

Exploration of Petrophysics for International Petroleum Engineering Students

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Abstract

With the socio-economic development and rising international status of China, an increasing number of international students are choosing to pursue their studies in the country. Education for international students in China plays a critical role in promoting people-to-people exchanges and friendship between China and other nations, as well as enhancing the global influence of China's higher education. Petroleum engineering is one of the most popular majors among international students. As a fundamental compulsory course in petroleum engineering, Petrophysics plays a significant role in laying the professional knowledge foundation for international students. By analyzing the existing issues in the teaching of Petrophysics for international petroleum engineering students in Chinese universities, this paper explores reform measures to develop a teaching framework tailored to international students. These measures include strengthening the development of an international teaching faculty, constructing comprehensive teaching resources, utilizing modern online teaching assistance tools, and improving teaching management. This research provides valuable insights for enhancing the quality of petroleum engineering education for international students in China.

Keywords

Petroleum Engineering; International Students; Petrophysics.

1. Introduction

In recent years, with China's socioeconomic development and rising international status, an increasing number of international students have chosen to pursue their studies in China. Driven by this trend, education for international students has become a significant component of China's higher education system. Enhancing the quality of education for international students is crucial for strengthening educational exchanges and cooperation between China and other countries, as well as for elevating the internationalization level of China's education. Furthermore, education for international students in China serves as a bridge connecting the opening-up of China's higher education with cultural exchanges between China and the world. It contributes to the dissemination of traditional Chinese culture, promotes a positive image of China as a major country, meets the demand for outstanding professional talent in China, supports supply-side structural reform, and advances the international development of China's higher education sector.

Changzhou University is an institution accredited by the Ministry of Education of China for the quality of its international student education and has been designated as a "Study in Jiangsu" target university by the Jiangsu Provincial Department of Education. It has been recognized multiple times with the honorary title of "Advanced Collective for International Student Education in Jiangsu Province." The School of Petroleum and Gas Engineering began enrolling undergraduate international students in petroleum engineering in 2016. After eight years of teaching practice, petroleum engineering has become one of the most popular engineering

majors for international students at Changzhou University, with the most comprehensive educational offerings (covering undergraduate, master's, and doctoral levels).

Petroleum Engineering has emerged as one of the preferred majors among international students. Within this discipline, the Petrophysics course, delivered entirely in English, serves as a core professional subject and a fundamental prerequisite for subsequent specialized courses in petroleum engineering. However, the current teaching design and curriculum development for the Petrophysics course for international students still face several challenges. Therefore, grounded in teaching practice, this paper explores insights gained from instructing international students and proposes constructive suggestions, aiming to provide reference and insights for petroleum engineering programs in domestic higher education institutions regarding the education of international students.

2. Course Overview

Petrophysics is a discipline that focuses on petroleum reservoirs, employing physical and physicochemical methods to investigate phenomena related to oil and gas field exploration and development. It is a compulsory course in petroleum engineering programs. The principles, methodologies, and techniques covered in Petrophysics form the foundation for understanding, modifying, and developing reservoirs in the field of petroleum engineering. Additionally, it serves as the basis for subsequent courses such as Flow in Porous Media, Reservoir Engineering, Drilling Engineering, Production Engineering, Principles of Enhanced Oil Recovery, and Reservoir Numerical Simulation, occupying a fundamental position within the broader petroleum engineering curriculum. The content of the Petrophysics course primarily consists of four major components: the physical properties of reservoir rocks, the physical properties of oil and gas reservoir fluids, the flow mechanisms of multiphase fluids, and the mechanisms of enhanced oil recovery. This includes topics such as the skeletal characteristics of reservoir rocks, porosity, permeability, saturation features, phase behavior and high-pressure high-temperature (PVT) properties of oil and gas in reservoirs, capillary pressure theory in reservoir rocks, and the flow theories of multiphase fluids. To ensure alignment with the Chinese-language curriculum for domestic students, the course utilizes a translated version of the Chinese textbook *Physical Properties of Petroleum Reservoir* (published by China University of Petroleum Press as a teaching material for university students).

3. The Primary Issues with the Course

Petrophysics is a course characterized by its extensive knowledge coverage, numerous and often abstract fundamental concepts, substantial experimental methodologies and technical knowledge, as well as strong practical orientation. Even for Chinese students, "Petrophysics" is regarded as a challenging subject, let alone for international students who face communication barriers in China. Based on the author's teaching experience and reflections, several common issues exist in the teaching of this course, or more broadly, in the education of international students, which can be summarized as follows.

(1) The course is challenging to study

Given its broad scope of knowledge and relatively abstract concepts, students encountering the Petrophysics course for the first time often perceive weak connections between chapters and sections, fragmented knowledge points, and considerable learning challenges. Moreover, the concepts and theories covered in the course are entirely derived from production practices and experimental research, rendering them highly application-oriented. Without a basic understanding of the practical aspects of petroleum engineering, students may struggle to effectively grasp the concepts and theories of Petrophysics. Furthermore, with the continuous application of new technologies and equipment in reservoir characterization, the

understanding of Petrophysics concepts has also evolved. These challenges further dampen students' enthusiasm for learning and undermine the interest of international students in the subject.

(2) The teaching methods are monotonous

The current teaching of the Petrophysics course primarily relies on instructor-led lectures, even in the experimental segments. Although instructors often employ heuristic teaching methods and observe students' reactions to gauge their understanding, the substantial amount of content covered in each Petrophysics session leaves limited time for meaningful teacher-student interaction. Coupled with the abstract and challenging nature of the subject matter, as well as a lack of engaging elements, students may gradually lose interest in learning or even develop a sense of aversion to the course over time. Additionally, constrained by the scale and timeliness of laboratory facilities, the coherence and systematic integration between the experimental and theoretical components of Petrophysics instruction require further enhancement.

(3) Difficulties in Verbal Communication Between Teachers and Students

Many instructors have had limited exposure to spoken English for years, leading to a decline in their oral proficiency. This presents challenges in communicating with international students, often manifesting as inaccuracies in expression, mispronunciations, and inappropriate word choices in the classroom. Additionally, as some international students are non-native English speakers, both teachers and students may speak English with accents, further complicating mutual comprehension. Moreover, the theoretical and experimental components of this course involve numerous specialized and uncommon terminologies. Effectively conveying complex and abstract concepts requires strong oral communication skills as well as deep expertise in the subject matter.

4. Several Approaches to Enhancing Course Instruction Effectiveness

(1) Strengthening the Development of an Internationalized Faculty

Building an internationalized teaching faculty is a prerequisite and foundation for curriculum development and teaching practices. Academic management departments at all levels of the university should enhance their emphasis on education for international students. On the basis of the existing petroleum engineering teaching team, instructors with strong English proficiency or overseas educational experience can be selected to participate in training programs aimed at improving their English-medium teaching capabilities. Universities may collaborate with foreign language departments to provide these instructors with training in English expression and pedagogical skills, with a particular focus on enhancing their spoken English proficiency and cross-cultural communication abilities. Additionally, universities should establish and refine professional development plans for faculty teaching fully English-medium courses. This could include supporting young instructors engaged in teaching international students to pursue further training or study abroad at foreign institutions.

(2) Developing Comprehensive Teaching Resources

When selecting teaching resources for the Petrophysics course, relying solely on existing domestic textbooks is insufficient; targeted revisions are necessary. Textbooks and lecture notes should increase the proportion of fundamental knowledge, simplify or eliminate highly specialized but less practical content, and incorporate more explanations of practical engineering application cases, applied designs, and the like. Multimedia courseware should be revised accordingly based on the updated textbooks and lecture notes, utilizing videos, images, and animations to elucidate the course content. In teaching, a combination of multimedia, board writing, and classroom discussions should be adopted. Board writing can better explain theoretical knowledge and formula derivations. For certain introductory or conceptual

knowledge, multimedia presentations and board explanations alone may not enable international students to deeply comprehend and master the material; thus, classroom discussion sessions should be incorporated to stimulate their self-directed learning.

(3) Utilizing Modern Online Teaching Assistant Tools

In response to issues such as insufficient attention to classroom discipline, lack of punctuality, frequent unscheduled entry and exit during classes, and serious tardiness among international students, modern online teaching assistant tools such as Xuetong and Changjiang Rain Classroom can be employed for management. These auxiliary tools can be used for attendance check-ins, in-class questioning, and assignment distribution. Additionally, learning materials and instructional videos can be uploaded to the platform to facilitate students' review and consolidation of knowledge after class.

(4) Enhancing the Management of International Student Education

To improve the quality of international student training, a strict approach should be prioritized. At present, the focus is no longer on increasing student numbers but rather on elevating the quality of education as the primary objective. Classroom management must be strengthened, and teaching regulations should be strictly enforced. Requirements should not be relaxed simply because the students are international. For those who frequently skip classes, their eligibility for examinations should be revoked. Examination management should also be reinforced, with closed-book exams being the preferred format and invigilation conducted rigorously to accurately assess students' actual knowledge mastery. Stricter management of international students should be implemented, including downgrading or advising withdrawal for those who fail to meet academic standards. Only through reasonable and strict evaluation can we screen out the students with poor performance and find out the students who try to fish in troubled waters.

5. Conclusions

To achieve the ambitious goal of "making China the world's most desirable destination for international students by 2049," collaborative efforts are required from universities across disciplines and educators involved in international student education. In response to the challenges identified in teaching the Petrophysics course to international students in China, this paper proposes reform measures focusing on faculty development, teaching resources, instructional methods, and educational management. The pedagogical exploration in this course also provides valuable experience and insights for the development of other similar courses.

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