Cultivation of Green Designers in China's Universities

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China has pledged to achieve a CO_2 emissions peak before 2030 and carbon neutrality before 2060. Based on this, an investigation is conducted on the current situation of green designer cultivation in China's universities, and problems in this regard are examined. Firstly, the objectives are proposed to cultivate the concept, theory and practices of green design among China's college students. Secondly, the framework system of green design cultivation in China's universities is constructed. The framework covers green designer cultivation objectives, modular green curriculum, comprehensive reform of green classroom teaching content and teaching methods, and quality supervision and assurance system of green designer cultivation.

Keywords: green design concept, green design theory and methodology, green design skills, modularity, supervision and assurance

INTRODUCTION

In the report delivered at the 19th National Congress of the Communist Party of China, General Secretary Xi Jinping stated that China must pursue innovative, coordinated, green, and open development for everyone. He proposed to ensure harmony between humans and nature and requested implementing China's fundamental national policy of conserving resources and protecting the environment. Also, he stressed that China should work on promoting green development and continuing the Beautiful China initiative.

At the 75th session of the United Nations General Assembly on September 22, 2020, China pledged to achieve a CO_2 emissions peak before 2030 and carbon neutrality before 2060. Subsequently, a series of carbon peak and neutrality policies were introduced. In 2021, China included carbon neutrality in the report of government work for the first time, so 2021 is China's first year of carbon neutrality. Green design has drawn much attention and research from scholars as one of the essential solutions to the source of environmental pollution, which is closely related to people's production and life.

In the long history of human design, designers have contributed to the convenient and comfortable modern life while accelerating the consumption of resources and energy and causing damage to the environment and ecology. In order to fundamentally solve the problem of environmental pollution, a wave of green consumption has been initiated globally. In the green wave, designers are prompted to think deeply about their future design, professional ethics, and social responsibility. The green design was thus developed and became an international trend in the late 1980s.

The green design concept was coined by Victor Papanek, an American design theorist, in the 1960s. He believed that the design should focus on the connection and communication between people, society and nature, prioritizing using the earth's finite resources and serving to protect them. The concept of green design was first interpreted in the environmental pollution regulations of the United States in the 1960s and 1970s. Since then, scholars worldwide have given various interpretations of green design, but no uniform and authoritative interpretation has been established.

Green design is mainly explained from the following perspectives. First, it considers the natural environment's sustainability and resources as the primary consideration. This consideration is aimed at designing disassemblable, decomposable and reusable products. Second, from the perspective of manufacturing products for recycling, it explains the product design that uses raw materials rationally, reduces components, and handles them safely. Third, the design of renewable or reusable products from the production, use and recycling process meets environmental protection requirements with no or little harm to the ecological environment. Fourth, it is the product design that the parts can be refurbished, reused or safely disposed of after the product's service life expires.

Thus, it can be seen that green design takes the natural ecological environment as the core objective, considering the environmental attributes of the product design (such as recyclable and reusable) while meeting the basic usage needs of the product (such as function, service life and experience). It covers the systematic design process of product conception, manufacturing, use, recycling, reuse and other aspects of the product life cycle.

According to Boston Consulting Group, 17 million of about 96 million designers worldwide are working in China, accounting for 17.7% and ranking first globally. From "made in China" to "created in China," designers have made numerous innovations and creations and contributed significantly to social development. Future designers' training affects whether China can achieve the goal of carbon peak and neutrality and build a beautiful China. It is a systematic project to cultivate designers' concepts, knowledge and capabilities of green design. Scholars have been actively investigating how to cultivate future designers with green design thinking and abilities.

Green education for college students has become a hot issue, such as environmental education theory, ecological civilization theory, and green development theory. The U.S. Green Building Council (USGBC) established the Center for Green Schools in 2010, proposing green schools for everyone and actively involving students, parents, teachers, and the government in building green schools (Gan, 2012). The Institute for Sustainable Futures (ISF) at the University of Technology of Sydney (UTS), Australia, believes universities should adapt curricula to prepare students to value economic, social and environmental sustainability. Moreover, they should take up ecological and social responsibility and conduct public discussions and academic activities to develop the best model of sustainable development (Li, 2012). In the UK, universities have shared responsibility for environmental education through legal and financial support (Wei, Hu & Wang, 2010). The development education program was incorporated into the national curriculum, and teachers were required to integrate environmental education and education for sustainable development based on the living scenario (Li, 2005). In the 1950s, Ernesto Rogers, a famous Italian designer and critic, noted that based on theories of art and humanities, we should break down professional barriers and emphasize whole-person education. Also, we should adopt diverse teaching models and curriculum systems to cultivate students' creativity, imagination and sustainability. The Danish Economic Council encourages universities to collaborate with enterprises in developing vocational and technical standards for sustainable development and actively promote green technology development.

In 1988, academician Wang Dazhong proposed to promote green education and included the Environmental Protection and Sustainable Development program in the introductory public courses for undergraduates at Tsinghua University. In October 2011, the Academy of Fine Arts of Tsinghua University successfully held The Tao of Sustainability: An International Conference on Sustainable Design Strategies in a Globalization Context. Meanwhile, he presented the idea of building a green university. In October 2011, the Academy of Arts & Design, Tsinghua University, held The Tao of Sustainability: An International Conference on Sustainable Design Strategies in a Globalization Context. Professors from internationally renowned universities in Italy, Finland and Japan have conducted in-depth discussions and exchanges on

sustainable development in arts and design (Huang, 2011). Fan (2014) proposed green school culture and the contents and modes of green design teaching around cultivating future designers' green concepts. Yu and Chen (2017) stated that green education in universities should be carried out in six aspects.

Universities should establish green disciplines, train faculty teams, and develop green courses. Teachers should learn green knowledge, conduct green practice investigations and research projects, and create an atmosphere of green design. Liu (2017) proposed that applied universities may offer green courses, provide students with environmental practices and construct green campuses. Also, they may develop green programs and research services and cultivate green behavioral traits among students. Fu and Zhang (2018) proposed that as work has been accelerated to construct a beautiful China, environmental art programs should integrate green education into their curriculum. In addition, reforms should be made to the professional teaching system, cultural heritage, outcome-based education (OBE) and faculty. At the start of the circular economy and green industry chain, the production line urgently demands application-oriented talents from applied universities to meet the needs.

Based on the example of the Nantong Institute of Technology, Wang (2018) analyzed the factors affecting and restricting green education and proposed methods and strategies for green education. He (2021) proposed strengthening the top-level design of green education in universities and constructing a multi-party coordination mechanism and evaluation mechanism. Given this, he suggested introducing a three-in-one model of green curriculum, green practice and green academic activity systems. Ren (2020) suggested integrating green education with the ideological education of universities, improving the working mechanism and clarifying the value orientation. Based on this, universities should cultivate many high-quality applied talents with green innovation by rooting the concept of ecological priority and green development in students' minds. Moreover, they should have advanced and practical professional skills and strong environmental awareness and ecological maintenance (restoration) capabilities.

In summary, scholars in China and abroad have studied and discussed green education from various perspectives. Their research covers cultivating green concepts, building green campuses, constructing green curricula, designing green disciplines, and developing green faculty. At the same time, they also investigate the coordination of multiple parties in promoting green education, evaluation mechanisms and national green regulations. From the existing research results in China and abroad, there are few research results on green education and the cultivation of art and designers in universities. Most existing research is conceptual and oriented research on training green designers without more in-depth, systematic and operable research results. There is still much room for research on the cultivation of green designers. Based on this, this paper proposes cultivating green designers in China's universities.

SURVEY ON THE CURRENT SITUATION OF CULTIVATING GREEN DESIGNERS IN CHINA'S UNIVERSITIES

According to the components of green design talent training objectives, the questionnaire was designed based on the content design of the existing research scales and the research theme of green design talent training.

Questionnaire Design and Market Survey

The questionnaire was initially designed based on the review, analysis and summary of the existing research results on the cultivation of green designers. The questionnaire consisted of four parts: basic personal information, green design concept, green design theory and green design practice skills. Afterward, we selected different samples by gender, age, occupation and major and conducted a pre-survey. Thirty questionnaires were distributed, and 30 questionnaires were collected. We initially analyzed the survey data and summarized the problems found during the pre-survey and the feedback from the respondents. Also, we partially modified and improved the questionnaire design and expressions. Finally, we developed a formal questionnaire on the current state of cultivation of green designers.

We chose an online questionnaire and investigated some respondents on a peer-to-peer basis. A total of 200 questionnaires were distributed, with 186 questionnaires recovered and 180 valid questionnaires. The recovered questionnaires were sorted, summarized and preliminarily screened for data analysis.

Data Analysis

Descriptive Analysis

Based on the questionnaires collected, descriptive statistics were conducted on the respondents' basic information, as shown in Table 1.

TABLE 1
BASIC SAMPLE INFORMATION

DEMOGRAPHIC VARIABLE	VARIABLE VALUE	NUMBER OF RESPONDENTS	PERCENTAGE %
GENDER	Male	68	37.78
	Female	112	62.22
AGE	≥18 but <25	44	24.44
	≥22 but <25	45	25.00
	≥25 but <30	58	32.22
	Other	33	18.33
OCCUPATION	College student	78	43.33
	Graduate student	63	35.00
	Designer	16	8.89
	Design enthusiast	8	4.44
	Other	15	8.33
MAJOR	Art and Design	154	85.56
	Other	26	14.44

The questionnaire survey met the respondents' requirements. As shown in Table 1, 37.78% of the sample were male, and 62.22% were female. Regarding gender, the proportion of females in the design industry is higher than that of males, which is consistent with the ratio of male to female students of art majors in universities. In terms of age, 81.67% of the respondents were between 18 and 30 years old, meaning that most were either in school or graduated within five years. Regarding occupational distribution, 87.23% of the respondents were university students, postgraduates and designers, and 12.77% were in other occupations. While regarding the majors, 85.56% of the students studied art and design, and 14.44% studied other majors. In summary, the sample selected in this survey can represent the actual situation of the target group well.

Analysis of Expected Value

The data obtained from the questionnaire were categorized and summarized. In addition, according to Likert's method, the five options for questions on green design concepts, theories, and practice were assigned. The five options were assigned a score of 1, 2, 3, 4, and 5, as shown in Table 1.

TABLE 2
ANALYSIS OF EXPECTED VALUES OF THREE ITEMS

Item	The proportion of options assignment (%) 1	2	3	4	5	Expectation value (points)
Green design concept	20.98	21.89	25.88	27.36	3.98	2.72
Green design theory	18.41	49.25	21.89	7.96	2.49	2.27
Green design practice	44.78	29.85	18.40	4.48	12.44	1.90

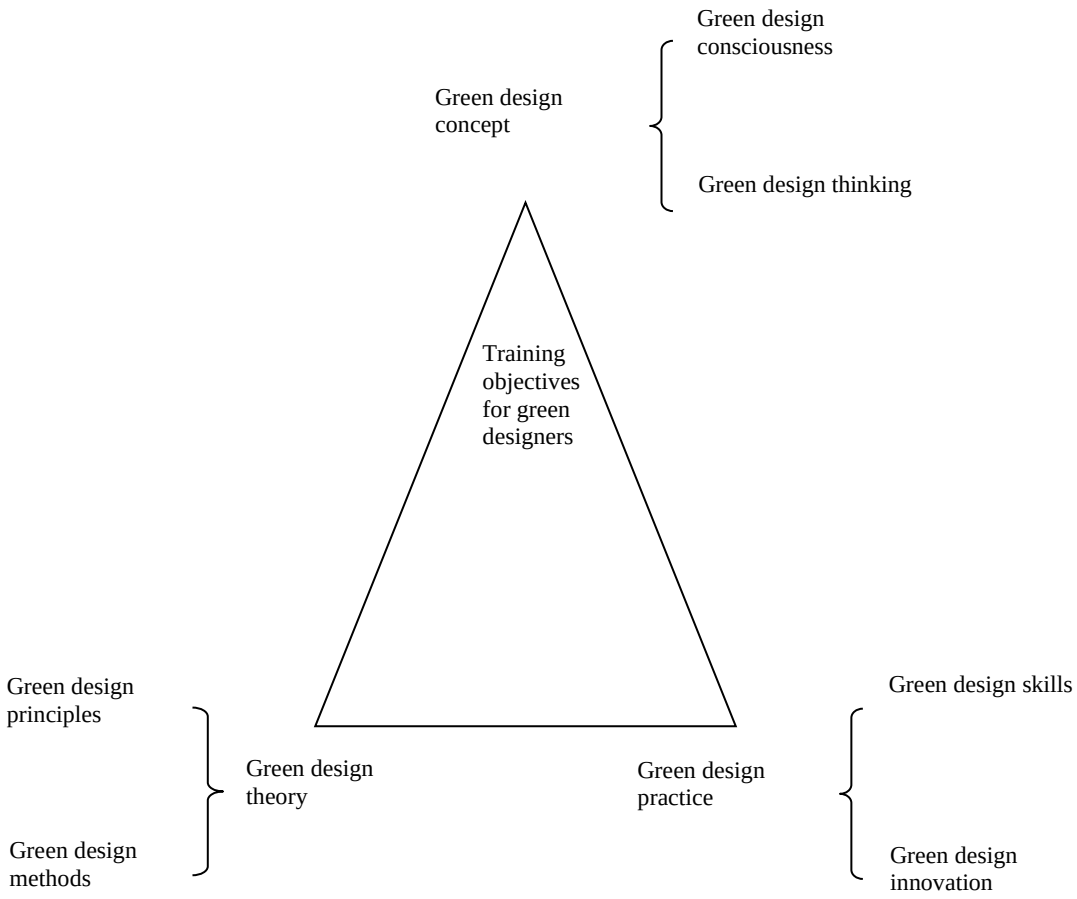
Among the three research items, the expected values of the green design concept, theories and practices were 2.72, 2.27 and 19.4. As shown in Table 2, the statistics of the green design concept showed that the percentages of respondents who chose the scores of 1-3 were 20.98%, 21.89%, 25.88%, or 68.75% in total. The statistics of green design theory showed that the percentages of respondents who chose the scores of 1-3 were 18.41%, 49.25%, 21.89%, or 89.55% in total. The statistics of green design practice showed that the percentages of respondents who chose 1-3 points were 44.78%, 29.85%, and 18.40%, respectively or 93.03% in total. It indicates that most respondents have not been systematically trained in green design. It means that respondents are less trained in green design practice skills. Thus, most of the respondents have not developed green design concepts subconsciously, and they have little knowledge of green design theory and design methods. They have not been systematically trained in green design practice skills.

Based on this, China's universities need to train students in art and design in the concept, theories, methods and practices of green design in the context of China's commitment to carbon compliance and carbon neutrality. Therefore, it is of great theoretical value and practical significance to investigate the cultivation of green designers in China's universities.

OBJECTIVES OF GREEN DESIGNER TRAINING IN CHINA'S UNIVERSITIES

Green development is demanded by the times, and green education is the fundamental guarantee to promote green growth. Most graduates in art and design programs in China's universities choose to work immediately. They will become the core of the design sector in the future, making it critical for them to develop the concept, thinking and skills of green design. Therefore, students majoring in art and design should be trained in environmental awareness during their student years so that green design thinking can be embedded in their minds implicitly. Also, universities should teach students about green design theories and methods so that they can apply and innovate green design in their future work with practical design problems. Based on this, we propose the training objectives of art and design majors, as shown in Figure 1.

FIGURE 1
TRAINING OBJECTIVES OF GREEN DESIGNERS IN ART AND DESIGN



Cultivation of Green Design Concept

In 1992, the United Nations Conference on Environment and Development formally proposed to expand environmental education into education for sustainable development within the framework of green education. The famous educator and academician Shuzi Yang noted that the ultimate goal of green education is to cultivate persons who can correctly deal with the relationship between human beings and nature and develop with the concept and will of sustainable development. Environmental education and education for sustainable development should be incorporated into college students' ideological, moral and professional education. Based on this, students can serve ecological civilization, environmental friendliness and social harmony.

Art and design majors are trained in green design to penetrate the concept of environmental protection and sustainable development into students' learning and life in all aspects. In this way, the green concept can be implanted in the minds of art and design students, enabling them to be aware of and think about green design. Thus, it can guide their future design practice activities.

Cultivation of Green Design Theories

Green designers are trained to focus on students' green design concept and their knowledge and mastery of green design theories. By designing a green curriculum, universities should optimize its structure and design content, reconstruct the knowledge system of green design theories, and elaborately design contemporary and interdisciplinary green courses. At the same time, they should strengthen the development of green teachers and the evaluation and assessment mechanisms of the green curriculum.

Thus, it can ensure that art and design students systematically learn and master the principles and methods of green design, providing professional technical support for their future green design practices.

Cultivation of Green Design Skills

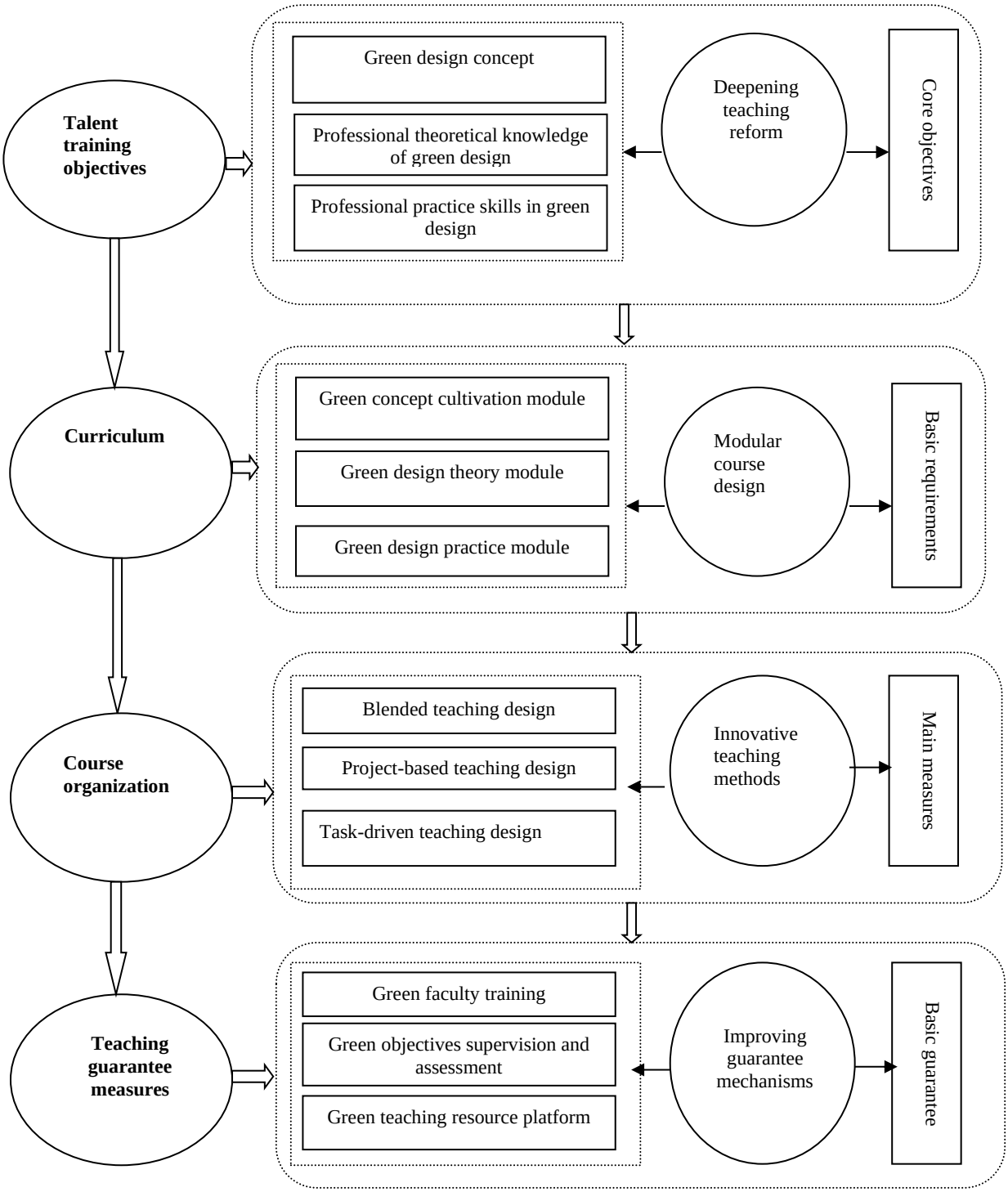
Through systematic training and cultivation of green design practice skills, art and design students should acquire green design practice skills and innovation capabilities of green design. Art and design professionals should learn green design theories and combine green theoretical knowledge with design practices to improve their green practice skills and green innovation capabilities. Universities should systematically design internship training courses for art majors to enhance their green design practice skills. Moreover, green design internships and training courses should be offered independently, and the content of professional training courses should be adjusted to integrate green design concepts into course practice. Secondly, universities should cooperate with enterprises to guide teachers and students in green design projects and training activities and share green designers with enterprises. In this case, the instructors of enterprises should be involved in designing green design training courses and guiding students in green design competitions.

THE CONSTRUCTION OF GREEN DESIGNER CULTIVATION SYSTEM IN CHINA'S UNIVERSITIES

The cultivation of green designers is a complex and systematic project involving numerous work contents and subjects. Therefore, it should be planned scientifically, collaborated by many parties and promoted comprehensively. It covers the training objectives of green designers, the design of green curriculum, the training of green teachers, and the supervision and guarantee mechanism of the training process of green designers. This paper proposes a system for cultivating green designers in universities based on previous research results and the realistic demands for green designers' quality, knowledge and competence structures. The system is shown in Figure 2.

As seen in Figure 2, we focus on the requirements of quality, knowledge and competence for the cultivation of green designers and four perspectives of talent training objectives, professional curriculum, classroom teaching organization and teaching guarantee measures for art and design students. Based on this, we should establish green design objectives, design green curriculum modules, create innovative teaching formats for green classes and improve green teaching guarantee mechanisms. Moreover, we should establish a special training mode for green designers by integrating science and education, production and education. Based on this, we expect to cultivate green designers with the green design concept, mastering green design theories. Furthermore, they should be able to apply green design principles and methods to solve practical problems.

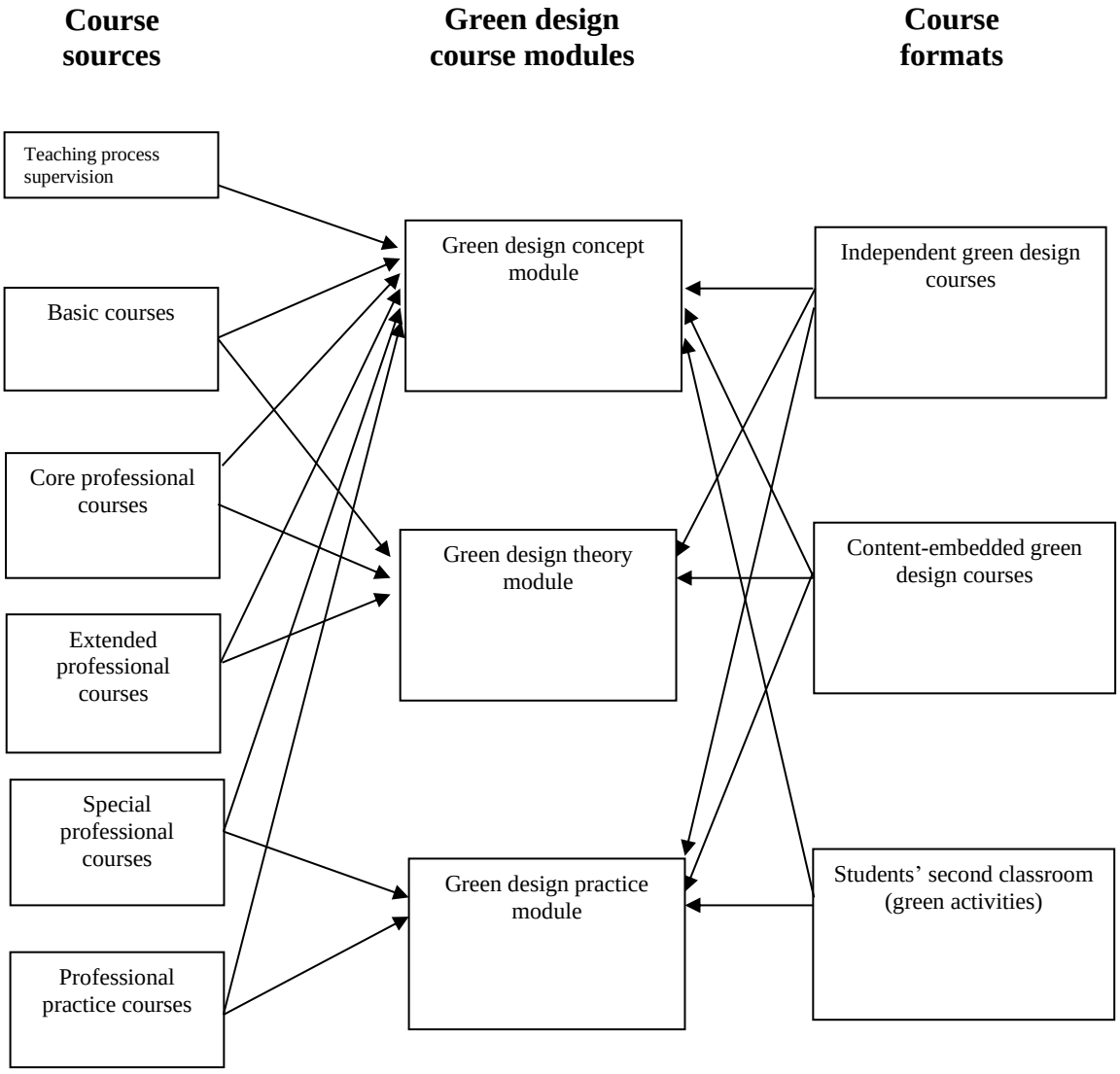
FIGURE 2
CULTIVATION SYSTEM OF GREEN DESIGNERS IN UNIVERSITIES



BUILDING MODULAR GREEN CURRICULUM BY FOLLOWING THE TRAINING OBJECTIVES OF GREEN DESIGNERS

In the new era and new situation, universities should establish the training orientations and guiding ideology of art and design majors and establish the required green contents and technologies for art and design majors according to the standard requirements of China's carbon peak and carbon neutral objectives and the changes of market demand for art and design majors. Moreover, a modular green curriculum should be built according to green design's core content and technology requirements, as shown in Figure 3.

FIGURE 3
MODULAR GREEN CURRICULUM SYSTEM FOR ART AND DESIGN MAJORS



As shown in Figure 3, the green design course modules are divided into the green design concept module, green design theory module and green practice module. The three modules originated from different combinations of general education courses, fundamental courses, professional core courses, comprehensive professional courses, special professional courses and professional practice courses. The green design concept module is offered as an independent green design course. The green design theory

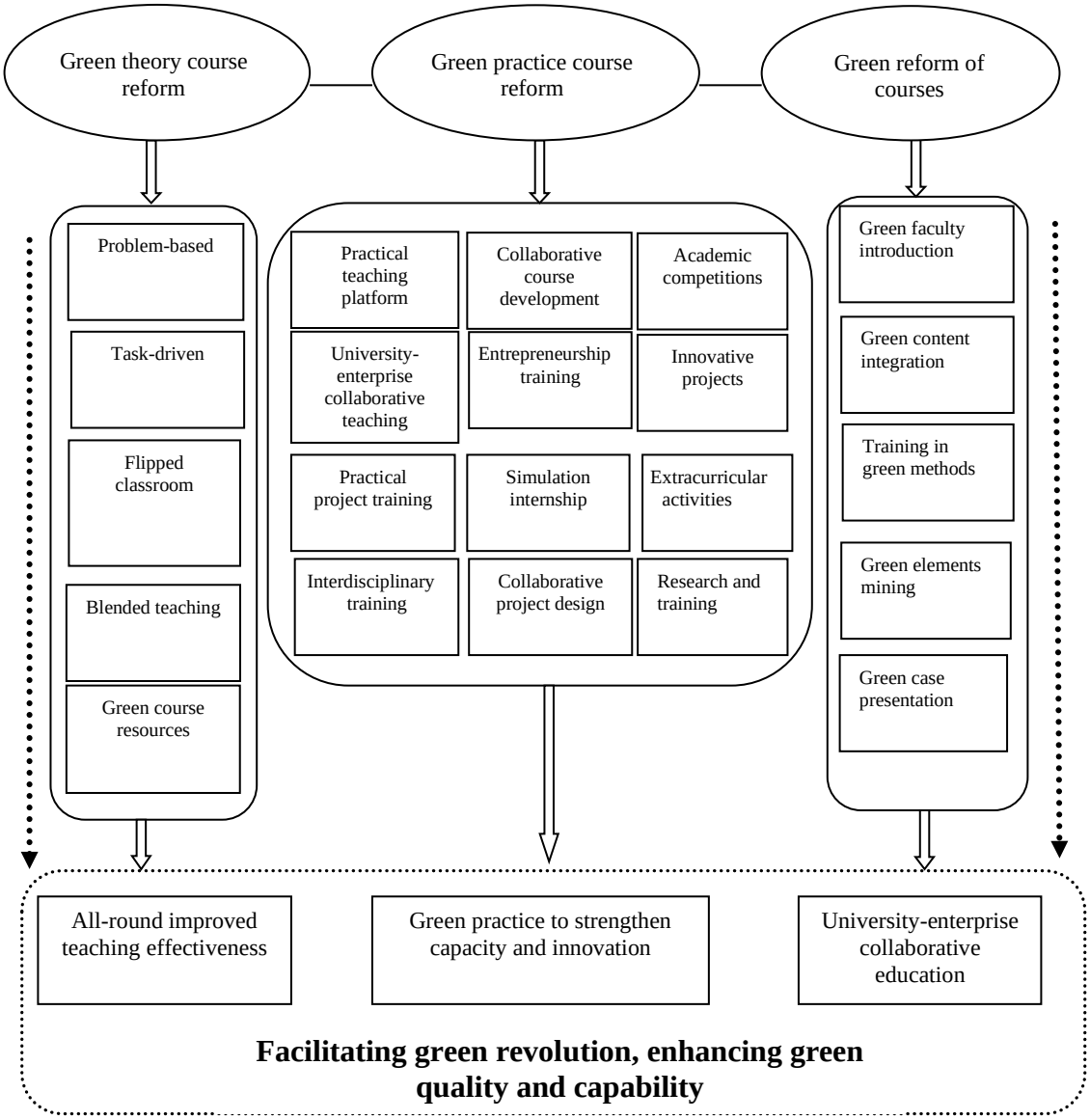
module is provided in content-embedded green design courses. Moreover, the green practice module is offered in green design activities or second-class formats like green design projects. Based on this, universities should build a unique and three-dimensional modular green curriculum system. At the same time, they should further perfect quality courses and textbooks for green design, increase the proportion of green design practice hours, and continuously improve the art and design students' green design theories and professional practice skills.

MULTIPLE MEASURES TO PROMOTE CURRICULUM TEACHING REFORM AND EFFECTIVELY IMPROVE THE TEACHING EFFECTS OF GREEN DESIGN COURSES

Guided by the cultivation objectives of green designers, universities should explore the reform of green classroom teaching and methods, actively develop university-enterprise collaborative practice bases, and innovate green practice teaching forms. Moreover, they should launch various extracurricular activities for students with green themes to enrich the green connotation of art and design courses and dig deeper into the green elements of the courses. Based on this, they should establish a team of green design teachers jointly with enterprises and create a new pattern of educating students in the entire curriculum and the whole staff, as shown in Figure 4.

As shown in Figure 4, the green curriculum teaching reform is mainly conducted through the teaching reform of green theory courses, green practice courses and the greening reform of general classes. The teaching reform of green theory courses emphasizes the development of resources and digital transformation of green courses. Moreover, it encourages combining multiple teaching methods, such as problem-oriented, task-driven, intelligent classrooms, flipped classrooms, blended teaching and other methods, changing the traditional single-teaching approaches. The teaching reform of green practice courses emphasizes virtual simulation training and practical project training. Universities should collaborate with enterprises to develop teaching materials for green design training. Corporate instructors should engage in green design training courses, assist professional teachers in tutoring and training green entrepreneurship projects, and jointly guide green design discipline competitions, green innovation projects and scientific research and training activities. Universities should implement green reform of professional design courses by various methods. They may introduce green teachers, integrate green course contents, train in green design methods, explore green elements of courses and introduce green cases. Guided by these paths, universities should build a system for reforming green curriculum teaching. They should enhance students' green practical and innovation capabilities by collaborative education with enterprises, enabling all-around improvement of teaching effects. In this regard, it can promote the green revolution and enhance the art and design students' green quality and capabilities.

FIGURE 4
COMPREHENSIVE REFORM OF TEACHING CONTENT AND METHODS OF THE GREEN CLASSROOM



Implementing a Teaching Quality Monitoring and Assurance System with Multiple Subjects' Participation

Universities should develop quality standards for green design majors considering green designers' cultivation goals. It should cover the quality standards of course contents, teaching links, green curriculum construction standards, and evaluation standards of green design skills. According to the green design quality standards, universities should organize the inspection and evaluation of all teaching aspects, construct a closed-loop teaching quality supervision and assurance system that involves the whole staff, and covers the entire process. Also, they should collect and summarize all kinds of information from supervision, inspection and teaching operation, analyze the effectiveness of green designers' training, give feedback on the problems, and continuously improve and refine the quality supervision and assurance system of green talent training. The system is shown in Figure 5.

FIGURE 5
QUALITY SUPERVISION AND ASSURANCE SYSTEM OF GREEN DESIGNER TRAINING

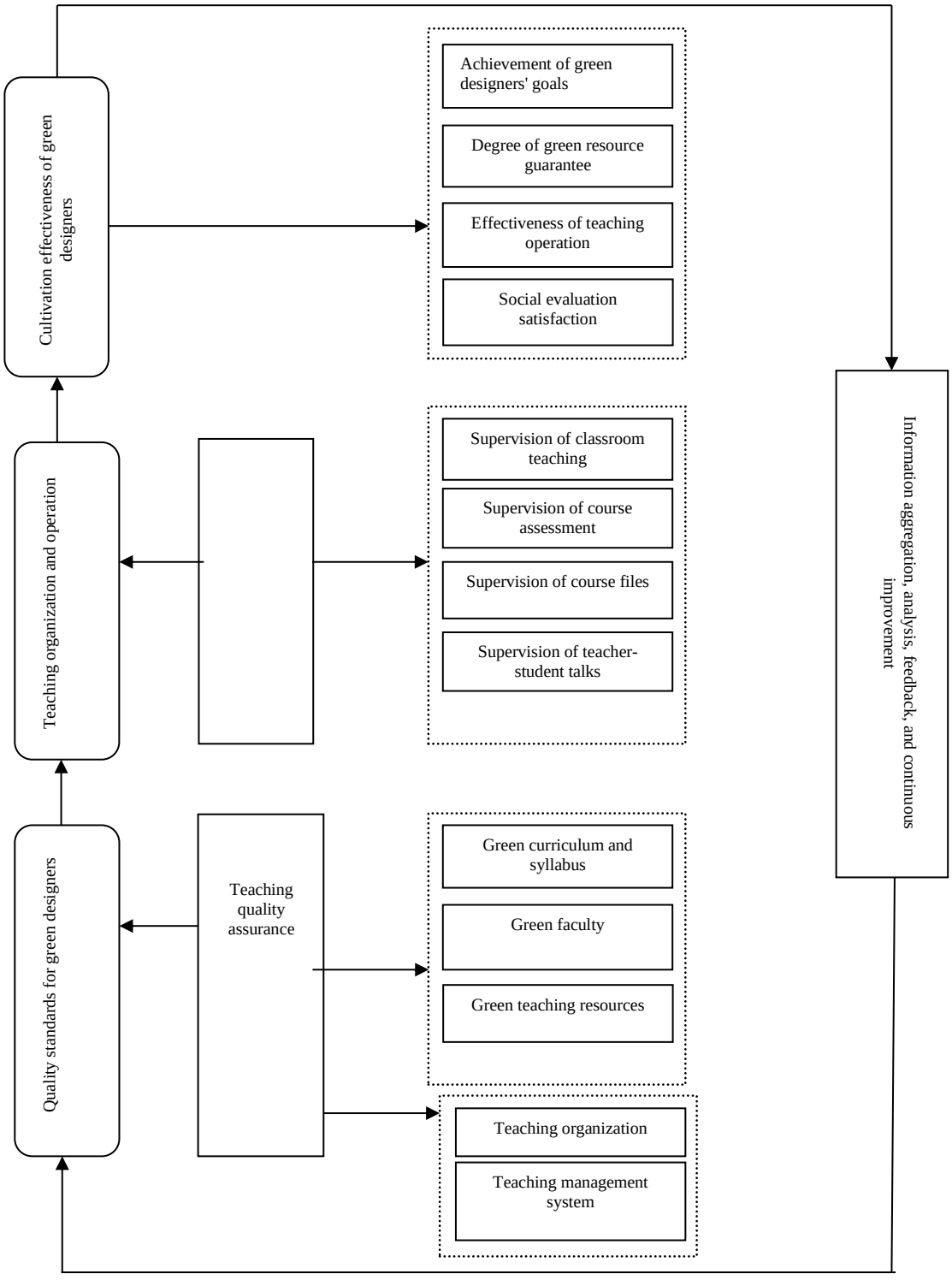


Figure 5 shows that the closed-loop system of quality supervision and assurance of green designers' cultivation is developed. It comprises green designers' quality standards, teaching organization and management, cultivation effectiveness and information summary, analysis, feedback and continuous

improvement. Green curriculum and syllabus, green teachers, and green teaching resources are the fundamentals of green designers' quality standards. The teaching organization and teaching management system secure the completion of the quality standards. The multi-link teaching supervision, such as classroom teaching, course assessment, course files and teacher-student talks, can guarantee the regular operation of a teaching organization. Universities should measure the effectiveness of green designer cultivation by the achievement of green designers' goals, the guarantee of green resources, the effectiveness of teaching operations and the satisfaction of social evaluation.

CONCLUSION AND PROSPECT

China pledged to achieve a CO_2 emissions peak before 2030 and carbon neutrality before 2060. In this context, green design has become a hot topic of concern, and the motive force of green design is green designers. This paper adopted a questionnaire survey on the green design concept, theories and practices of art and design students in China's universities. Moreover, we explored how to cultivate art and design majors' green concepts and capabilities in China's universities. The following conclusions were drawn:

First, China's universities' art and design programs do not have systematic training for students in green design, their training objectives are ambiguous, and the green curriculum system is not perfect. At present, they cannot meet the national demand for green designers.

Second, we proposed three objectives for training green designers in China's universities. They are the training objectives for the concept, theories and practice of green design.

Third, a system for training green designers in China's universities was constructed. The system covers the training objectives of green designers, the modular green curriculum system, the comprehensive reform of green classroom teaching content and teaching methods, and the quality supervision and assurance system of green designers' training.

This paper emphasizes the framework system of green designers' cultivation and systematically considers and examines the holistic and comprehensive aspects of green designers' cultivation. However, there are many deficiencies, such as the small sample size and single access to data. Future research can investigate green designers' cultivation mechanisms, such as reward and punishment and evaluation mechanisms. Moreover, we can also further examine the research methods of green designers' cultivation.

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