



REVIEW

Reflection on the teaching reform of parasitology experiment course for foreign students under the background of the belt and road

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Abstract Parasitic diseases remain a significant public health issue in underdeveloped countries and regions along “the Belt and Road”. Parasitology laboratory courses offered by domestic medical colleges and universities are crucial for international medical students to understand and master the identification and diagnosis of parasites and related diseases. Therefore, ensuring the learning outcomes of international students and improving their comprehensive understanding and practical skills are the primary considerations in developing the experimental teaching of parasitology. This paper conducts an in-depth analysis and discussion on this topic and provides a reference for related educational reforms.

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Reflexión sobre la reforma docente del curso experimental de parasitología para estudiantes extranjeros en el contexto de la franja y la ruta

Resumen Las enfermedades parasitarias siguen siendo un problema importante de salud pública en los países y regiones subdesarrollados de la Franja y la Ruta. Los cursos de laboratorio de parasitología que ofrecen las facultades y universidades de medicina nacionales son cruciales para que los estudiantes de medicina internacionales comprendan y dominen la identificación y el diagnóstico de parásitos y enfermedades relacionadas. Por lo tanto, garantizar los resultados de aprendizaje de los estudiantes internacionales y mejorar su comprensión integral y sus habilidades prácticas son consideraciones primordiales para el desarrollo de la enseñanza

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experimental de la parasitología. Este documento realiza un análisis y debate exhaustivos sobre este tema y proporciona una referencia para las reformas educativas relacionadas.

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Introduction

Since General Secretary Xi Jinping proposed the major policy of jointly building “the Belt and Road” (B&R) in 2013, higher education exchange and cooperation between China and the countries along this route have become a focus area. In July 2016, the Ministry of Education emphasized in the “Advancing the Education Initiative of Jointly Building the Belt and Road” (Initiative) that educational cooperation is not only an important part of the co-constructing work but also provides a solid foundation for transporting talents.^{1,2} It highlights the foundational and leading role of education in the co-construction of the B&R, proposing the cooperation principle of “education-oriented, humanities first”.³ At the “Twentieth National Congress” meeting, the General Secretary further proposed the initiative to promote high-quality development of the B&R initiative. Domestic universities recruiting international students from countries along the B&R to study in China through various channels are the main way to carry out educational cooperation with countries along the route and promote talent cultivation, as well as strong support and positive responses to this policy.

The “Initiative” clearly states that medicine is a professional field urgently needed for the development of countries along the route.³ According to data released by the Ministry of Education, approximately 492,000 international students were enrolled in China in 2018, of which international students from countries along the B&R accounted for more than 60% of the total number.⁴ Among the most popular subjects, medical-related majors rank as the top choice of international students in China.⁵ In particular, undergraduate studies in clinical medicine have always been popular.

Parasitology is a compulsory course for undergraduate clinical medical students. During the past few decades, China’s medical and healthcare levels have comprehensively improved, and rich experience and results have been achieved in scientific research, disease prevention, and control of parasitic diseases. However, in some countries along the B&R, parasitic diseases are still important factors affecting the lives and health of local people. The laboratory course of parasitology with practical operations is an important way for international students to understand parasites and related diseases and master common diagnostic techniques and methods, which makes it irreplaceable. Ensuring the learning outcomes of international students in China, improving their comprehensive understanding of parasites and parasitic diseases, and mastering practical methods and skills are the primary issues to consider in the implementation of laboratory course teaching of parasitology.

The necessity of strengthening human parasitological laboratory courses for international students

Knowledge reserve for clinical work

Cultivating more excellent international students for the B&R is an important mission of international student education.⁶ In the “Overall Plan for Coordinating and Promoting the Construction of World-Class Universities and Disciplines,” the State Council emphasized that promoting international exchanges and cooperation and creating a good international teaching and research environment is a major task in the construction of “double first-class” universities.⁷ Currently, more than 20 countries have signed agreements on the mutual recognition of higher education degrees with China, and international students from countries and regions along the B&R account for more than half of the total number.⁸

The majority of undergraduate medical students who complete their studies in China opt to return home to start their careers, although some stay on to continue their education. The quality of the Chinese medical education they receive will likely have an impact on how well they perform on license exams and on their future employment status once they return home. Most of these graduates lack the professional knowledge and skills required to pass the national exam or to find employment in their home country.^{9,10}

The survey results show that 39.7% of international students in China will return to their own countries after graduation, 6.3% will receive offers in China, and 19% will pursue further education. Over 70% of undergraduate graduates have found jobs that correspond to their majors.⁶

This means that a considerable number of international undergraduates who complete their studies in clinical majors in China will engage in clinical-related work once they return home. As a mandatory course for clinical medicine majors, the knowledge reserve of parasitology and related diseases is crucial for international students once they return to clinical work.

The prevalence of parasites cannot be ignored

Since its founding, China has made world-renowned achievements in the prevention and treatment of parasitic diseases, forming generally effective prevention and control strategies and measures for various parasitic diseases and significantly reducing the number of patients. However, throughout the world, parasitic diseases remain a significant factor affecting human health and are widespread public

health issues that exist widely in underdeveloped countries and regions along the B&R. In some areas, parasitic diseases still have a high incidence or are widespread.¹¹ The "WHO Report on Neglected Tropical Diseases" indicates that neglected tropical diseases (NTDs) pose a serious threat to human health, with many caused by parasitic infections.¹² Diseases such as malaria, filariasis, and schistosomiasis have been largely controlled or eliminated in China but are still prevalent in countries along the B&R. Furthermore, with international exchanges, there is potential for rapid spread.¹³ In addition, there are other parasite-related infections, such as Rickettsia and Crimean-Congo hemorrhagic fever, which are both carried by ticks and are referred to as emerging and re-emerging zoonotic infections. These diseases are endemic throughout the nations connected by the B&R.¹⁴ Therefore, promoting the concept of parasitic disease prevention and control among international students, sharing successful prevention and control experiences, and raising awareness will also contribute to improving public health in countries along the B&R.

Need for parasite identification and disease diagnosis capabilities

The human parasitological laboratory course covers the types, life cycles, morphological characteristics, pathogenic characteristics, diagnostic methods, etc., of common human parasites. The clinical symptoms of these parasitic diseases are complex. Furthermore, several newly discovered parasites may share clinical characteristics with the prevalent parasites found across countries within the B&R. Moreover, laboratory diagnosis is not common in these countries and requires advanced molecular techniques, making diagnosis, treatment, and prevention more challenging. Some parasitic diseases that have been controlled or unreported in China are still prevalent abroad and can easily lead to potential misdiagnosis. As international medical students, their demand for "parasitology" knowledge is greater than that of Chinese students. Therefore, guiding international students to understand and master the morphology, life cycle, pathogenic mechanisms, disease symptoms, diagnosis, and identification methods of human parasites, as well as cultivating the ability to comprehensively solve practical problems, can lay a solid foundation for clinical diagnosis, treatment, onsite prevention, and research.

Main issues in the course for international students

Classroom organization is outdated and lacks participation and interaction

In traditional laboratory teaching, there is a lack of interaction between teachers and students, leading to student boredom due to one-way information transmission. The course of this process mainly includes parasite morphology, species identification, disease tissue observation, and experimental operations. However, owing to the wide variety of parasites with subtle morphological differences that are easily confused and the single teaching format,

teachers lack timely guidance and problem-solving in class, resulting in the inability to effectively convey teaching content and the burden on student learning outcomes.¹⁵ The English communication and knowledge acceptance abilities of international students are uneven. The majority of international medical students who come from countries within the B&R are not English-speaking countries, and they are also not fluent in Chinese, which could have an adverse influence on their communication skills and hence their lack of understanding.^{9,10,16} Therefore, effective communication cannot be guaranteed.

In addition, international students are accustomed to open classroom environments where they can freely communicate, discuss, and ask questions at will. Interactive and discussion-based teaching methods make it easier for them to join the class. The traditional teaching mode of text and the rote learning method are not in line with the learning habits of international students, leading to poor comprehension and decreased enthusiasm for the class. Additionally, different cultural backgrounds and lifestyle habits can influence students' attitudes toward classroom discipline.¹⁷

Content lacks pertinence

The occurrence and distribution of parasites and related diseases are commonly endemic issues that vary between countries along the B&R.¹⁸ Domestic textbooks and teaching content focus primarily on common or previously occurring parasitic diseases in China, lacking specific materials and systematic teaching resources for international medical students to obtain knowledge of the parasites from which they originated.¹⁹ This results in international students who return from China to engage in medical work and lack knowledge of common parasitic diseases in their own countries, hindering their ability to engage in relevant medical work upon return.

Assessment and evaluation methods are unreasonable

The final grade usually consists of two aspects: the process grade and the final exam. Among them, the process grades mainly consist of lab reports and experimental technology assessment, focusing on parasite morphology identification, species determination, and mastery of experimental operations, but lacking a comprehensive evaluation of students' learning. Additionally, the class performance of students is not considered, which is not conducive to mobilizing students' enthusiasm. The methods of experimental assessment and paper-based examination focus on results rather than the process, which cannot truly reflect students' overall mastery of teaching content, impacting the cultivation of students' practical ability and medical quality.^{9,20}

Reform of teaching methods for parasitology laboratory courses

Enhancing the design of targeted content

When designing the course, data on the prevalence and occurrence status of representative parasitic diseases in

countries and regions along the B&R should first be collected and organized. The collection and sorting method can be a collaborative method between teachers and students, assigning tasks to international students before class. The teachers summarize the collected materials and extract content suitable for classroom teaching while maintaining coverage of the key points of learning about major domestic parasitic diseases. Under this premise, adjustments should be made on the basis of the trends of epidemic diseases around the world. Guiding international medical students to form a good knowledge system of parasites and related diseases and establishing comprehensive problem-solving skills to address problems according to local conditions will help them adapt to the needs of the times and society. Second, the content design of inspection and diagnostic methods in laboratory courses should be coordinated with parasite species and disease types, appropriately increasing the content of foreign clinical diagnostic methods, treatment strategies, case virtual diagnosis, etc., of parasitic diseases to expand the breadth of teaching content. In addition, in recent years, the occurrence and epidemic of new infectious diseases have attracted widespread attention worldwide. Teachers can design discussion topics for these new infectious diseases, allowing international students to share and discuss related parasites in their countries on this topic. In-class discussion can also enhance interest in and enthusiasm for learning. Furthermore, alliances with academic institutions or global organizations that deal with human parasites within the B&R should be formed to provide parasite samples that can be used to view images in practical classes.

Adjusting classroom organization

Parasitology laboratory courses typically include the following content: observation of parasite specimens or slides, pathological tissues of related diseases, learning of general diagnostic and examination methods, dissection, and observation of animal models of parasitic infection. Teaching methods include playing teaching recordings, illustration displays, experimental operation demonstrations, and specimen displays. Each aspect of the experiment is relatively independent and lacks communication between teachers and students. Moreover, the disconnection between morphological observations and experimental operations hampers holistic learning and memory, resulting in poor learning outcomes. For international students, this method of classroom organization makes them likely to be confused and fail to grasp the key points.

To this end, we designed a diagnostic specimen observation experiment based on case analysis, which includes the following steps:

- (1) Distribute case materials before class to understand background knowledge.
- (2) Introduction to the classroom content and observation of physical samples: typical specimens and pathological tissues.
- (3) Experimental operation demonstration.
- (4) Group case discussion: elaborate on the knowledge points and diagnostic points contained in the case.

- (5) Group experiment: judge and summarize the experimental results.
- (6) The teacher comments, and students complete the experimental reports.

Through this organizational method, international and Chinese students can participate at the same time, changing the rigid and one-way dissemination of knowledge and information, promoting exchanges and discussion, enhancing learning motivation, and cultivating teamwork skills. Gao et al.²¹ used virtual reality techniques to achieve a simulation-based learning experience in the parasitology experiment course, including foreign students. Their practice also requires the foreign students to learn the course based on greater student engagement with Chinese students together, which obviously improves the knowledge gain of foreign students. Yong et al.²² also provide an example that group case discussion, experimental operation, and Lab report completion have enhanced the teaching quality of instructors, boosted international students' interest in learning, and achieved excellent educational outcomes.

In addition, when distributing materials before class, international and Chinese students are required to mix and match, sort out the professional vocabulary involved in this lesson, and annotate these words in Chinese and English. After running for a semester, the professional vocabulary compiled by the students in each class was carefully screened and compiled into a booklet, which was distributed with the case materials. This not only helps international students remember and understand the classroom content but also helps Chinese students master professional vocabulary. To prepare international medical students, medical vocabulary terms should be included in their one-year Chinese language preparatory course, which will enable them to become familiar with medical vocabulary.

Joint teaching by virtual teaching and research groups

Taking our school as an example, parasitology teachers maintain close contact with local disease control staff and medical department staff. Recruiting staff with experience in overseas medical assistance or staff who are currently receiving medical assistance overseas to join the teaching team as virtual research groups. These groups carefully select classic cases of parasitic diseases encountered in assisting countries and regions, remove privacy-related content, retain highly restored case scenarios, invite personnel to co-teach off or online, interpret cases, introduce diagnostic and treatment methods, and enhance international students' knowledge immersion and recognition.

Adjust assessment and evaluation methods

Skill-based experimental operations are essential and should be scored on the basis of practical operation and detection results, combined with group discussions, classroom performance, and specimen identification assessments for a comprehensive evaluation. Formative evaluation methods have unique advantages in comprehensively examining students' participation in various links, knowledge mastery,

teaching effectiveness, etc., and can conduct dynamic inspections of the above aspects. Through case discussion group reports, experimental operation inspections, microscopic specimen identification, and written exams, a comprehensive evaluation is conducted of case interpretation and analysis capabilities, experimental operation mastery, parasite species identification, and teamwork skills comprehensively. Among them, the group reports account for 15% of classroom performance and experiment report writing, experiment grades account for 20%, and traditional theoretical exams account for 50%. This detailed and comprehensive assessment system provides an objective evaluation of students' performance in all aspects.

Conclusion

The education of international students is an important link and component of extensive cooperation in the field of education between China and countries and regions related to the B&R policy, and an important measure in the internationalization of higher education. In this context, teachers should start from the actual needs of international students for parasitology knowledge, carefully study and think about and reform teaching methods, continuously summarize the teaching experience of laboratory courses, explore new teaching methods, and integrate them with the content of theoretical courses to ensure the learning outcomes of international students, improve the quality of laboratory course teaching, and meet the needs of cultivating high-quality international talent.

Ethics approval and consent to participate

Not applicable. This review did not involve human participants, animals, or sensitive data that required ethical approval.

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Generative AI statement

The authors declare that no Generative AI was used to create this manuscript.

CRedit authorship contribution statement

Yuting Ma: Conceptualization, Writing – original draft, Writing – review & editing, Visualization, Investigation.
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Conflict of interest

The authors declare no competing interests.

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