

Impact of International Student Mobility in Distinctive Disciplines on Internationalization Capabilities

Guangli Xu¹, Liangxue Cai^{1,2}, Gao Li¹

¹School of Petroleum and Natural Gas Engineering, Southwest Petroleum University, Chengdu 610500, China

²Sichuan Provincial Key Laboratory of Oil and Gas Fire Protection, Chengdu 610500, China

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Abstract: To deeply analyze the impact of international student mobility on their internationalization capabilities in the field of Petroleum and Natural Gas Engineering, this study systematically reviewed the exchange dynamics of international students at Southwest Petroleum University from 2014 to 2024, as well as detailed data on students' overseas visits from 2016 to 2024, carefully outlining the trends and characteristics of student international mobility over the past decade. Based on this, using an evaluation system for internationalization capabilities constructed by the authors, which closely follows the characteristics of Petroleum and Natural Gas Engineering and covers key dimensions such as language skills, international perspective, cross-cultural communication, and global cooperation, graduate students from the research team of international students were selected as a sample group. Through a carefully designed survey questionnaire, their current internationalization capabilities were systematically evaluated. The results showed that compared to the benchmark level in 2019, students' internationalization capabilities have shown a significant improvement trend, especially in cross-cultural communication. This finding not only reveals the positive role of international student mobility in promoting academic exchanges and integration but also further emphasizes the unique value of multicultural integration in scientific research teams to enhance the internationalization capabilities of domestic students.

Keywords: International mobility; Internationalization capabilities; Petroleum and natural gas engineering discipline

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1. Introduction

In the grand blueprint of the “National Medium and Long-Term Education Reform and Development Plan (2010-2020)”, strengthening international exchanges and cooperation has been placed in a prominent position. The aim is to forge an international talent team with a global perspective, proficient in international norms, and brave enough to emerge on the international stage. This strategic deployment profoundly reflects the country's high attention and eager expectations for the internationalization process of higher education. The “Overall Plan for Promoting the Development of World-Class Universities and Disciplines” issued by the State Council further refines this vision, clearly proposing to deepen international cooperation and promote higher education

to a higher level through core measures such as building a top-notch teaching team and cultivating outstanding innovative talents. As a key link in this strategic deployment, the positive effect of international student mobility on promoting students' internationalization capabilities cannot be ignored. Specifically, international student mobility not only provides students with opportunities to directly experience foreign cultures and learn advanced knowledge, but also subtly shapes their open and inclusive attitudes, cross-cultural communication skills, and comprehensive qualities required for participating in international competition and cooperation. Therefore, exploring the positive impact of international student mobility on enhancing students' internationalization capabilities have important theoretical and practical significance for promoting the internationalization process of higher education and cultivating high-quality talents who meet the needs of globalization.

This article involved students from the “Double First-Class” construction university, Southwest Petroleum University’s Petroleum and Natural Gas Engineering discipline, as the analysis object. Focusing on students’ international mobility and their internationalization capabilities, it investigates student mobility data from 2014 to 2024 in the Petroleum and Natural Gas Engineering discipline. Combined with the evaluation scale of students’ internationalization capabilities, it explores the impact of international student mobility on their internationalization capabilities. This has certain theoretical significance and practical value for further deepening the understanding of the development law of higher education in the context of internationalization.

2. International student mobility

International student mobility, as a prominent phenomenon in the field of education in the era of globalization, encompasses a rich connotation that includes both the acceptance of international students from various parts of the world by higher education institutions and the scenario of domestic students crossing borders to pursue further studies and exchanges overseas ^[1]. Since the in-depth implementation of the “Belt and Road” Initiative, this mobility trend has shown vigorous development, not only promoted cultural integration and collision but also accelerating the cross-border dissemination of knowledge and technology ^[2].

Currently, academic research on international student mobility has formed a relatively systematic framework, mainly focusing on two core areas ^[3]. Firstly, researchers focus on the diverse influencing factors behind international student mobility. From multiple perspectives, they deeply analyze the comprehensive advantages of the destination country in terms of political stability, economic development level, cultural heritage, quality of the education system, social environment, university reputation, international recognition of academic qualifications, and even the cost of living such as housing prices. Through quantitative analysis methods, they accurately measure the strength and sensitivity of each factor’s role in attracting international students ^[4]. This research thread reveals the importance of economic factors and education quality as the two core driving forces for attracting international students. Secondly, the research emphasizes the specific scale, unique characteristics, and mobility paths of student mobility. Through empirical analysis, it is found that international students tend to choose countries with strong economic strength, geographical proximity, minor language barriers, and high-quality education when selecting study destinations ^[5]. This preference not only reflects students’ rational considerations for their personal development prospects but also illustrates the inherent logic of educational resource allocation and mobility in the context of globalization.

2.1. International students

After conducting in-depth research on the data of international students received by the Petroleum and Natural

Gas Engineering discipline at Southwest Petroleum University from 2014 to 2024 (as shown in **Figure 1**), a series of significant trends were observed. The discipline has attracted elite students from 19 countries around the world, including Bangladesh, Pakistan, and Iraq, with 105 undergraduates, 39 master’s students, and 4 doctoral students. The convergence of this diverse student population has undoubtedly injected new vitality into academic research and cultural exchanges. In particular, the deepening implementation of the “Belt and Road” Initiative has established a broader platform for young students from countries along the route to visit and study, significantly promoting international student mobility and educational cooperation. This strategy not only deepens economic ties between countries, but also promotes the sharing and complementarity of educational resources invisibly, demonstrating China’s comprehensive attractiveness and influence in politics, economy, culture, and education on the international stage.

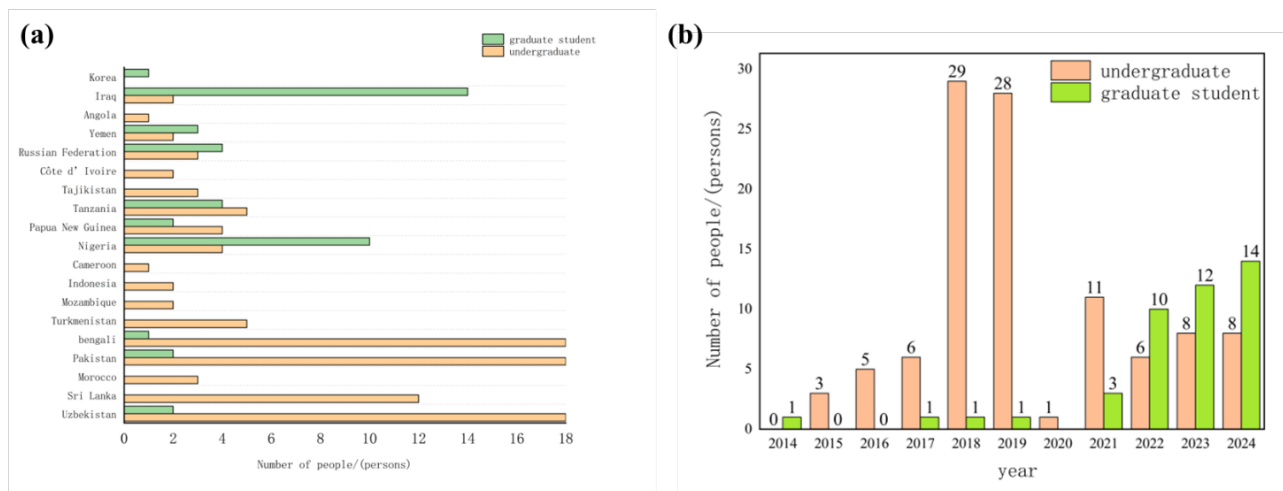


Figure 1. Data on foreign students received by the petroleum and natural gas engineering discipline at Southwest Petroleum University. (a) Number of students from different countries of origin; (b) Number of students enrolled in different years.

Furthermore, as a national “double first-class” construction university, Southwest Petroleum University’s Petroleum and Natural Gas Engineering discipline has been awarded an A + rating. This honor is directly reflected in the changes in the number of international students. From 2018 to 2019, there was a significant increase in the number of undergraduate international students. Although there was a decline in 2020 due to the global impact of the COVID-19 pandemic, it quickly recovered and continued to rise. Simultaneously, the number of graduate international students has also shown a steady recovery trend. This is not only a strong testament to the enhanced international competitiveness of China’s higher education, but also a vivid portrayal of the growing charm of education in petroleum and natural gas disciplines. This series of data changes profoundly reveals the important role of international cooperation and exchanges in promoting the internationalization of higher education.

2.2. Students visiting abroad for study

Based on a survey of data from 2016 to 2024 on students from the Petroleum and Natural Gas Engineering discipline at Southwest Petroleum University participating in study abroad and short-term exchange programs, as shown in **Figure 2**, it was found that most of the funding sources for students in this discipline to study abroad come from government scholarships (statistics for students studying abroad after graduation are not

included). The destination countries for student visits are becoming more diversified, mainly including Canada, the United States, Australia, the United Kingdom, Singapore, Germany, Norway, Russia, Israel and more. This indicated that students not only base their choice of destination country on the level of national economic and educational development but also pay more attention to the global ranking of the university, the international reputation, and influence of the subject team in the research field. Additionally, influenced by the university's policy for newly recruited teachers, students in petroleum and natural gas engineering-related disciplines have a strong willingness to return to work at the university after studying abroad, for example, among the 33 students who went abroad in 2017, 9 stayed to teach after their studies, which helps to enhance the internationalization level of teachers, improve students' international attitudes and perspectives, and form a positive promotion of mutual teaching and learning.

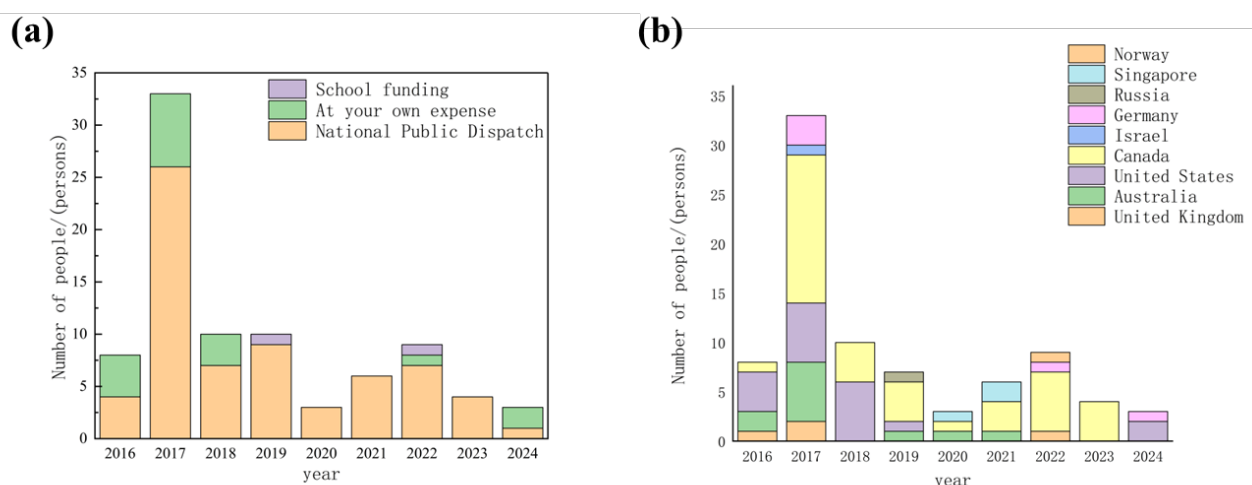


Figure 2. Data on students from the petroleum and natural gas engineering discipline at Southwest Petroleum University studying abroad. (a) Funding sources for students studying abroad in different years; (b) Distribution of destination countries for students studying abroad in different years.

3. Evaluation index system of students' internationalization ability

In exploring the evolution of the evaluation system for internationalization ability, Hunter innovatively constructed a three-tiered evaluation framework in 2004^[6]. It laid a solid foundation for subsequent research. This framework not only promotes a deeper understanding of the multiple dimensions of internationalization ability in academia but also inspires further exploration and expansion by many scholars based on it. Liu Yang et al.'s 2015 study focused on undergraduate students from five universities in the Beijing area. By constructing a three-dimensional, seven-factor evaluation scale, they refined the assessment and analysis of undergraduates' international abilities, providing valuable empirical data for the field of educational evaluation^[7].

Subsequently, in 2017, Hu Dexin conducted a comparative analysis of international capabilities using a three-dimensional, eight-factor evaluation system targeted at graduate students from Tsinghua University and Freie Universität Berlin^[8]. This cross-border and cross-cultural comparative study not only broadened the horizons of international capability evaluation but also deepened the understanding of the internationalization trend in higher education.

By 2018, Liu Yang and others made further contributions to this field. Based on the original scale, they innovatively added two key elements, international professional knowledge and international academic

exchanges, and incorporated considerations of international experience, thus constructing a more comprehensive and contemporary analysis framework for international capabilities ^[9]. This adjustment not only reflects the dynamic development of the international capability evaluation system but also demonstrates the continuous improvement of academic requirements for international talent cultivation.

In 2019, Xu Guangli and others proposed a highly targeted international capability evaluation index system specific to the field of oil and gas engineering ^[10]. This system continues the three major dimensions of “knowledge and understanding, skills, attitudes, and values” for evaluating international capabilities and is refined into seven specific factors: “world knowledge, globalization understanding, tool usage, scientific research innovation, cross-cultural communication, international attitude, and value identification” (as shown in **Table 1**). Through extensive surveys of graduate students, it was found that students in this discipline excel in international attitudes and perspectives but still have significant room for improvement in terms of oil and gas professional knowledge, cross-cultural communication skills, and tool usage skills ^[11]. This discovery not only provides important feedback and guidance for graduate education in oil and gas engineering but also offers valuable insights and inspiration for the cultivation of international capabilities in other disciplines.

Table 1. Evaluation index system for international capabilities of graduate students in oil and gas engineering

Dimension	Factor	Explanation
Knowledge & Understanding	Oil & Gas Knowledge	Understanding of oil and gas resources in other countries, pipeline networks, petroleum companies, research teams, and their specialized fields.
	Global Perspective	Understanding the implications of globalization in the petroleum industry, and awareness of international industry trends and academic organizations.
Skills	Tool Proficiency	Ability to effectively use languages, international databases, and globally recognized simulation software.
	Research & Innovation	Capability to operate and analyze data from imported precision equipment; proficiency in applying for international patents; ability to publish in international academic journals; skill in collaborating with international research teams; proficiency in using international databases for scientific research; mastery of industry-standard global simulation software; active participation in international academic events and ease in communicating with foreign peers.
	Cross-Cultural Communication	Ability to communicate fluently in foreign languages; skill in interacting with people from diverse cultural backgrounds; willingness to understand foreigners and establish mutual understanding and trust.
Attitudes & Values	International Mindset	Willingness to respect, understand, and appreciate other cultures and values with an open attitude when interacting with people from different cultural backgrounds; eagerness to collaborate and communicate with international peers.
	Value Identity	Belief in one’s own significance to national development; identification with and pride in one’s native culture and values.

4. Analysis of the internationalization ability of students in teams with international students

As the impact of the pandemic fades, the international mobility of students is gradually regaining vitality. Taking Southwest Petroleum University as an example, in 2022, the discipline of Petroleum and Natural Gas Engineering admitted 16 international students pursuing degrees, including 6 for bachelor’s degrees, 9 for master’s degrees, and 1 for a doctoral degree. Ten graduate students, hailing from Russia, Iraq, and Pakistan, have integrated into ten different research teams based on their research interests and national employment

needs, truly becoming a part of the Chinese graduate student population. The integration of international students into research teams virtually creates an environment conducive to international exchange. During regular team meetings, both Chinese and international students, as well as their mentors, communicate and discuss in both Chinese and English, rapidly improving the Chinese students' professional scientific English application skills and English listening and speaking abilities through practical use. Referring to **Table 1**, it can be inferred that students' cross-cultural communication skills will be enhanced.

When constructing the online survey questionnaire for evaluating students' internationalization abilities, we strictly followed the seven core factors set out in **Table 1**, included world knowledge, globalization understanding, tool usage, scientific research innovation, cross-cultural communication, international attitude, and value identification. To ensure comprehensive and accurate evaluation, each factor was carefully designed with a corresponding number of items, totaling 34 items, covering various dimensions of students' internationalization abilities.

The questionnaire adopted the internationally recognized Likert five-point rating scale, aiming to guide respondents to objectively evaluate each item description based on their actual situations. The scoring system is rigorous and detailed, ranging from 1 point for "completely disagree" to 5 points for "completely agree", forming a clear evaluation gradient. This design facilitates respondents to accurately express their opinions and aids in subsequent data statistics and analysis, providing solid support for precise evaluation of students' internationalization abilities.

The survey was conducted among Chinese students in research teams with international students in the field of oil and gas engineering. A total of 120 questionnaires were distributed, and after a rigorous screening and elimination process, 116 valid questionnaires were finally collected, ensuring the validity and representativeness of the data sample.

To comprehensively evaluate the reliability and validity of the constructed evaluation index system, various statistical methods were used for in-depth analysis. Firstly, the Cronbach's α coefficient, a classic reliability index, was used to test the internal consistency of the three core dimensions. The results showed that the α coefficients of each dimension were significantly higher than the threshold of 0.88. This high level of consistency not only highlights the close connection between the items within each dimension but also further confirms the stability and reliability of the evaluation index system in terms of reliability.

In terms of validity analysis, a diversified perspective combining content validity, criterion validity, and structural validity was adopted. Through the calculation of Spearman's rank correlation coefficient, a significant positive correlation was found between the overall evaluation of internationalization ability and the three dimensions, which fully demonstrates the validity and rationality of the evaluation content. In other words, the index system can accurately reflect the true level of internationalization ability of the measured objects.

Based on the in-depth statistical analysis of the existing questionnaire data, we can comprehensively review the performance characteristics of students in various dimensions and specific factors of internationalization ability in the field of oil and gas engineering. As shown in **Table 2 and 3**, the degree of dispersion of students in the three dimensions of "attitude and values", "skills", and "knowledge and understanding" maintains a similar level. This result reveals a high consistency in the international abilities among the student population, with relatively small differences between individuals, reflecting the stability of the overall international ability framework. Meanwhile, the average scores of the three dimensions all exceed the baseline of 3.0, indicating that students have achieved a relatively ideal level in terms of international attitude, skill mastery, and knowledge understanding.

Upon careful analysis of the specific performance of each factor, notable differences and challenges were identified. Among them, the average score of the “World Knowledge” factor failed to reach the threshold of 3.0, which was significantly lower than other factors. This clearly pointed out students’ cognitive shortcomings in the field of international oil and gas knowledge, especially regarding the distribution of global oil and gas resources and pipelines, as well as developments in international academic institutions. This finding not only revealed students’ inadequate knowledge reserves in the context of globalization but also highlighted the urgent need to strengthen certain areas in subsequent training programs.

Table 2. Statistical data for each dimension

Dimension	Knowledge & Understanding	Skills	Attitudes & Values
Mean	3.04	3.16	3.88
Standard Deviation	0.91	0.91	0.94

Table 3. Statistical data for specific dimension

Factor	World knowledge	Global perspective	Research & innovation	Cross cultural communication	Tool proficiency	International Mindset	Value identity
Mean	2.85	3.24	3.34	3.03	3.12	3.60	4.16
Std Dev	0.90	0.92	0.90	0.92			

Comparing the current data with the survey results from previous literature (as shown in **Table 4**), an encouraging trend was observed, students’ scores on multiple factors, especially cross-cultural communication skills, had significantly improved. This positive change was undoubtedly closely related to the integration of international students into the research team. The inclusion of international students not only brought diversified cultural perspectives to the team but also created a small yet vibrant international exchange environment for local students through their unique learning and life experiences. This environment effectively fostered students’ desire to explore world knowledge and subconsciously enhanced their cross-cultural communication and understanding abilities.

Table 4. Comparison of internationalization skills between students in teams with international students and students from literature ^[11]

Factor	World knowledge	Global perspective	Research & innovation	Cross cultural communication	Tool proficiency	International Mindset	Value identity
Current score	2.85	3.24	3.34	3.03	3.12	3.60	4.16
Ref score	2.70	3.13	3.21	2.61	2.99	3.45	4.16

The reasons behind this phenomenon can be attributed to two main factors. Firstly, the professional courses that international students participate in are taught in English, and the instructors generally have overseas study experience. This teaching model not only enhances the internationalization level of the courses but also promotes the systematization and structuring of teaching content, providing students with a broader international perspective and learning platform. Secondly, the daily presence of international students acts as a catalyst, sparking a small-scale international exchange within the research group. This allows local students

to naturally encounter different cultural backgrounds and ways of thinking in their daily study and life, thus accelerating their cross-cultural adaptation and growth process.

However, it should be clearly recognized that the current research still has certain limitations. The relative limitation of sample data and the short duration of international students' participation in the research group may affect the universality and long-term effects of the research results. Therefore, future research should aim to further explore the multi-dimensional and deep-level impact of international students on students' international capabilities over a longer time span and with a larger sample size. This will provide more solid data support and theoretical guidance for the continuous optimization of China's higher education internationalization strategy.

5. Summary and outlook

Based on an in-depth analysis of the international student intake at Southwest Petroleum University in recent years and the data on overseas study visits by domestic students, this paper systematically summarizes the current situation and trends of student international mobility and clarifies its unique characteristics of international development. Using an evaluation index system for student internationalization capabilities that reflects the distinct characteristics of petroleum and natural gas engineering disciplines, this study focuses on graduate students in research teams where international students are located. Through carefully designed surveys, the current status of graduate students' internationalization capabilities are deeply explored. Research results show that international mobility indeed has a significant positive effect on improving students' internationalization capabilities. Especially when international students integrate into research teams and participate in team meetings, this effect is particularly evident, and the cross-cultural communication skills of domestic students have been rapidly and significantly improved.

In light of the aforementioned findings, we recognize the necessity of further exploring the impact mechanism of international mobility on students' internationalization capabilities. In the next step, we can reveal the inherent mechanisms of the impact of international mobility on students' internationalization capabilities through larger-scale and more detailed data analysis. Based on this, we can guide the development of postgraduate training objectives and programs according to the dimensions of lacking internationalization capabilities. This will not only help deepen our understanding of the laws of international education but also provide strong theoretical support and practical guidance for Southwest Petroleum University to promote its internationalization strategy and improve the quality of talent training.

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Disclosure statement

The authors declare no conflict of interest.

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