Teaching Reform of Meteorology Course in Landscape Architecture with the Goal of "Cultivating Applied Talents"

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Abstract The cultivation of "applied innovative talents" is of great significance for the transformation of talent cultivation methods in various majors of universities. Meteorology is a compulsory basic course for landscape architecture major in universities, and is one of the compulsory basic courses for forestry, horticulture and other majors in similar universities in China. It is closely related to subsequent professional courses. The practical teaching system of meteorology under the new situation is studied and explored, and a complete curriculum system that combines the concept of cultivating "applied innovative talents" is established, which can achieve new breakthroughs in students hands-on ability and experimental level. The research results have certain reference value for similar universities.

Key words Meteorology; Higher education; Applied innovative talents; Landscape architecture major; Teaching reform

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In the context of global warming, the number of extreme weather and climate events in China has increased, and the requirements for coordinated development and safety to prevent major risks of meteorological disasters are becoming higher and higher. The people's demand for meteorological service guarantees for a better life, especially in agricultural and forestry production practices, is becoming increasingly diverse. To accelerate the development of the knowledge economy and promote the construction of an innovative country, it is more urgent to cultivate new agricultural and forestry technology talents with high theoretical, innovative, and practical abilities. With the advent of the big data and information age, society has put forward new requirements for agricultural and forestry professionals. There is an urgent need for a group of applied innovative talents with high theoretical literacy, strong innovation and creativity, excellent technology, good at solving on-site technical problems in agriculture and forestry, strong technical integration and application capabilities, and the ability to innovate skills. Local high-level applied universities aim to cultivate frontline applied technical talents who directly serve enterprises and industries. Therefore, it is of great significance for the transformation of talent cultivation methods in various majors of universities by emphasizing the cultivation of "applied innovative talents".

According to the requirements for cultivating applied innovative talents, various universities have proposed corresponding strategies for cultivating innovative talents. Northwest A&F University integrates innovative talent cultivation elements into the ideological and political construction of agricultural and forestry meteorology course[1-2]; Hubei Minzu University has carried out teaching reforms based on the characteristics of the agricultural and forestry meteorology course, innovated the training methods for agricultural and forestry talents, and strengthened agricultural and forestry education in order to improve the teaching effectiveness of the course[3]; based on the characteristics of agricultural meteorology course, it carries out professional targeted teacher allocation, reasonably setts up first-come courses for agricultural meteorology, innovates teaching materials and re-cultivates teachers to enhance the diversity of teaching methods. Adhering to the educational concept of "creation, innovation, and entrepreneurship", it is committed to cultivating interdisciplinary and composite "three innovation" talents. Adopting a series of measures such as setting up experimental classes, base classes, fully implementing university research training programs, and internationalizing undergraduate education, new ways of cultivating innovative talents are explored[4-5]. A diversified talent cultivation strategy of "hierarchical, multi specification, and tailored to individual needs" is developed, the organization of comprehensive education reform classes is used as an important means of selecting innovative talent cultivation, and the laws of innovative talent cultivation are explored[6-9]. Looking at the talent cultivation of high-level applied universities across China, there are three main aspects of cultivating applied innovative talents[10-15]. Firstly, the cultivation of applied innovative talents must adhere to the unity of theory and practice; secondly, the cultivation of applied innovative talents should adhere to the principle of training guided by social needs; thirdly, the cultivation of applied innovative talents must

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be carried out in an innovative education model. In short, the purpose of cultivating applied innovative talents is the integration and scientific application of knowledge.

This study takes the Meteorology course in the landscape architecture major from the School of Environment and Tourism, West Anhui University as an example to conduct research. Meteorology is a compulsory basic course for the landscape architecture major of West Anhui University, and is one of the compulsory basic courses for forestry, horticulture and other majors in similar universities in China. It is closely related to subsequent professional courses. The application field of Meteorology is very broad. In agricultural and forestry production, meteorological conditions affect the growth and development of plants and trees; in urban planning, the layout of residential and industrial areas needs to consider the influence of prevailing wind direction; in sports events, wind has a certain impact on competitions and sailing races; in military warfare, the story of borrowing arrows from a straw boat tells us without exception that meteorology is not only closely related to production and life, but also a highly applied course in the profession.

1 With the goal of cultivating applied talents, reasonably determining the course content, and innovating the construction of the practical teaching system for Meteorology

Taking the landscape architecture major at West Anhui University as an example, the teaching syllabus of Meteorology specifies 24 theoretical hours and 16 practical hours. In the context of a significant reduction in class hours, especially in practical classes, facing a large amount of teaching content in textbooks, it is necessary to conduct targeted teaching according to the training objectives of the landscape architecture major, and achieve teaching tailored to the profession, such as strengthening and deepening meteorology related content closely related to landscape architecture courses. For example, when discussing agricultural evapotranspiration, it includes soil evaporation and plant transpiration in the field, which students already have studied in their sophomore year of university courses and can be simplified. With the development of the times, some new knowledge has emerged in meteorology, such as unmanned aerial vehicles for fertilization and pest control of agricultural and forestry crops, and the use of remote sensing technology for infrared photography of forest vegetation to determine the soil moisture content of forests. These cutting-edge technologies could be introduced into the teaching process of undergraduate students. In this way, students not only understand the rapid development of agricultural and forestry technology and meteorology, but also broaden their horizons and knowledge.

Meteorology is a fundamental course in the landscape architecture major at West Anhui University, with strong theoretical and practical aspects. However, in the context of the reform of the training plan in the landscape architecture major, the current practical class hours are only 16 h. Therefore, teachers need to adopt a combination of school and enterprise within a relatively limited time, such as cooperating with the Lu'an Meteorological Bureau and the Lu'an National Climate Reference Station, to provide students with a broader teaching and research platform, create more practical activities for students, integrate course teaching with students' practical hands-on experience, and make curriculum teaching and practical teaching complement each other. At the Lu'an National Climate Reference Station, students have mastered the correct observation content and methods of various meteorological instruments through hands-on operation. At the same time, combining the professional characteristics of forestry and horticulture, they watch science popularization videos from the meteorological bureau to understand the destructive effects of catastrophic rain and snow weather on roads and houses in Lu'an City, especially on farmland, gardens, nurseries, forests, *etc.* related to the profession, in order to deepen students' impression of catastrophic weather and improve their awareness of defending against catastrophic weather.

Practical teaching is an important component of teaching work in higher education, and a key link in cultivating students' innovative and comprehensive practical abilities[16]. Based on the characteristics of West Anhui University, this study explores and researches the practical teaching system of meteorology under the new situation, and establishes a complete meteorological experimental internship curriculum system. The applied meteorology major is a highly practical field, and the landscape architecture major at the School of Environment and Tourism, West Anhui University, has always attached great importance to the cultivation of practical abilities in meteorology course, especially focusing on the training of students' practical skills in applied meteorological experiments, agricultural meteorological disaster determination methods, and experimental design abilities. Meteorological experiments are a compulsory course in the field of landscape architecture, which plays a very important role in cultivating various abilities of landscape architecture students. With the continuous progress of society, in order to meet the needs of society and in accordance with the talent training objectives, it should construct a meteorological practical teaching system under the new situation based on the training philosophy of "broadening foundation, strengthening practice, emphasizing innovation, and broadening horizons". It mainly includes: ① increasing the teaching hours of practical courses in meteorology for landscape architecture major and strengthening the cultivation of students' hands-on abilities. In order to enhance students' practical abilities, courses and class hours related to practical content can be increased, mainly including comprehensive internships in agriculture, forestry, meteorology, Chinese weather forecasting, agricultural meteorology, radar meteorology, satellite meteorology, *etc.* It could increase the teaching hours of students' practical internship courses, and culti-

vate students' hands-on abilities, to adapt to the new requirements of meteorological development. ② Improving the teaching content of each course and hiring external experts and scholars to give lectures on campus. The internship content of basic meteorological element observation in the Comprehensive Observation of Agriculture, Forestry and Meteorology should be completed, and the course should be offered after the second year. After completing advanced mathematics and university physics, a relatively systematic arrangement should be made for the application of professional knowledge in practice, cultivating students' hands-on ability and enabling them to apply the knowledge in the textbook in practice. At the same time, it should actively invite experts and scholars to give lectures at the school, broadening students' horizons, understanding the forefront of subject development, and continuously improving students' various abilities. ③ Carrying out bureau-school cooperation and establishing off campus internship bases. In order to familiarize students with modern meteorological services and cultivate their meteorological skills, strengthening basic practice, enhancing students' basic quality and application of meteorological services, and training in business skills are important contents of the reform of the practical teaching system. It should establish bureau – school cooperation with the Anhui Provincial Meteorological Bureau and the Lu'an Meteorological Bureau, familiarize oneself with meteorological business at provincial and district level meteorological bureaus, and understand the actual needs of meteorological work at all levels, enabling oneself to continuously improve in the learning process. It should adjust knowledge structure, enhance practical skills, adapt to the practical teaching curriculum system, and introduce modern applied meteorological services and business into practical teaching. ④ Strengthening the construction of the teaching team and gradually improving the teaching and research level of teachers. It should attach great importance to the construction of the teaching staff. For the existing college teachers, they will study at the China Meteorological Administration, the Institute of Atmospheric Physics of the Chinese Academy of Sciences, and provincial and municipal meteorological bureaus by stages and in batches. At the same time, it should invite experts and scholars outside the school to give lectures at the school, understand the latest needs of business research, constantly improve the scientific research level of teachers, and broaden their horizons, to adapt to the development of meteorological undertakings. The college also actively introduces talents of all levels and types to teach at the school, strengthens the construction of the teaching staff, and continuously improves the teaching level and research ability.

2 Integrating multimedia technology to enhance the teaching quality of the Meteorology course

Meteorology is known for its broad and complex characteristics, with a wide range of research fields and a very long time span. Meteorology is not only abstract, but also has infinite characteristics and indirectness, which are quite complex[17]. Multimedia technology applied in meteorology can reproduce the changes in sound, light, shape, and color of various meteorological phenomena, and can reveal these changes through multimedia three-dimensional images. Through this visual and textual form, students can form a good knowledge exchange, which is conducive to their mastery of knowledge. This technology is applied in the field of meteorological teaching, simplifying and logicalizing some abstract knowledge content. It enable students to deepen their understanding of meteorological knowledge through this visual and textual format. Therefore, in the reform of meteorology teaching, the use of multimedia technology can achieve twice the result with half the effort, which is a new teaching method that must be introduced in the reform of meteorology teaching and is in line with the development of the times. This is also more in line with the comprehensive quality education promoted within China[18].

This study creates a good teaching environment for students through the use of multimedia technology, making classroom teaching more active and avoiding the dull and rigid explanation of written knowledge in the past teaching process. Through multimedia technology, many problem scenarios have been created for students. By delving into them, students can maintain a good learning state as the problems are raised, which promotes the improvement of teaching quality.

3 Utilizing the school – enterprise cooperation teaching practice platform to cultivate students' practical ability and innovative thinking

It should give full play to the role of the existing school – enterprise cooperation practice teaching base for the Meteorology course in the field of landscape architecture. Following the model of "introducing schools into schools, majors into enterprises, and two-way embedding", it becomes an integrated teaching factory with the functions of "teaching, learning, and research". Starting from the engineering – teaching integration and school – enterprise cooperation", based on the multiple benefits of schools, enterprises (institutions), and students, it should clarify the training objectives and construct a talent training model.

(1) Establishing a new type of dual mentor system both on campus and off campus. The training system for innovative talents adopts dual mentor training, namely one on campus mentor and one off campus mentor. Its purpose is to cultivate students' theoretical knowledge level and practical work ability, and to provide "composite" talents for off campus mentor units. At the same time, it is important to strengthen the understanding of students' practical and innovative abilities among on campus mentors, so that students can personally follow off campus mentors to experience actual agricultural and forestry production, and familiarize themselves with the application fields of meteorological theory knowledge in social agricultural and forestry production projects.

It should focus on screening candidates for off campus mentors, and sign student internship agreements with off campus mentors. Management and professional technical personnel could be hired to enter educational reform practice as innovative practice mentors, guiding students in landscape planning, and the design, innovation, and optimization of agricultural and forestry research project plans, forming a new model of cultivating students' applied innovative ability through multi-party integration. Senior engineers with rich practical experience in the field of meteorology could be introduced to participate in the construction of on campus and off campus experimental internship bases, and provide guidance for students' practical internships, in order to improve their practical and meteorological technology application abilities, enhance the ability structure of the teaching staff, and improve the pertinence and applicability of teaching.

(2) Utilizing the off campus internship training platform jointly built by cooperative units to carry out practical training of landscape + meteorological experiment courses. It should establish a high-level practical teaching platform that integrates "disciplinary construction, experimental teaching, scientific research, and social services". It should realize platform based sharing in experimental teaching and student innovative research activities, increase opportunities for students to exercise their innovative abilities, organize students to participate in meteorological services and research projects of enterprises, meteorological bureaus, or agricultural and forestry departments, and continuously broaden their horizons. And students can learn practical knowledge beyond textbooks, cultivate their application awareness and professional quality, stimulate their desire to actively improve themselves, and elevate their thinking in practice. A lot of work has been carried out in the early stage of this work. Although meteorological experimental courses have been studied at the Lu'an Meteorological Observatory, the frequency, duration, and depth of internships still need to be further strengthened. The practice and learning of horse riding and observing fancy skills are of no benefit to the application of knowledge. Only by mastering basic theoretical knowledge and participating in practical work in the internship base can one apply knowledge freely, and only by proficiently applying can technological innovation be achieved. It should strengthen the organization and team guidance of professional practice, allowing students to participate in actual enterprise planning or agricultural and forestry engineering projects through this method. Under the guidance of teachers and technical personnel, students can undertake the design, construction, management, and meteorological environment evaluation of actual engineering projects. This will expose students to the core technical integration points of meteorology and landscape architecture major in practical work, and enable them to master the application skills of meteorological theoretical knowledge in agricultural and forestry production through practical exercises. Through intensive training in basic laboratories and practical bases both inside and outside the school, students' abilities to apply meteorological theory knowledge, handle landscape + meteorological problems, apply meteorological data processing software, integrate landscape planning and design software with meteorological data are trained, the theoretical knowledge system of agricultural and forestry meteorology is strengthened, and various abilities and comprehensive qualities such as quantitative calculation and qualitative analysis, theoretical knowledge and practical ability, written explanation and drawing expression are improved.

4 Constructing cultivation methods of innovative talents of "landscape + meteorology" multi-disciplinary integration for local application-oriented undergraduate universities under the background of new agricultural science

A new teaching model for cultivating applied innovative talents is constructed, as shown in Fig. 1. In terms of teaching design, it is divided into three parts: research innovative practice, comprehensive applied practice, and basic cognitive practice, which are respectively used for teaching implementation and goal cultivation.

Research and analysis: through extensive research, the key limiting factors that affect the cultivation of applied innovative talents are analyzed, such as whether the traditional teaching mode emphasizes theory over practice, whether the teaching curriculum is seriously disconnected from the needs of enterprises, whether professional teachers generally lack engineering experience, and whether there is a lack of necessary engineering training platforms. By fully utilizing the collection of materials and computer retrieval systems in library of West Anhui University, relevant domestic and foreign materials are consulted, and the experience of relevant universities is learned. To highlight the scientific and objective nature of this project, relevant teaching departments, management departments, and teachers and students of the major are selected as research objects. Through questionnaires and symposiums, it investigates the main factors that affect teaching quality, the main problems that exist, and the key issues that urgently need to be solved. By comparing the experience and lessons of cultivating applied innovative talents in domestic and foreign universities, as well as relevant majors of similar domestic universities, problems are identified, and their causes are analyzed for improvement. In the context of vigorous promotion of farming and reading education in China, it should innovate the cultivation methods of agricultural and forestry talents and cultivate new talents who know and love agriculture. It mainly explores from the following three aspects: first, integrate Xi Jinping's socialist ideological education with Chinese characteristics in the new era into professional courses. In this regard, the National Teaching Materials Committee has formulated the *Guide for Xi Jinping's Thought on Socialism with Chinese Characteristics for a New Era into the Curriculum Teaching Materi-*

als, which systematically incorporates the latest achievements of the sinicization of Marxism into the curriculum teaching materials, and uses Xi Jinping's thought on socialism with Chinese characteristics for a new era to forge a road map for educating people. Combining the characteristics of the landscape architecture major of West Anhui University, relevant content is organically integrated, the concept of educating people and value orientation are strengthened, and the noble sentiment of landscape architecture students who are willing to bear hardships and love "agriculture, rural areas and farmers" is more specifically cultivated. The second is to strengthen school – enterprise cooperation and solve the problem of the disconnect between traditional theoretical and experimental courses and practical hands-on abilities. Through cooperation with the Lu'an Meteorological Bureau and the Lu'an National Climate Reference Station, more internship and practical opportunities will be created to integrate course teaching with hands-on practice, providing students with a broader teaching and research platform, enabling them to experience meteorological knowledge as early as possible and apply what they have learned. It should improve the integration of theoretical and practical learning in curriculum teaching. The third is to strengthen the application of digital information technology in meteorology courses. In today's rapidly developing information technology, the development of digital meteorology is a key factor in promoting the development of agriculture and forestry, and it is also the development trend of agriculture and forestry in China in the future. It can promote the digital development of agricultural meteorology by effectively combining agriculture and forestry with computers. At present, computers, drones, data acquisition devices, and digital micro meteorological stations have been widely used in agriculture and forestry, giving rise to "digital agriculture" and "digital forestry". Therefore, it should strengthen the application of information technology in the course of agroforestry meteorology. For example, combining agroforestry meteorology with remote sensing technology can effectively predict the occurrence of agroforestry meteorological disasters. Combining agroforestry meteorology with the Internet, a national agroforestry meteorological network could be established to exchange and summarize the national agroforestry meteorological information.

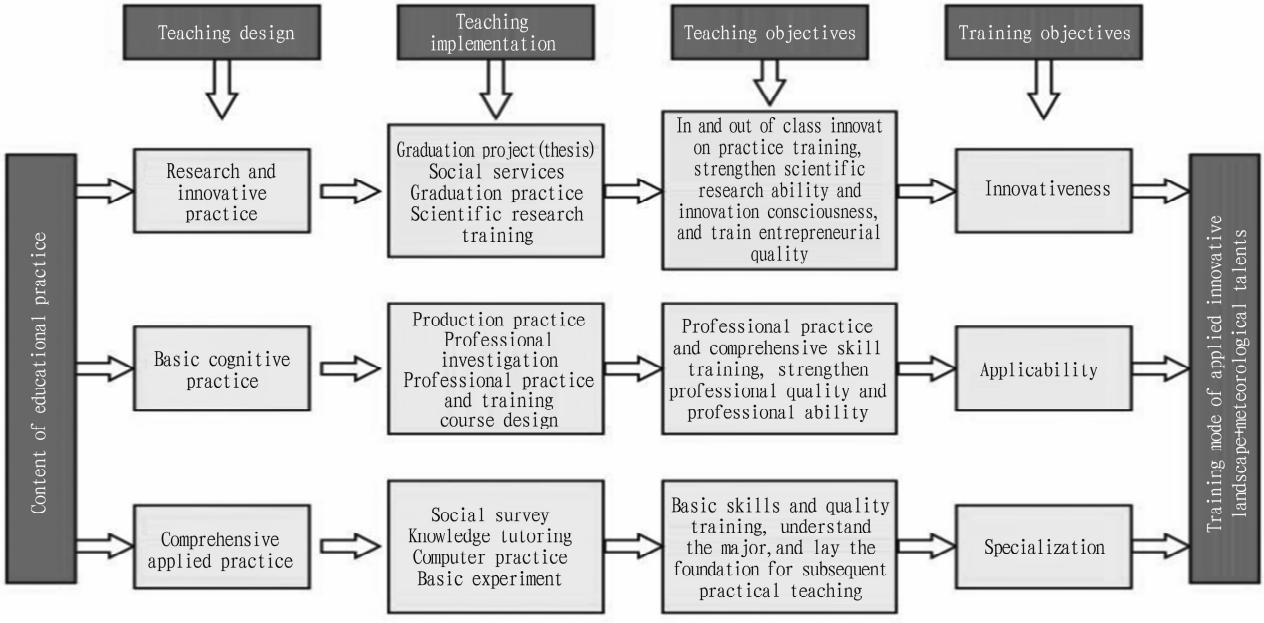

Fig. 1 Innovative talent education model of "landscape + meteorology" multidisciplinary integration in local applied undergraduate universities under the background of new agricultural science

Teaching design: in terms of teaching, it should improve the content of professional experimental courses by using practical cases, meteorological technology service projects, and landscape planning and design projects as task drivers. It should design experimental content that is close to the reality of agriculture and forestry and intersects knowledge, so that the experimental teaching content reflects the systematic and comprehensive nature of landscape + meteorological technology service projects. Adopting heuristic, exploratory, open-ended, discussion based, case-based and other teaching methods to enable students to better exert their subjective initiative in learning. By focusing on guiding students to engage in learning steps such as "thinking", "exploring", "discovering", and "recalling", and conducting teacher – student and group exchanges, teachers appear as supporters, participants, appreciators, and collaborators. Through inquiry based learning methods such as inspiration, guidance, and communication, it is beneficial for students to diverge their thinking and achieve self-directed and personalized learning. Emphasis is placed on cultivating students' independent and divergent thinking, and teaching them learning methods. Taking the cultivation of students' voca-

tional abilities, professional qualities, and sustainable development abilities as the basic point, guided by the training objectives, the training objectives revolve around the cultivation of students' applied innovative abilities, and the cultivation of students' ability to propose and solve practical problems; capable of effective communication and teamwork; having a solid foundation in the fields of landscaping and meteorology, as well as basic theories and specialized knowledge and skills in related professional fields; ability to track and develop new theories, knowledge, and technologies in relevant professional fields; capable of engaging in scientific research, technological development, education, and management in related professional fields.

Teaching implementation: with the cultivation of applied innovative abilities of "landscape + meteorology" as the main line, the principle of "optimizing basic theories, emphasizing applied thinking, strengthening practical abilities, and cultivating innovative spirit" is proposed for the construction of the curriculum system. A distinctive curriculum system is constructed according to the three parts of basic knowledge, technical knowledge, and ability modules of landscape + meteorology. For professional basic courses, it should take optimization and consolidation as the guide, integrate and improve the content connection and knowledge point replacement between courses, and achieve overall optimization. For professional courses, emphasis is placed on cultivating students' applied innovative thinking ability, introducing abstract mathematical formula descriptions from practical application cases in agriculture and forestry, and emphasizing parameter selection that is in line with the actual needs of agriculture and forestry production. For professional course design and comprehensive practical courses, it is required to emphasize practical drawing and calculation applications on the basis of explaining the principles of meteorological observation instruments. At the same time, combining the advantages and characteristics of scientific research, cutting-edge technologies in the application of meteorology in agriculture and forestry, such as light and agricultural and forestry production, the impact of wind on agriculture and forestry, the impact of water on agriculture and forestry, the relationship between temperature and agriculture and forestry, and comprehensive observation experiments of agriculture and forestry meteorology, will be introduced into classroom teaching content to strengthen the cultivation of students' professional comprehensive quality and cultivate their innovative spirit. In order to highlight the practical aspects and also increase the requirements for in class experiments, designed, promoted, and comprehensive experiments should be offered as much as possible, fully tapping into students' initiative and proactivity in learning.

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