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Review Article

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Teaching pharmacology in China: challenges faced by students and lecturer in the new era.

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ABSTRACT

The rapid advancement of medical science in China has made teaching pharmacology increasingly challenging. Traditional teaching methods, mainly relying on didactic lectures and experimental sessions, are no longer sufficient to meet the diverse learning needs of modern students or to keep pace with newly developed drugs. Educators are required to continuously update their knowledge and adopt innovative teaching strategies such as problem-based learning (PBL), team-based learning (TBL), and flipped classrooms (FC). These approaches have been shown to improve student engagement, attendance, academic performance, and overall satisfaction. However, language barriers remain a major challenge, as pharmacological terminology is largely derived from Greek and Latin. To address this issue, strategies such as breaking complex terms into smaller components and implementing flipped classroom models are recommended. Pharmacology plays a vital role in medical education by linking drug mechanisms with clinical application. This paper highlights innovative teaching methods, technology-based tools, collaborative learning, and bilingual support to enhance pharmacology education in China.

KEYWORDS: Pharmacology, Education, China, Medical, Student.

INTRODUCTION

Pharmacology is the discipline of drug effects and is also an important subject in medical training. Pharmacology teaching in China and around the globe faces unique challenges, including rapid advances in medical technology, the complexity of the discipline, and a changing educational environment. This review aims to discuss the common problems that affect both attrition and progression among lecturers and students in pharmacology [1,2].

Pharmacology is undoubtedly one of the most fundamental subjects in the medical Curriculum. It is a cornerstone of modern medicine, controlling the delivery and use of medicines for disease prevention, diagnosis, or treatment. However, we recognize the vitality of pharmacology as a discipline, which demands teaching strategies that are responsive to change and wholly reflective of current knowledge in medical progress [3].

The teaching and integration of Pharmacology within the context of Chinese medical education curricula should be a primary focus of investigation and improvement. Understanding the specific challenges, barriers, and opportunities inherent to the current delivery and application of pharmacology in Chinese medical schools is crucial to enhancing the comprehensive understanding and practical application of pharmacological knowledge among Chinese medical students and faculty. A deeper examination of the pedagogical approaches, curricular structure, resource allocation, and institutional support mechanisms surrounding Pharmacology education in China could shed light on areas that need strengthening to better prepare future students in medical and health sciences to be more competent, informed prescribers and practitioners of pharmaceutical therapies [4].

In rural or semi- developed province in China, there's often a gap between the basic science taught in classrooms and its application in real-world clinical settings. This disconnect makes it harder for medical students to fully understand and use their pharmacological knowledge when they start practicing [5]. To address this, pharmacology education in rural areas needs to evolve [6]. It's important to move beyond traditional methods and focus on teaching approaches that connect foundational science with clinical practice. This helps students think critically and make better decisions as future healthcare providers. Introducing methods like case-based learning, hands-on simulations, and team-teaching with experts from different fields can make a big difference. These approaches not only help students see how theory translates into practice but also keep the learning process engaging. Supporting educators with the right tools and training is equally important, especially in rural areas where resources are often limited. With these changes, we can ensure that students in rural China are better prepared to meet the needs of their communities [7].

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Addressing Language Barriers:

Pharmacology instruction in China is uniquely challenged by language barriers, as the subject relies heavily on understanding complex medical terminology, much of which originates from Greek and Latin. Unlike other medical disciplines that focus on practical skills or broader concepts, pharmacology demands a detailed comprehension of drug names, mechanisms, and their interactions, which are often presented in English-language resources. This language barrier can pose significant obstacles for Chinese medical students, hindering their ability to fully grasp pharmacological principles and apply them effectively.

As a result, the teaching of pharmacology is disproportionately impacted compared to other medical disciplines, making it essential to adopt bilingual resources, provide translation support, and introduce innovative teaching strategies to bridge the gap and ensure students grasp both the language and the subject matter effectively. In addition, the challenge of accessing the latest research findings, innovative practices, and advanced knowledge in pharmacology for students and lecturers in China who are not fluent in English is multifaceted and deeply rooted in both personal and systemic issues. One significant barrier is limited oral and written English proficiency, which impedes effective access to academic resources. Among Chinese students, this hampers their ability to engage with English. This issue is exacerbated by the educational system's historical emphasis on written English over oral proficiency, resulting in students who can read and write but struggle with speaking and listening. Therefore, this language barrier greatly hinders their ability to stay up to date in the field. In a study conducted by Huang et al. (2017), it was found that most nurses had difficulty keeping up with the latest literature, especially since it was mostly in English. According to the source, the most common issues were the language barrier and inadequate article presentation [7].

Birhane et al. (2023) proposed several key strategies to improve scientific communication among non-native English speakers. In his article, he emphasized the importance of using clear, simple, and comprehensive language when discussing and writing about research [8].

The language barrier presents a significant challenge for students and educators worldwide,including in China. From previous research, English proficiency is demonstrated to provide access to the latest research findings, innovative techniques, and an advanced understanding of pharmacology [9,10]. Limitations in English proficiency greatly restrict the students' ability to engage with scientific content, which is primarily available in English, including research papers, journals, and textbooks. An effective way to tackle this problem is by implementing a bilingual strategy. By engaging in this activity, students can develop a strong grasp of pharmacology while also enhancing their English language abilities . In China, where Mandarin is the primary language of instruction, students may struggle to comprehend pharmacological terms, drug classifications, and clinical guidelines that are predominantly available in English. This difficulty is compounded by the lack of direct translations for many technical terms, leaving students with a fragmented understanding of the subject. Moreover, pharmacology is heavily research-driven, requiring students and lecturers to engage with international journals and databases, which are mostly published in English.This creates an additional hurdle in staying updated with advancements in the field [11].

When considering the situation, it's important to take another factor into account: the policies implemented. Government support and the cultural environment are important in facilitating the integration of innovative teaching approaches into pharmacology education in China [12]. Dadi et al (2019) revealed that several other factors have a significant impact on early childhood bilingual education [13]. These factors include language ideologies, age of acquisition, methods of acquisition, family environment, and socio-cultural factors [14].

Resource Limitations and Quality of the Resources

The limited access to high-quality materials, such as international pharmaceutical databases and journals, will further complicate the learning process. The rapid pace of new drug approvals and practice guideline updates necessitates frequent revisions to the pharmacology curriculum. This is because new discoveries and advancements in pharmacology are constantly being published, leading to ongoing change. Additionally, most of the materials are available in English. This presents a significant challenge for both educators and students in China [15,16].

Web-based resources, such as web alerts, medical newsletters, and electronic databases, have been suggested to help healthcare professionals stay up to date with medical information [17]. It also emphasized the importance of fully disclosing pharmacological data on new medications, as this can offer valuable information to scientists and physicians [18].

However, there is a limitation that hinders their ability to stay up to date with the latest research findings and developments, which are essential for understanding new drugs and treatments. A study by Xie et al. (2018) found that health sciences libraries in China are undergoing significant changes [19]. These libraries are now providing new services, and librarians are taking on more responsibilities, requiring them to learn new skills [20]. To overcome this obstacle, it is important to establish strong partnerships with respected international pharmaceutical organizations and research institutions [21,22]. These partnerships, in turn, would facilitate access to high-quality databases, journals, and research publications, enabling the lecturers to stay abreast of cutting-edge advancements and subsequently contribute to the global pharmacology landscape [23,24].

Improvement of Pharmacology Teaching Approach

The field of pharmacology education employs a variety of instructional methodologies. Problem-based learning, team-based learning, case-based learning, and flipped classrooms are among the methods [25]. The integration of problem-based learning and case-based learning is likely to improve both theoretical and subjective test scores [26,27]. Another method of teaching pharmacology is team-based

learning (TBL), introduced in 1983 to enhance learning in large classes. It is also referred to as team- oriented learning. This entails students collaborating in teams to resolve issues or accomplish certain tasks. TBL is intended to foster collaboration, critical thinking, and active learning among students. Students are typically assigned pre-class readings or materials to examine prior to attending class in accordance with this methodology [28,29]. Chen et al. (2022) further elaborated on a novel teaching method for medicinal chemistry, "student-centered team-based learning" (SCTBL), to enhance students' learning experience and engagement. Ultimately, the SCTBL method was developed to address these obstacles, leveraging extensive teaching experience [30].

The activities must take place prior to class to acquire foundational knowledge. FC disrupts the conventional approach to education, which involves instructing students in the classroom and requiring them to apply the material at home. Rather, students acquire knowledge outside of the classroom and apply it in the classroom. Then, interactive tasks are implemented in place of the conventional lecture format to engage students [31]. The flipped classroom concept is significant because it cultivates a more participatory and dynamic learning environment. The flipped classroom (FC), also referred to as flipped learning or the inverted classroom, is a blended learning approach that was developed in accordance with the principles of student-centered learning and constructivism [32,33].

In a flipped classroom, the conventional teaching approach is replaced by requiring students to review lecture materials. This includes videos, PowerPoint presentations, notes, and pre-class exercises/quizzes. This approach enhances student motivation, active participation, and involvement, leading to improved perceptions of academic and learning [34,35].

Therefore, implementing a rotated classroom teaching model in pharmacology education would not only mitigate language barriers but also enhance student learning. It also fosters active learning and collaboration among students. Student motivation, engagement, and achievement have been positively impacted by the implementation of a flipped classroom [36,37]. Therefore, FC is a cutting-edge, interactive instructional approach that integrates theory, practice, and innovation. Students are encouraged to take the initiative in their own learning [38,39].

Nevertheless, challenges such as providing device access and preparing educational materials for all students must also be addressed. In general, the FC indicates a transition to active learning and student-centered education. In addition, the FC teaching model has demonstrated significant potential to foster collaboration and active learning [40]. However, its efficacy may differ depending on the cultural and educational context. There could be various challenges in fully implementing this approach in a way that aligns with the traditional teaching methods and the preferences of educators and students in China.

Future Curriculum and Educational Resources

The depth of knowledge that students can acquire may be impacted by the accessibility of textbooks and other learning materials. In some cases, these resources might not be as up to date as those available in more resource-rich countries. This limitation can create a disparity in students' knowledge acquisition. Textbooks and educational resources that are not consistently updated eventually fail to reflect the latest developments and understandings across most pharmacology disciplines [41]. A study on various teaching methods in pharmacology found improvement in teaching Pharmacology. The approaches include Problem-Based Learning (PBL), Case-Based Learning (CBL), Team- Based Learning (TBL), and Flipped Classrooms (FC) [42]. There may be a knowledge gap between students who receive training in countries with limited resources, such as China, and those who have access to more up-to-date educational materials in other countries. Hence, it is crucial to utilize up-to-date learning resources. This includes the textbooks, online platforms, and other academic materials. These resources foster students' enthusiasm and engagement in learning [43].

Rapid Advancement in Pharmacology Teaching

Advances in pharmacology significantly impacted the teaching of this subject. Slowly, the traditional standard teaching methods like lectures and lab sessions are being changed to include student-centered and competency-based approaches. It has become essential to incorporate real-life situations and apply knowledge in clinical cases in pharmacology education.

One of the biggest challenges that lecturers face is keeping up with the rapid advancements in pharmacological research. One of the newest trends in teaching materials is to include scientific research in the curriculum and help students become more aware of scientific research and Innovation . In a study conducted by Tang et al. (2021), it was found that these challenges hold significant importance. Based on the study, it is suggested that teachers should adapt their teaching methods to better suit the unique characteristics of their students and effectively address the common challenges encountered in traditional teaching [3]. It is important to create a curriculum that matches the most recent developments in Pharmacological sciences.

DISCUSSION

Pharmacology education in China faces significant challenges due to limited resources and language barriers. Addressing these issues requires a combination of innovative strategies and institutional support. Because of the rapid advancement of pharmacological knowledge, the curriculum needs to be continuously updated [43].

Limited access to high-quality educational materials, such as international pharmaceutical databases and journals, restricts students and educators from keeping up with advancements in the field. This is a serious problem that frequently arises. In order for educators to keep up with the latest breakthroughs in the field of education, they need to incorporate the most recent scientific research and technological resources. This will help students develop a culture of lifelong learning and curiosity.

Given that the majority of the most influential research in pharmacology is published in English, language barriers further complicate the teaching process [44]. The ability of students to access and interpret the most recent studies

has been negatively affected, and, as a result, it presents an additional difficulty for lecturers, who may be required to translate and adapt specific content [45,46]. These problems can be alleviated through bilingual education practices and improvements in English proficiency among both students and instructors.

Resource limitations, particularly the availability of up-to-date textbooks and access to international pharmacological databases, create additional obstacles [47]. Establishing strategic partnerships with leading global research institutions can significantly enhance access to cutting-edge pharmacological information and resources [41,48]. Leveraging these collaborations will help educators and students stay informed about the latest developments in the field, enabling them to integrate the latest research into the curriculum [49]. Furthermore, open-access databases, digital libraries,Online platforms provide a wide range of up-to-date pharmacological data, articles, and educational resources that are easily accessible. This comprehensive approach to obtaining and incorporating current knowledge ensures that the learning experience remains dynamic, relevant, and aligned with the rapid advances in the field of pharmacological sciences.

Innovative teaching strategies, such as team-based learning and flipped classrooms, have demonstrated the potential to engage students and encourage active learning [50]. Teaching pharmacology in China requires lecturers and students to adapt to the changing field by developing pedagogical strategies that match the diversity of student learning styles and by keeping up to date with the latest developments in Pharmacology [51,52].

Therefore, pharmacology teaching in China requires adapting to rapid advances, overcoming language hurdles, and using creative pedagogical methods. This includes multilingual instruction, active learning methods such as the flipped classroom model, and staying current on pharmaceutical research [53,54]. It was reported that these new approaches greatly enhance scores on both theoretical and practical tests, as well as overall student satisfaction. Moreover, enjoyable activities and relevant examples in teaching complex topics have been shown to help students learn better. This is supported by clear improvements in learning outcomes, as evidenced by Hake's learning gain [55,56]. By adopting these multifaceted adjustments, instructors can provide Chinese students with a more comprehensive, engaging, and productive education [57].

It was reported that these new approaches greatly enhance scores on both theoretical and practical tests, as well as overall student satisfaction. Moreover, enjoyable activities and relevant examples in teaching complex topics have been shown to help students learn better. This is supported by a clear improvement in learning outcomes, as evidenced by Hake's learning gain [58]. These initiatives will also provide a more dynamic and efficient learning environment, improving students' understanding and application of clinical pharmacology. The emergence of artificial intelligence-driven tools such as ChatGPT has introduced new opportunities in medical education by supporting personalized learning, academic writing, and rapid access to updated scientific information. The integration of AI technologies can enhance teaching efficiency, promote self-directed learning, and assist educators in curriculum development within pharmacology and medical sciences [59].

CONCLUSION

Establishing partnerships with international pharmaceutical organizations and research institutions can help secure access to essential databases, journals, and other resources. Additionally, investment in digital infrastructure, such as providing devices and ensuring campus-wide internet connectivity, is critical for enhancing accessibility. This entails the development of pedagogical strategies that are compatible with the diverse learning modalities of students, in addition to remaining informed about the most recent developments in pharmaceutical sciences. This review could underline the importance of combining the practical clinical applications and the firm theoretical basis, especially when it comes to the scientific literature in English and the language barriers, as well as the importance of overcoming the technological barriers and increasing the accessibility of Education materials and contemporary resources, which direct more efforts towards the improvement of the effectiveness of pharmacological education, using the latest instruments in active learning, such as the development of cognitive aides, case-based discussions.

It also can be concluded that active learning has been shown to successfully enhance the clinical application of pharmacology courses, illustrating the objective of developing the ability of independent learning, critical thinking, and rational prescribing in students. However, their implementation must consider cultural and resource constraints to ensure alignment with traditional teaching styles and the availability of resources. By institutionalizing these strategies through national policies, partnerships and investments, pharmacology education in China can be transformed to meet the evolving demands of the field. Ultimately, we have outlined the evaluation approaches that more precisely capture students' knowledge with the aim of advancing pharmacology education on a global scale especially in the Academic institution of sub-urban China Provinces.

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