Ind. J. Pharm. Edu. Res., 2023; 57(4):1192-1195.
https://www.ijper.org

Original Article

Application of Multi-element Integrated Teaching in the Human Anatomy and Physiology Course in Pharmacy Majors

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ABSTRACT

Background: A professional foundational course in human anatomy and physiology is required of pharmacy students to establish their understanding of the field. Since it includes human anatomy and human physiology, two crucial theoretical courses for medical students, the teaching material for these subjects was employed to adhere to the standards of medical disciplines rather than those of pharmacy. **Objectives:** This study aimed to establish a multi-element integrated teaching method for human anatomy and physiology to address the training requirements of pharmacy students. **Materials and Methods:** For pharmacy majors, we designed a multi-element integrated teaching method of human anatomy and physiology from the viewpoints of medicine, pharmacy, and professional ethics. We also summarized the feasibility, significance, and issues associated with multi-element integrated teaching of human anatomy and physiology. **Conclusion:** Our multi-element integrated teaching method for human anatomy and physiology increased student interest and enhanced the effectiveness of lessons. This approach will promote the development of skilled pharmaceutical workers who are enthusiastic about scientific research and have a sense of social responsibility.

Keywords: Human anatomy and physiology, Pharmacy characteristics, Integrated teaching, Pharmaceutical students growing.

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Received: 09-09-2022;
Revised: 28-03-2023;
Accepted: 08-06-2023.

INTRODUCTION

Human Anatomy and Physiology consist of two subjects: Human Anatomy and Human Physiology. The principles and influences that affect human daily activities are further explained based on the structure of a healthy human body, which is the key step in mastering the structure and physical functioning of the human body.[1] Human anatomy and physiology, a vital specialty-basic course for Pharmacy majors, can not only help students build a solid medical foundation but also serve as a link between fundamental courses and the subsequent pharmaceutical courses, which is essential for them to begin their careers in pharmaceutical research.

Pharmacy is a field that studies the interrelation between drugs and diseased bodies. Its knowledge structure encompasses the fundamental theoretical understanding of all branches of pharmacy and the basic training in experimental techniques and skills.[2,3] The training objective of the pharmacy major is to develop students' fundamental skills in drug preparation, quality control, and evaluation. It also aims to direct the rational use of clinical drugs and develop specialized pharmaceutical personnel with professional quality and professional ethics, who view "the welfare of patients" as their primary value and ultimate goal in life.[4,5] Therefore, the human anatomy and physiology teaching materials for pharmacy majors should adhere to their training objectives[6] and incorporate the pertinent information in line with the peculiarities of pharmacy and its various related degrees. This not only lays a solid foundation for further studying professional pharmaceutical courses, such as pathology, pharmacology, pharmaceutical chemistry, etc., but is also important for training pharmaceutical professionals in academic planning and establishing professional ethics.

The integrated teaching method integrates the information offered or correlational material from the textbook with the material in the textbook.[7] It is a novel teaching method that helps students master information comprehensively by promoting their ability to divergent thinking and connections to other related subjects.[8]

In this study, we attempted to construct an integrated teaching method of human anatomy and physiology for pharmacy students by integrating medical, pharmaceutical, and professional ethical components into the teaching contents per the requirements of pharmacy. We also expected our research to play a guiding and exemplary role in the teaching process, to promote the scientific

DOI: 10.5530/ijper.57.4.142

spirit, professional ethics, and social sense of mission of students, and grow them into skilled pharmaceutical professionals.

MATERIALS AND METHODS

Integration of medical components

Human anatomy and physiology, as a professional basic course that is offered to pharmaceutical students in their second academic year, lays a strong foundation for subsequent professional subjects such as pathology, pharmacology, pharmaceutical chemistry, etc. However, most of the students had an insufficient understanding of the significance of this course for the pharmaceutical personnel and could not connect it with other related courses. Furthermore, some students complained that the human body structure was complex and the physiological processes of the human body were obscure and challenging to understand. These factors influence teaching effectiveness. In order to help students in making a connection between human anatomy and physiology and their pharmacy major, we tried to construct a transition from a healthy human body to a diseased human body and then to clinical medication. Thus, we incorporated medical topics including pathophysiology, pathology, pharmacology, and forensic medicine in the teaching materials for human anatomy and physiology. Clinical situations can include medical components, thus explaining cases helps students understand key points and piques their interest in learning and clarifies the role of pharmaceutical personnel.

The teaching contents should nevertheless focus on the anatomical structure and physiological functioning of a healthy human body despite the short class sessions. Therefore, the teachers we chosen to integrate multi-element in the teaching content of human anatomy and physiology were familiar with the curriculum and could ensure the key and challenging concepts are understood.

Customize teaching content for sub-majors of pharmacy

Human anatomy and human physiology are the two most important fundamental theoretical courses in medical schools, and their teaching material was based more on the requirements of the medical field than on the characteristics of pharmacy. Students from different sub-majors of pharmacy had the same teaching material. However, their research field and contents were different.[9] For instance, research into pharmaceutical product synthesis and manufacturing processes is the core focus of pharmaceutical engineering. Traditional Chinese Medicine (TCM) specialty focuses on the underlying theory and techniques of TCM development. The pharmaceutical analysis focuses on quality control of medicine. In addition, the production of pharmacological dosage forms is the main emphasis of pharmaceutical preparation. However, pharmacology aims to elucidate the underlying mechanisms of drug action. Furthermore, the goal of pharmaceutical administration was to train adaptable managers who are skilled in both legal theory and pharmaceuticals. Therefore, to help students understand the research field of their majors and become familiar with the pharmaceutical discipline, we integrated pharmaceutical elements into the course, including pharmacology, pharmaceutical analysis, and pharmaceutical engineering.

Since different pharmacy sub-majors cover diverse subjects, we adopt the "curriculum responsibility system", in which each sub-major selected 1–2 teachers to "tailor" the teaching material.

Integration of professional ethic elements

Pharmacy is a people-focused specialty. Therefore, pharmaceutical education should help students develop their professional ethics in addition to their knowledge of pharmaceutical science. If pharmaceutical practitioners lack moral awareness and a sense of responsibility, it is challenging to ensure the safety and efficacy of drug use.[10] Therefore, professional ethics lessons that are pertinent to human anatomy and physiology should be included in the curriculum of pharmacy students. This will help students develop professional ethics and morals, adopt a scientific attitude of fact-based truth-seeking, and develop moral qualities such as dedication.

RESULTS

Integrating medical components could link fundamental courses with pharmaceutical courses

Pathophysiology is the study of the general laws and mechanisms of the occurrence and development of diseases from the perspective of the function, metabolic changes, and mechanisms of the diseased body.[11] Although the healthy human body and diseased human body are the study objects of human anatomy and physiology and pathophysiology, respectively, the contents of the two courses are closely related, since both are based on the human body. Therefore, incorporating pathophysiological components in the lectures on human anatomy and physiology not only made the material more interesting and applicable to real-world situations but also improved the basic medical knowledge's organization and coherence and prepared the students to approach medical problems from a scientific perspective. For instance, after teaching students about blood coagulation in the blood system, we added the pathophysiological aspect of anticoagulant disorder into the course through the clinical manifestations of atherosclerosis, and this could help students to comprehend the balance between coagulation and anticoagulation better. We also added the pathophysiological aspect of hemorrhagic or anaphylactic shock into the teaching content, and this enhanced students' understanding of the three factors of arterial blood pressure formation. We also introduced the etiology and therapeutic concepts of gastric ulcers, and this further assisted students in understanding and remembering the roles of the stomach mucosal barrier and mucous bicarbonate

barrier. And we integrated the procedure for determining the cause of death of a deceased infant in forensic medicine into the teaching material on the respiratory system, this improved students' understanding of residual capacity. When teaching the cardiac anatomy in the circulatory system, the impact of the unclosed foramen ovale on the body and the surgical elements connected to repair surgery was also introduced to help students remember the internal structure of the heart better.

In the process of carefully selecting reasonable medically integrated aspects according to the course's key points and challenges, teachers also reserved their specific medical information, expanded their area of expertise, improved their professional standards. Afterward, the course's theme was more prominent, and the teaching effect was better.

Customize teaching content could follow the characteristics of pharmacy and pharmaceutical discipline

Pharmacy major is composed of different pharmaceutical sub-majors, mainly including pharmacology, pharmaceutical analysis, pharmaceutical engineering, traditional Chinese medicine, etc. Since these sub-majors had different training objectives, the teaching contents of human anatomy and physiology should integrate their specialty characteristics. Therefore, we incorporated the importance of the blood-brain barrier in the treatment of central nervous system diseases including cephalomeningitis and Alzheimer's disease. This made it clearer to students majoring in how altering the dose form can assist medicine to reach its intended patient. For students majoring in pharmaceutical analysis, we introduced disease-related biomarkers in the respective chapters. This helped students to understand that pursuing biomarkers or drug metabolites can help reveal organism status or conduct biopharmaceutical analyses. We also explained to students majoring in pharmaceutical engineering that leads compounds created following target sites learned when learning receptors and ligands are the basis for novel drug discovery.

Pharmacy spans a vast range. During the process of integration, teachers further understood the relevant subfields of pharmacy and integrated the required elements into the course according to the specialty characteristics. In addition, this also assisted students to gain a purposeful understanding of human anatomy and physiology from the perspective of their major. Moreover, this helped students to understand the relevant professional elements of their major and progressively foster the scientific curiosity of pharmacy students in the future.

Integrating professional ethic elements could develop high-level pharmaceutical personnel

Pharmacy is a people-focused specialty which needs students to have professional ethic and morals to ensure the safety and efficacy of drug use. Moreover, they should also adopt scientific attitude of fact-based truth-seeking to conduct scientific research, and develop moral qualities such as dedication. Therefore, we included the development of TCM as a professional ethics component in the human anatomy and physiology course of students majoring in pharmacy. A highly toxic drug, arsenic trioxide, was listed as "Pi Shuang" in the ancient Compendium of Materia Medica. Arsenic trioxide was incorporated into the course of the blood system when we discussed the physiological function of white blood cells. Chinese scientists worked tirelessly to identify the anti-leukemia effect of "Pi Shuang" in M_3 acute promyelocytic leukemia and clarify its underlying mechanisms, using modern medical techniques. We also added a section on professional ethics related to the precursors of pharmacy. Youyou Tu, a researcher and developer of TCM, won the Nobel Prize at the age of 86 for his work on the anti-malarial drug artemisinin and double hydrogen artemisinin, which were extracted from the TCM of *Artemisia annua* Linn. Integrating professional ethics related to TCM helped students build their cultural confidence and lay a foundation for them to inherit the discipline.

During the process of integrating the elements of professional ethics in human anatomy and physiology in pharmacy courses, teachers accumulated the knowledge reserve for professional ethics. They also combined their expertise with professional ethics to find a suitable point to integrate the elements of professional ethics into courses naturally. In addition, they also completely comprehend the professional ethics of pharmacy and selected the topics that are closely related to human anatomy and physiology. This could eliminate the baldness of professional ethics studies and slightly affect the students' mental state. Incorporating the elements of professional ethics helped students establish strong values and understand their role as members of the pharmaceutical industry.

DISCUSSION

Human anatomy and physiology is a professional foundational course for pharmaceutical students. Since it is composed by human anatomy and human physiology, and both of these courses are basic courses for medical students, the previous teaching contents were conformed to the training requirements of medical students. Therefore, we integrated the elements of medicine, pharmacy and professional ethics into the teaching contents of human anatomy and physiology, thereby enabling to meet the needs of pharmaceutical specialty.

We first integrated medical elements into the teaching contents, including pathophysiological and forensic cases. This not only made the teaching atmosphere live and active, greatly arose students' interest in learning, but also deepened the impression of students to improve the study efficiency. Then, we focused on the characteristics of pharmaceutical sub-majors, and integrated pharmaceutical contents into the teaching contents

of human anatomy and physiology, including pharmacology, pharmaceutical analysis and pharmaceutical engineering. This established the connection between pharmaceutical sub-majors and human anatomy and physiology, which not only helped students to apply human anatomy and physiology knowledge to the pharmaceutical field, but also deepened their understanding of pharmaceutical research field and disciplines. Finally, as pharmacy is a people-oriented specialty and "welfare of patient" is the primary value and ultimate goal of pharmaceutical personnel, we integrated professional ethic elements into the teaching contents of human anatomy and physiology. This not only helped students to clarify their professional purpose, but also established their professional ethics and morals to engage in the field of pharmacy.

Moreover, in the process of carrying out the integrated teaching of human anatomy and physiology, we found that the "curriculum responsibility system" was the key factor to complete the integrated teaching. The responsible teachers for each sub-major of pharmacy developed the teaching syllabus that fully appropriate to the professional characteristics of the sub-major, which not only helped teacher to obtain good teaching effect, but also enabled teachers to continuously accumulate teaching experience for this sub-major.

CONCLUSION

Human anatomy and physiology are a crucial professional fundamental course for pharmacy majors. It plays an important role in laying the medical foundation, connecting professional knowledge, and helping pharmacy students plan their academic careers. However, teaching human anatomy and physiology via conventional methods is occasionally tedious, which not only decreases students' enthusiasm for learning but also fails to inspire them to enthusiastically participate in medical research.

Therefore, integrating medicine, pharmacy, and professional elements into human anatomy and physiology to make it specialized for various pharmaceutical sub-majors can not only pique students' interest in learning but also help them understand the significance of this course and their scientific orientation. In addition, this will aid students to establish professional morals and ethics, which will help in developing skilled pharmaceutical professionals with a strong sense of social responsibility, a commitment to rigorous scientific research, enthusiasm, and dedication to their work.

ACKNOWLEDGEMENT

This study was financially supported by the Special topic of online examination reform of Shenyang Pharmaceutical University in 2020 (3) and Shenyang Pharmaceutical University undergraduate teaching reform Research Project (1825; 10163-22-21).

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

ABBREVIATIONS

TCM: Traditional Chinese Medicine.

SUMMARY

In this study we established a multi-element integrated teaching method for human anatomy and physiology to address the training requirements of pharmacy students. Our method increased student interest and enhanced the effectiveness of lesson for human anatomy and physiology, which promoted the development of skilled pharmaceutical workers who are enthusiastic about scientific research and have a sense of social responsibility.

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Cite this article: Zhang H, Xu J, Wang J, Gu Y, Sun G. Application of Multi-element Integrated Teaching in the Human Anatomy and Physiology Course in Pharmacy Majors. Indian J of Pharmaceutical Education and Research. 2023;57(4):1192-5.