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Application of Motic Digital Microscope Mutual System in the Experimental Teaching of Medicinal Plants

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Abstract In comparison with conventional experimental teaching methods, the implementation of the Motic digital microscope mutual system in the experimental teaching of medicinal botany has been demonstrated to be a highly efficacious approach to enhance the teaching level of experimental courses in medicinal botany. The implementation of a digital microscope mutual system in experimental teaching not only enhances students' practical skills in laboratory operations but also increases classroom efficiency. Furthermore, it supports personalized development among students while fostering innovative thinking, independent learning capabilities, and analysis and problem-solving skills. Additionally, this approach contributes to the enhancement of students' scientific literacy.

Key words Microscope, Medicinal plants, Mutual system, Experimental teaching

1 Introduction

In the teaching process of medicinal botany, microscopic experimental teaching has been recognized as a significant method for students to acquire knowledge and enhance their practical skills. Nevertheless, traditional methods of microscopic experimental teaching present several challenges. These include limitations in experimental equipment that hinder interaction and communication between teachers and students, a low level of student engagement, and significant discrepancies in the indicators of students' experimental outcomes. In this context, Guangxi University of Chinese Medicine has introduced the Motic digital microscope mutual system. This system integrates the benefits of microscopy technology, computer networking, and microscopic image acquisition and analysis technologies[1], thereby offering new opportunities for microscopic experimental teaching. Through digital microscope mutual system, students are afforded a clearer observation of cellular organization and microstructure. This approach significantly enhances their enthusiasm for participation in experiments. Furthermore, teachers can project students' experimental results onto a screen, facilitating communication, explanation, and interaction. This method markedly improves teaching efficiency, stimulates students' interest in learning, and contributes to the enhancement of their overall literacy skills. The practice of applying Motic digital microscope mutual system in the experimental teaching of medicinal plants has demonstrated its efficacy in enhancing students' practical skills in experimental operations. Furthermore, it has been shown to improve the efficiency of interactions between teachers and students, as well as among students themselves, thereby facilitating better communication and comprehension of classroom knowledge. This system also promotes personalized development, innovative thinking, independent learning capabilities, and problem-solving skills among students. These outcomes are crucial for advancing students' scientific literacy and enhancing the overall quality of education[1-4].

2 Features and advantages of Motic digital microscope mutual system and applications

2.1 Features and advantages In recent years, the rapid advancement of digital technology has significantly enhanced the role of digital microscope mutual systems in the field of medicinal botany education. The Motic digital microscope mutual system integrates various technologies and methodologies, thereby offering an efficient means of communication and interaction for microscopic experimental teaching[5]. The Motic digital microscope mutual system enables both teachers and students, as well as peer-to-peer interactions among students, to observe experimental conditions in real time via the internet. This system facilitates online communication and immediate interaction, thereby enhancing the engagement and communication between teachers and students, as well as among students themselves, ultimately contributing to improved learning outcomes. The digital microscope mutual system offers enhanced clarity and intuitiveness in experimental observation results. This system aids students in comprehending theoretical concepts and operational techniques. Furthermore, the results can be permanently stored on a computer, facilitating convenient review for students.

2.2 Applications

2.2.1 Teachers are efficient and effective in their instructional methods, and students readily embrace the knowledge presented to them. Prior to the commencement of the experimental procedures, the teacher will present the typical microscopic characteristics of the teaching object using a PowerPoint presentation. During the student practice sessions, the teacher is able to monitor real-time images from all students' workstations via the teacher's interface of the system. Microscopic features that are particularly well observed by students, as well as those that do not meet the established criteria, will be displayed on a large screen at the front of

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the classroom for the benefit of all students. This approach minimizes confusion and potential errors during the experimental process, thereby enhancing the overall teaching experience. It facilitates a more vivid and intuitive understanding of the object, making it easier for students to comprehend and master the concepts, ultimately leading to improved experimental efficiency. Through the observation of the teacher's terminal, it is possible to continuously assess the classroom dynamics, thereby facilitating effective classroom instruction and enhancing the overall efficiency of teaching.

2.2.2 The student experiment is straightforward and user-friendly, facilitating effective guidance from teachers. The system is capable of capturing images observed under the microscope via a camera and transmitting them to a computer screen. This allows students to observe the object more comfortably, reducing eye strain and encouraging more meticulous examination. When students encounter unfamiliar or unique objects under the microscope, they have the option to pose questions to the teacher via the system or to seek assistance in person. The teacher can provide intuitive responses to the students' inquiries through the computer screen. This technology facilitates effective communication among students and enhances the instructional support provided by the teacher.

2.2.3 The assessment is more equitable and just, and can accurately reflect the students' comprehension and mastery of knowledge. Utilizing the Motic digital microscope mutual system, the teacher is able to monitor the students' real-time observation process during the production of microscopic slices. This system facilitates the evaluation of both the quality of the produced microscopic slices and the appropriateness of the operational techniques employed. Students will capture images of the microscopic features related to their results and submit an electronic version of the assignment through the designated system. They are permitted to submit multiple images as necessary. The teacher will provide feedback electronically, which will facilitate the assessment of the students' understanding of the key concepts. Subsequently, students will create plots based on the typical microscopic features and submit a paper version of the assignment. The final grades for the experimental report will be determined by combining the paper and electronic versions of the assignment. This approach aims to mitigate the impact of inadequate drawing skills on students' ability to effectively demonstrate their comprehension of the knowledge points.

2.3 Comparison between Motic digital microscope mutual system teaching and traditional teaching

2.3.1 Limitations of traditional experimental teaching methods. The conventional experimental teaching method has historically been the predominant approach in the instruction of medicinal plants. However, the constraints imposed by experimental equipment and teaching environments hinder the ability of this method to fulfill students' demands for diversity and engagement in experimental learning. Consequently, this limitation adversely impacts students' interest and enthusiasm for the course. Traditional experimental teaching methods are predominantly teacher-centered, resulting in limited opportunities for students to engage actively in the learning process. Consequently, students often passively receive information regarding the experimental procedures and outcomes, which diminishes interactivity, practicality, and the potential for personalized teaching. As a result, in the contemporary educational landscape, traditional experimental teaching approaches are increasingly inadequate in addressing the diverse learning needs of students and the objectives of professional training.

2.3.2 Advantages of using Motic digital microscope mutual system for teaching. The Motic digital microscope mutual system offers students a more intuitive and vivid display of experimental content. By utilizing high-definition imaging and real-time interactive features, students are able to observe and comprehend the microstructure of medicinal plants with greater clarity, thereby enhancing their understanding of the experimental content. Compared to observations conducted with a traditional microscope, the Motic digital microscope system enhances student engagement in the experimental process, thereby improving their skills in experimental manipulation and their literacy in experimental investigation. The Motic digital microscope mutual system significantly enhances the timeliness and efficiency of experimental teaching. By utilizing an online platform that offers experimental operation videos and information download capabilities, students are able to engage in preparatory and review activities outside of the classroom. This approach facilitates the active consolidation of experimental knowledge and skills. Meantime, teachers are equipped to monitor students' experimental progress in a timely fashion, provide targeted guidance and feedback, and enhance the personalization and relevance of experimental teaching.

2.3.3 Comparison of teaching effect of two teaching methods. In the experimental teaching of medicinal botany, multiple groups within the same professional class, all taught by the same teacher, were utilized. One group was designated for traditional experimental teaching, while the other group was assigned to experimental teaching utilizing the Motic digital microscope mutual system. The experiments focused on the observation of potato starch grains within the context of medicinal botany. During the experiment, students were required to utilize a microscope to observe and document the morphological characteristics of potato starch grains. The results indicated that at high magnification, the starch granules exhibited a regular polygonal or elliptical morphology characterized by a smooth surface and well-defined edges. Additionally, various forms of umbilical dots were observed within the starch granules, and distinct laminae were formed surrounding these umbilical dots.

The results of the comparative study indicated that the Motic digital microscope mutual system enabled students to observe and analyze the morphological characteristics of starch grains more intuitively. Additionally, the system facilitated the examination of differences among various starch grains. The real-time image ac-

quisition feature allowed for the documentation of starch grains exhibiting distinct morphological characteristics, such as umbilical points and laminae, thereby enabling their permanent preservation. Students who utilized traditional experimental teaching methods were often limited to merely describing the morphological characteristics of starch grains observed under a microscope and subsequently illustrating these observations on their experimental report papers. The quality of these drawings significantly influenced the overall experimental outcomes. This was particularly evident among students who struggled with drawing; although they might comprehend the knowledge point visually, their inability to accurately represent it graphically can result in suboptimal experimental results. Consequently, this situation may diminish the interest of these students in the subject. Upon comparing the experimental outcomes of two groups of students, it was observed that the results obtained by students utilizing traditional experimental teaching methods were more closely aligned with the theoretical representations found in textbooks. The descriptions provided by these students were similar to the content of the textbooks. In contrast, the experimental results from students employing the Motic digital microscope mutual system accurately reflected the actual morphology of potato starch grains, and their descriptions were notably more informative and relevant.

3 Deficiencies and preventive measures of Motic digital microscope mutual system teaching

Guangxi University of Chinese Medicine has implemented this system for medicinal plant experimental teaching for over 20 years. While it demonstrates significant advantages in comparison to traditional experimental teaching methods, it also exhibits certain deficiencies in its instructional approach. Firstly, the convenience of observing objects on a computer screen, as opposed to utilizing microscope eyepieces, has led to a decline in students' engagement with traditional microscopic observation techniques. This shift not only hampers the mastery of essential microscopic experimental skills but also limits the observation of specific microscopic features. The clarity of images displayed on computer monitors is contingent upon their resolution. The presence of inadequate resolution may result in the inability to observe certain microscopic features, potentially leading students to erroneously conclude that the observed object possesses these characteristics, which is misleading. Secondly, certain students who do not approach experiments with the requisite seriousness fail to prepare temporary slices independently and neglect to utilize microscope observations. Instead, they rely on the screens of their neighboring classmates to create their drawings, which undermines the development of their practical skills. Additionally, some students engage in computer games and share images of their electronic assignments with one another, further detracting from the effectiveness of the experimental teaching process. In light of the aforementioned issues, it is imperative to implement measures aimed at their prevention[6]. For instance, in the first and second experiments, students should be prohibited from using computers; instead, they should complete the experimental report solely through the use of a microscope. This approach guarantees that students thoroughly learn and master the operation of the microscope prior to being allowed to use the computer screen for observational purposes. They are required to conduct meticulous observations under the microscope before completing the experimental report using the computer screen. Teachers go back and forth between classes, simultaneously remaining prepared to address student inquiries while simultaneously supervising independent work to ensure that no student engages in academic dishonesty by appropriating the results of their peers' experiments. Additionally, they implement relevant ideological and political education as part of their responsibilities.

4 Conclusions

In conclusion, the comparative analysis of the Motic digital microscope mutual system and traditional experimental teaching methods reveals the distinct advantages of the digital microscope mutual system in the context of medicinal plant experimental teaching. This system significantly enhances both the effectiveness and quality of teaching. Furthermore, it improves the timeliness and efficiency of experimental teaching by fostering students' independent learning and innovative capabilities, while simultaneously enhancing their experimental skills and investigative literacy. In the context of the ongoing educational and pedagogical reforms, the digital microscope mutual system has emerged as a significant auxiliary tool for the experimental teaching of medicinal plants. This system facilitates the continuous enhancement of the teaching quality in microscopic experimental courses.

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