

Exploration and Application of Educational Elements in Botany Teaching from Ideology and Politics Education

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Abstract: The unique history, culture and national conditions of China determine that professional course teachers should be unified in imparting professional knowledge, value guidance and ability cultivation when teaching. Botany is an important basic course for biology and related majors in colleges and universities. In the process of botany teaching, teachers should absorb and learn from the rational core of Western theoretical achievements to improve the quality of teaching. At the same time, based on Chinese reality, they should take China and time as a reference to solve Chinese problems, show Chinese wisdom, and present Chinese style. This is not only the basic requirement of curriculum ideology and politics, but also the fundamental requirement of the college to train the new people of the era.

Keywords: Botany teaching; Educational elements; The value of life; Scientific literacy; Ecological civilization

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1. Introduction

During his inspection and research at Renmin University of China, General Secretary Xi Jinping emphasized that “The essence of ideological and political theory courses lies in explaining principles. It is essential to focus on methods and approaches, to explain the principles thoroughly, deeply, and vividly. Teachers should teach with dedication, and students should understand with diligence to achieve the goals of communicating hearts and minds, enlightening wisdom and nurturing the spirit, and inspiring morale.” This important discussion provides a new direction and practical path for teachers to make good use of the main channel of classroom teaching in the new era and cultivate a good field of responsibility to realize the same direction of various courses and ideological and political theory courses, and realize collaborative education ^[1]. However, to realize the unity of the three in the actual curriculum teaching, teachers are required to actively explore the ideological and political education elements of professional courses in teaching, integrate these elements into the curriculum objectives and contents, and optimize the teaching structure and mode. The ideological and political education elements

such as excellent traditional Chinese culture education, ideal and belief education, outlook on life and values education, professional quality education and ecological civilization education are organically and closely combined with the knowledge and skills imparts inherent in various courses, to promote the free and all-round development of students and give full play to the role of cultivating morality and people in the new era ^[2,3].

The freshman year of university is a critical transitional period for undergraduates to establish a correct worldview and cultivate lofty ideals and goals. However, freshmen often encounter a multitude of psychological challenges, including adaptation to new living environments, navigation of interpersonal relationships, adjustment to academic demands, and the development of self-identity ^[4,5]. Especially in terms of learning adaptation, there will be maladjustment of learning attitudes and goals, which will lead to some soul-searching questions: “What should I do in this course?” “Do I have dreams for this major?” “I am so confused, do I have clear goals and plans? Are the goals and plans in line with the actual situation of the major?” These ideological issues cannot be deeply answered by ideological and political course teachers and counselors. Therefore, it is urgent for professional course teachers to help students answer their souls subtly in the teaching process ^[6]. Botany is a professional basic course for biological and applied biological science majors in colleges and universities, which is concentrated in the first year of university ^[7]. It is the best time for botany teachers to actively explore the elements of substantive curriculum ideology and politics and practice, improving the teaching model. Effectively integrating the elements of curriculum ideology and politics into students’ daily lives, combining the teaching of professional knowledge with students’ current psychological confusions, and consciously addressing the real problems they encounter in learning and social practice, can truly resonate with their cognitive and practical depths, positively influencing them. This approach aims to cultivate students with lofty scientific literacy and a sense of responsibility, which is also the ultimate goal for botany teachers in achieving the multiple unity of knowledge transfer, value shaping, and ability cultivation.

2. The exploration of ideological and political elements in botany curricula

The breadth and depth of botany instruction are considerable. In terms of depth, it encompasses the morphological characteristics, development, and physiological functions of plant cells, tissues, and organs (vegetative and reproductive), as well as the characteristics and evolution of major plant groups, and the fundamental theories and methods of angiosperm classification. In terms of breadth, it involves both abstract and difficult-to-understand professional terminology and systematic principles, as well as the close connections between plants and various aspects such as politics, economics, culture, and society. Therefore, it is a practical issue for every botany instructor to consider how to use botany as the basic carrier for curriculum-based ideological and political education, identify the points of convergence between professional knowledge and “ideological and political content,” explore curriculum-based ideological and political elements, and achieve the educational effect of subtly influencing students. **Table 1** shows the list of ideological and political elements corresponding to botany topics.

Table 1. List of ideological and political elements corresponding to the teaching knowledge points of botany topics

Curriculum learning objectives		Integration of ideological and political elements into the curriculum		Civic and moral education materials	Practical methodologies	Achievement of objectives
Introduction	Flora and plant diversity	Elements of ecological civilization education		Documentary on the List of Wild Plants under National Key Protection: "Chinese Plants That Changed the World"	Provide supplementary multimedia resources, such as documents and videos, to facilitate student learning outside of class	Cultivate ecological conservation awareness
	The objectives of botanical studies	Ideological and belief components		The story of botanist Wu Zhengyi, who could predict the arrival of autumn by observing a single leaf	Classroom lecture prompts	Cultivate a steadfast commitment to the ideals and principles of botanical scholarship
	A Brief History of Botanical Research	Elements of education in the outstanding traditional culture of China		"The Shijing", a collection of poems dating back to the Spring and Autumn period "The Shennong Ben Cao Jing", dating back to the Qin and Han dynasties. Li Shizhen's "Compendium of Materia Medica" "Flora of China"	The lecture will provide supplementary materials for students to review and reinforce concepts outside of class.	Cultivate cultural competence, and stimulate enthusiasm and interest in learning.
	Seed structure and classification	Incorporating elements of life philosophy and value systems education		"Sowing the Future" and "Stories of China" pay a touching tribute to botanist Zhong Yang's "Life of Seeds"	In class, stories about scientists are told and video materials are provided for students to enjoy after class	Learn from the spirit of pioneers, be courageous to overcome learning difficulties, and actively establish a correct outlook on life and values
Seeds and seedlings	Seed structure of grasses	Elements of professional literacy education		Yuan Longping and hybrid rice	Classroom tells stories of scientists	Study scientist spirit and establish scientific view
The root	Structure and function of roots	Dialectical view of materialism		The roots are deep and the trees are flourishing	classroom lecture	Dialectical thinking about causes and effects leads students to build a strong foundation for life
The stalk	Structural features of the stems of monocotyledonous and dicotyledonous plants	materialist dialectical view		Structure determines function, function reflects structure	classroom lecture	
The leaf	Leaf photosynthesis	Elements of ecological civilization education		Peak Carbon, Carbon Neutral, Carbon Emissions Trading	Presentation of current news related to the profession	Deep understanding of everyone's responsibility to reduce carbon emissions

Table 1 (Continued)

Curriculum learning objectives	Integration of ideological and political elements into the curriculum	Civic and moral education materials	Practical methodologies	Achievement of objectives
Botanical classification	The significance of plant taxonomic studies	Tu Youyou and Artemisinin	Classroom tells stories of scientists' characters	Motivation to learn about the spirit of scientists and the concept of science
	Elements of professional literacy education	Zeng Xiaolian and Botanical Painting	Classroom tells stories of scientists' characters	
	Phytoplankton	Zhong Guan Guan, Qian Chongshu, Hu Xianying, Chen Huanyong and others and Research on Plant Taxonomy	Provide video materials for students to enjoy after class	
	Mossy plant	Academician Zeng Chengkui and Artificial Kelp Culture	Classroom tells stories of scientists' characters	Understand that the tension of life is not necessarily the idleness and quietness that it appears to be.
	Brake	Yuan Mei's Inspirational Poem on moss, "Moss"	Classroom lecture	
Campus Plant Surveys and Field Practicums	Brake	The Story of Cyathea and the Dinosaurs	Classroom lecture	Understanding that the evolutionary process is well documented
	Elements of professional literacy education	Qin Renchang and the fern classification system	Classroom lecture	Respect for practice, the pursuit of scientific truth, and respect for the profession
	Angiosperm	The Spirit and Spirituality of Pine, Grass, Lotus, Plum, Orchid, Bamboo and Chrysanthemum	Classroom lecture	Passing on valuable cultural heritage while learning about the spirituality of plants
	Elements of education in the outstanding traditional culture of China	Relationship of the 24 Solar Terms to Agricultural Activities and Plants	Classroom lectures, post-class video materials to enjoy	Fully understand the importance of treasuring endangered plants and enhance the awareness of the protection of wild plant resources
	Elements of ecological civilization education	"Convention on International Trade in Endangered Species of Wild Fauna and Flora"		
Field Practicums	Plant Resources Survey and Conservation	"Convention on Biological Diversity"		
		Rhododendron, Solanum, Orchidaceae and other State conservation cases of key protected wild plants	Practical Learning	Philosophical principles of commonality and individuality
		Seed Law of the People's Republic of China		
		Chinese herbal medicine original plant		
		Identify plants and understand the commonality of morphological features of major families and the individual characteristics of specific species		

2.1. Ideological and belief education elements

At the commencement of the botany course, the instructor should elucidate the significance of botanical knowledge in the inaugural lesson, thereby reinforcing students' professional ideals and commitment to their studies. The first lesson should clarify the objectives of studying botany, emphasizing that “no knowledge is useless, and no knowledge is unlearnable.” Botany is not only a fundamental course in life sciences but also closely related to national economic development and the resolution of major global issues, including food security, environmental sustainability, public health, and peace. Instructors should inspire students to aspire to great ideals and take responsibility for national rejuvenation, passionately introducing the story of Wu Zhengyi, a botanist and recipient of China's highest science and technology award. In 1951, during the Korean War, 35-year-old Wu Zhengyi identified variants of *Litsea cubeba* varieties and *Quercus coccinea*, both native to South Korea, amidst a multitude of similar-looking fallen leaves. Through botanical identification, he provided evidence of the U.S. military's biological warfare in Korea. In 1933, when Wu Zhengyi was about to apply to Tsinghua University for botany, his father asked him, “What's the use of studying this?” At that time, he couldn't answer. Through his outstanding contributions to botanical research, 92-year-old Wu Zhengyi received the 2007 National Highest Science and Technology Award. In a media interview, he said, “My father once asked me what the use of studying plants was. I couldn't answer then, but I can now.” By sharing Wu Zhengyi's lifelong dedication and his profound understanding of the world through the study of plants, instructors aim to ignite students' pride in studying botany, thereby strengthening their ideals and beliefs in their chosen field.

2.2. Elements of life philosophy and value education

The introductory botany course presents a substantial volume of information, encompassing a broad spectrum of knowledge, numerous concepts, and specialized terminology. The target audience for this course comprises first-year undergraduates. These students often exhibit limited prior academic experience, a narrow knowledge base, underdeveloped abstract reasoning skills, and insufficient capacity for knowledge transfer^[8]. Furthermore, they are undergoing a transition from passive learning in secondary education to a more autonomous learning approach at the university level. During this challenging transitional period, students lacking resilience, those unable to confront difficulties and setbacks, may lose their motivation and enthusiasm for learning, leading to a negative attitude towards the specialized subject matter. Consequently, instructors must not only facilitate students' comprehension of complex botanical content but also utilize the course material to guide students in developing a sound worldview and set of values.

In the instructional process, it is appropriate to inspire and motivate students through the incorporation of compelling narratives of scientists. This approach aims to cultivate students' resilience in the face of challenges, fostering their dedication to learning, a strong work ethic, and a sense of responsibility. The ultimate goal is to equip them with the ability to address practical issues within their field of study. For instance, during the “Seed Structure and Types” module, educators can integrate the life of botanist Mr. Yang Zhong, whose 16-year commitment was dedicated to the investigation and analysis of plant resources on the Qinghai-Tibet Plateau. Despite the harsh environmental conditions and life-threatening risks, he persevered in his expeditions to Tibet, expending considerable effort to collect a treasure trove of over 40 million seeds representing more than 1,000 plant species. This work provided a comprehensive understanding of the distribution of biological resources in Tibet, filling significant gaps in the research of Tibetan flora. As Mr. Zhong articulated in his writings, “When a species seeks to expand its territory, it must confront the challenges of a hostile environment, with some pioneers sacrificing individual advantages to secure new survival and development opportunities for the entire group and

even the species.” By studying the pioneering spirit of Mr. Zhong, students can develop the courage to overcome academic difficulties and actively explore the world of botany, thereby realizing their lofty life values.

2.3. Elements of professional ethics education

In the 21st century, human society has entered an era of intelligent technology. Biotechnology, along with information technology and materials technology, constitutes the three major driving forces behind artificial intelligence, representing the fastest-growing high-tech fields globally. As one of the world’s four major pillar industries, the biotechnology industry exhibits strong technological versatility, product diversity, and resource richness. Consequently, life science programs in higher education institutions must adopt a national and even global perspective to cultivate biotechnology professionals with a solid foundation of specialized knowledge, comprehensive professional qualities, and robust innovative and practical abilities ^[9]. Instructors teaching the foundational life science course of “Botany” are thus required to closely integrate teaching content with professional ethics education, guiding students to not only diligently acquire scientific knowledge but also to cultivate a correct scientific attitude, establish a scientific spirit, and foster a meticulous work ethic and a strong sense of social responsibility.

Scientific spirit and professional ethics are the most valuable spiritual assets when engaging in scientific work, gradually cultivated and developed by students during the process of learning professional knowledge. In the teaching of botany in the freshman year, the instructors should tell the stories of scientists corresponding to different teaching contents. Inspire and enlighten students with the touching deeds of scientists such as Yuan Longping and hybrid rice, Tu Youyou and artemisinin, Zeng Xiaolian and plant painting, Academician Zeng Chengkui and artificial cultivation of kelp, Zhong Guanguang, Qian Chongsheng, Hu Xiansu, Chen Huanyong and plant taxonomy research, Qin Renchang and the classification system of ferns, so that students can recognize that scientists respect practice, pursue scientific truth, and advocate professionalism, thereby planning their own career ideals, and realizing their ideals through dedication and struggle.

2.4. Elements of excellent traditional Chinese culture education

The profound and intricate nature of China’s outstanding traditional culture encompasses a wealth of philosophical thought, humanistic spirit, and moral principles, offering subsequent generations invaluable intellectual resources for understanding and transforming the world. As President Xi Jinping emphasized in his 2013 address at the Central Party School’s spring semester commencement, “Leading cadres must also study China’s outstanding traditional culture to enhance their wisdom and cultivate their character through learning” ^[10]. China, being one of the earliest nations to study and utilize plants, has amassed a significant body of Chinese cultural elements that utilize plants as their medium. Educators can enrich the ideological depth of the curriculum, cultivate students’ cultural confidence, and stimulate their enthusiasm and interest in learning, thereby facilitating the effective completion of botany course objectives, by skillfully and appropriately integrating education on China’s outstanding traditional culture into botany instruction.

Integrating elements of excellent Chinese traditional culture education permeates nearly the entire botany teaching process. In the introductory section, when discussing the history of botanical research, the study introduce the “Book of Songs” from the Spring and Autumn period, the “Shennong Ben Cao Jing” from the Qin and Han dynasties, and Li Shizhen’s “Compendium of Materia Medica” from the Ming Dynasty. These are among the world’s earliest botanical masterpieces, highly valued by botanists. Additionally, the “Flora of China,” published in 2004, and its English version, “Flora of China,” published in 2013, represent one of the

largest and most diverse botanical works globally. The study encourages students to read these botanical classics and take notes, guiding them to appreciate Chinese traditional culture, enhance their national cultural pride and self-esteem, and build confidence in Chinese culture and their professional prospects. When elucidating the characteristics of diverse plant species, the study integrates cultural elements using specific plants as examples. For instance, when discussing the distribution and habitats of bryophytes, the study introduces Yuan Mei's inspirational poem "Moss": "Where sunlight fails to reach, youth arrives on its own. Though moss flowers are as tiny as rice, they strive to bloom like peonies." Moss, a pioneer plant, appears quiescent, yet it grows dynamically through encroachment and coverage, weathering storms and time to adorn the human world. This approach guides students to understand that the vitality of life is not always reflected in its outward appearance of tranquility. For ferns, the study uses the narrative of "Cyathea and Dinosaurs" to illustrate their past and present, helping students grasp the epochs of geological transformation. The decline of these "plant giants" represents the evolutionary journey of ferns over time, with evidence of their past struggles and glory. When teaching about Pinus, the study references the Huangshan Welcome Pine's tenacious spirit of growing through rock to introduce the dialectical relationship of "structure determines function, and function reflects structure." For herbaceous plants, the study incorporates the saying "Wildfire cannot burn them all, the spring wind brings them back to life" to inspire students with the resilience and perseverance of grass. In explaining the life cycle of angiosperms, the study integrates the twenty-four solar terms and their relationship to plant growth and agricultural activities, highlighting the wisdom of ancient Chinese laborers. The study aims for the students to not only acquire professional knowledge but also to inherit this invaluable cultural heritage.

2.5. Elements of ecological civilization education

Over the past few decades, the emphasis on economic development and industrialization has led to a diminished awareness of ecological protection and the overexploitation of resources, resulting in severe environmental degradation. Consequently, the 18th National Congress of the Communist Party of China incorporated ecological civilization construction as a fundamental component of the overall layout of the cause of socialism with Chinese characteristics within the "Five-Sphere Integrated Plan." General Secretary Xi Jinping explicitly stated in the Report of the 19th National Congress of the Communist Party of China that "ecological civilization construction benefits both the present and future generations" and "to adhere to the harmonious coexistence between humanity and nature, we must establish and practice the concept that lucid waters and lush mountains are invaluable assets, and adhere to the basic state policy of conserving resources and protecting the environment" ^[11]. University students are the key players in the future ecological civilization construction of the nation, and cultivating a solid socialist ecological civilization perspective among students is a core educational mission of higher education institutions ^[12]. Therefore, botany instructors, by utilizing the knowledge of botany as a vehicle to conduct ecological civilization education, have an excellent opportunity to cultivate students' environmental protection awareness and promote ecological civilization construction.

Educators can leverage opportunities such as campus plant surveys and field excursions to implement ecological civilization education. This involves fostering discussions with students on "plants and nature" and "plant resources and ecological civilization." In the field, instructors should enthusiastically guide students in appreciating natural landscapes and proactively collect non-biodegradable waste generated during practical investigations. Through practical actions, educators should encourage students to conserve plant resources, minimizing specimen collection unless essential. When encountering plants like *Cyathea*, *Paphiopedilum*,

Cymbidium goeringii, or *Cycas*, educators should explicitly communicate the concept of wild plant protection, emphasizing legal prohibitions against the collection, sale, or acquisition of nationally protected wild plants. Students should also be instructed to memorize the national key protected wild plant list, thereby enhancing their understanding of the importance of conserving endangered plants and strengthening their awareness of wild plant resource protection. Furthermore, ecological civilization construction is intrinsically linked to plant diversity conservation. When teaching plant diversity, educators should guide students to investigate campus plant diversity and ecological environments during their free time, formulating appropriate conservation plans to initiate ecological civilization construction within the campus. To establish an ecologically civilized and beautiful environment, the concept of low-carbon environmental protection should be instilled in students. During lessons on leaf physiology and structure, educators can introduce concepts such as “carbon peak, carbon neutrality, and carbon emissions” through the principle of “plant photosynthesis consuming carbon dioxide,” enabling students to deeply understand the necessity and strategic significance of the national carbon peak and carbon neutrality goals, emphasizing that reducing carbon emissions is a shared responsibility.

3. Integrating ideological and political elements into the botany curriculum as the main teaching channel

3.1. Expand the scope of the classroom curriculum

Given the constraints of a two-semester botany curriculum, the allocated instructional time is relatively limited. To effectively integrate ideological and political theory (IPT) into the course, instructors should identify relevant IPT elements. They should then address real-world issues encountered by students, strategically selecting IPT content. The goal is to pinpoint the convergence of these IPT elements with the core botanical knowledge. This approach will enrich the explanation of specialized knowledge, encouraging students to engage in extended learning or research. Simultaneously, it will highlight the concise and impactful nature of the IPT education, guiding students to contemplate and investigate pressing societal issues. This strategy aims to enhance the synergistic effect of “IPT” and “specialized knowledge,” thereby leveraging the educational function of the discipline’s culture.

3.2. Innovative pedagogical approaches in the classroom

To effectively integrate ideological and political elements into botany courses, innovative pedagogical approaches are essential. These methods should address students’ intellectual and psychological development, as well as their key concerns. Meticulous refinement of the implementation details and the development of practical teaching plans are crucial. A multifaceted approach should be adopted, including instructor-led lectures, student-led extracurricular study, and both on-campus and off-campus practical experiences. During classroom instruction, emphasis should be placed on stimulating student agency through active learning strategies such as group problem-solving discussions, scenario presentations, research project explorations, in-class debates, and case study analyses to introduce ideological and political content. The extracurricular study component should integrate online and offline resources, leveraging platforms like MOOCs, learning apps, and interactive classroom systems to provide access to files, video materials, relevant news articles, and legal references for students to study outside of class. Students should be encouraged to provide feedback and write reflections after completing these assignments. The on-campus practical component should begin with a survey of campus plant resources, utilizing online information resources to link species information to QR codes that direct to the Flora

of China, thereby promoting plant classification learning throughout the campus and extending the ideological and political education to the entire faculty and student body. The off-campus practical component should utilize external “ideological and political” teaching bases to conduct resource surveys and establish specialized resource gardens, allowing students to participate in the maintenance and propagation management of these gardens. This will enrich teaching resources while implementing the ideological and political curriculum.

3.3. Develop a high-quality ideological and political teaching resource database for botany courses

As botany educators, we should integrate elements of ideological and political education, including the cultivation of excellent traditional Chinese culture, ideals and beliefs, life values, professional ethics, and ecological civilization, into our teaching, aligning with the great practices of the new era. We should incorporate vivid practical achievements and the exemplary deeds of scientists into our lectures, organizing and developing a high-quality, diverse teaching case library. Furthermore, we should dynamically gather students’ concerns regarding learning difficulties and ideological questions, with the faculty collectively researching and providing answers to create a problem bank for botany instruction. We must enrich the ideological and political content of botany courses by actively collecting, reviewing, and sharing outstanding course materials, including lecture notes, key point analyses, domestic and international references, micro-videos, and multimedia open courses, to establish a high-quality teaching resource repository.

3.4. Developing a high-caliber teaching faculty for the ideological and political elements of botany curricula

As emphasized by General Secretary Xi Jinping, a botany educator’s fundamental qualities encompass a robust knowledge base, proficient teaching capabilities, a diligent instructional approach, and effective pedagogical methodologies ^[13]. For a botany course instructor integrating ideological and political elements, continuous enhancement of teaching proficiency and expansion of subject matter expertise are essential for delivering course content. Furthermore, in practical course instruction, educators must clearly define their political stance and continuously elevate their ideological awareness to effectively improve their professional competence and ethical standards. Effective communication among botany instructors is crucial. Collaborative course refinement, involving discussions based on lecture content, instructional challenges, and student feedback, is necessary. This collaborative effort should foster innovation in teaching methods, aiming to transform each ideological and political botany lesson into a high-quality course. The ultimate goal is to cultivate educators who are, in the students’ eyes, idealistic, principled, ethical, and possess a wealth of professional knowledge.

4. Conclusion

The integration of ideological and political elements into botany curricula necessitates a thorough exploration of these elements as a foundational step. Furthermore, the cultivation of a highly qualified teaching staff is essential to ensure the effective amalgamation of specialized knowledge with ideological and political education. By strategically leveraging the content of the discipline and accurately incorporating ideological and political elements, we can assist students in developing sound life philosophies. This approach aims to cultivate students who embody patriotism, professional ethics, and a sense of responsibility, thereby shaping them into exemplary young citizens of the new era. Ultimately, this strategy enables educators to achieve the comprehensive

educational objectives of knowledge dissemination, value formation, and skill development.

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