for online learning.

5.5 Project Practice and Information Collection

Practice in the petroleum engineering industry on campus, collect feedback information in a timely manner, continuously optimize project content, and ensure that teaching content

matches actual needs.

5.6 Follow the Trend of the Times and Establish a Long-term Stable Sharing and Co Construction Mechanism

After a period of practical experience in the project, I shared and co built with other universities and industry experts, and continuously optimized the project content in operation, promoting innovation and development of big data in seismic exploration teaching [13].

6. The Significance of Internationalization Course Teaching Reform in Seismic Data Interpretation in Higher Education Institutions under the Background of Big Data

6.1 Realize Open Development of Students

Through the application of big data in the field of seismic exploration, students can achieve open development. In seismic exploration work, a large amount of data needs to be collected, processed, and analyzed. Through the dynamic and open network teaching environment, the flexible use of Internet thinking, combined with the application of big data in the field of seismic exploration, can break through the time-space constraints of traditional seismic data interpretation teaching, and flexibly conduct network learning, so that students can access the latest seismic exploration knowledge and technology anytime and anywhere. At the same time, emphasizing the relationship between research and various industries, strengthening the practicality and practicality of seismic data interpretation education, can promote the open development of seismic data interpretation education and teaching, and cultivate students' international cooperation awareness and ability.

6.2 Realize Diversified Education

By collaborating with well-known seismic exploration institutions and experts both domestically and internationally, online collaborative courses, seminars, academic exchanges, and other teaching activities can be carried out. Students can interact and learn from experts and peers from different regions and backgrounds. This diversified education model can broaden students' horizons,

cultivate their awareness and ability of international cooperation.

6.3 Improve Students' Practical Operational Abilities

By utilizing big data technology to analyze actual data in the field of seismic exploration, practical and practical educational scenarios can be created. By monitoring and analyzing seismic data in real-time and simulating the process of seismic exploration, students can engage in practical operations in a virtual environment, enhancing their practical application abilities.

7. Conclusion

With the deepening of reform and opening up and the rapid development of the economy, the internationalization of seismic data interpretation courses in universities also needs to be combined with big data for teaching reform, in order to meet the requirements of the local petroleum industry for high-quality talents. Through the construction of a three-dimensional teaching material system, diversified teaching models, and the construction of domestic and foreign online teaching platforms, we will carry out teaching reforms on the international course of seismic data interpretation, further enhancing students' international perspectives and on-site practical abilities.

Acknowledgments

This research was financially funded by the International Course Construction Project of Yulin University (GJKC2412).

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