

# Creativity Promotion Strategies, Interdisciplinary and Teamwork Competencies Among Design Students in China

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**Abstract** – The purpose of this study is to evaluate the creativity promotion strategies, interdisciplinary and teamwork competences of design majors in five universities in the eastern coastal areas of China, explore the correlation between interdisciplinary and teamwork competence and creativity promotion strategy selection, and then propose corresponding creativity promotion strategies. It provides a theoretical basis for design professionals to cultivate their competences with creativity as the core.

The study made full use of the online survey tool "Wen Juan Xing" to survey 530 respondents from five universities in China's eastern coastal areas, and finally obtained 480 valid questionnaires. SPSS 26.0 was used for descriptive statistics, variance analysis and correlation analysis. The findings indicate that design students in Chinese higher education institutions generally hold a positive attitude toward the value of interdisciplinary competences, teamwork competences and creativity in design practice, and realize that the cultivation of interdisciplinary and teamwork competences is of great significance to enhance creativity.

According to the three variables of creativity promotion strategies, interdisciplinary and teamwork competences, there exist notable variances in the feedback provided by students across varying year levels and design majors. In terms of year level, the evaluation of senior students is better than that of other grade students. In terms of majors, students majoring in environmental design and architectural design were evaluated significantly better than other majors. However, in terms of sex, only the goal-setting and role-positioning dimensions of teamwork competence showed differences.

This study deeply analyzed the correlation between these three variables, and proposed a scheme to enhance the interdisciplinary and team collaboration competence, so as to enhance the creativity level of design students and optimize the creativity strategy selection. It is anticipated that this study can offer valuable insights for the reform of design professional education in China..

**Keywords** – Creativity Promotion Strategies, Interdisciplinary Competences, Teamwork competences, Chinese Design Students

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## INTRODUCTION

With the advancement and progress of science and technology, the change of new energy, materials and processes, and the closer integration of information technology with the physical world, the global industry is in the midst of a major change. Design students in the era of Industry 4.0 need to possess various competences centered on creativity to cope with the rapid changes of the times [1]. In the era of innovation-driven leading new economy, the increasingly complex design practice makes designers' roles, behaviors, and purposes gradually change: progressing from a single, pure operation and execution level to a complex, integrated decision-making level in the future; possessing a more open, holistic, and diversified design consciousness, design concepts, thinking modes, and technological capabilities; thinking about the position of design in the whole industrial chain or sustainable development of a project, as well as how to manage and strategize it [2]. Therefore, by fostering interdisciplinary abilities and strengthening teamwork, the creative potential of research design students can be greatly stimulated, thereby promoting their all-round development. This initiative is not only crucial to enhancing students' creativity, but also helps them to better cope with complex challenges and problems in their future careers, demonstrating exceptional innovation and comprehensive literacy.

The changes associated with Industry 4.0 do not only involve engineers and technicians, it will expose all areas of society to unprecedented challenges that cannot be met by simply adapting what already exists, innovative

solutions will need to emerge in response [3]. She believes that in the era of Industry 4.0, people need not only excellent technical abilities but also competencies with creativity as the core to cope with the changes of The Times. In May 2015, The State Council issued "Made in China 2025" to elaborate on enhancing the nation's high-end manufacturing innovation capability through the "four measures" of "innovative design capability." In the face of the lack of innovation ability and talent training of students majoring in design, It is imperative to enhance innovation and creativity abilities driven by sound theories. It is easy to see that, as the first variable in this study, creativity enhancement strategy is a key competency for design students to improve their core competitiveness, as well as an urgent need to improve China's high-end manufacturing industry.

Since the higher education reform in 1952, China has been adhering to education based on professionalism, and has gradually been confined to the walls of "disciplines", and there are strict boundaries between disciplines. Students trained in the subject-oriented teaching mode lack "T-shaped" knowledge (T-shaped knowledge refers to the capability to acquire knowledge across different disciplines both in depth and breadth, emphasizing the integration of specialized skills), and it is difficult to integrate the knowledge at both ends of the "T" shape [4]. The document "Made in China 2025" shows the updating of the professional setting of design education in China and the thinning trend of the professional direction: From "environmental design", "visual communication design" and "product design", which were originally classified as goals, professional directions or professional clusters oriented by problems, events or even ideas have gradually emerged, and have obvious interdisciplinary characteristics [2].

Interdisciplinary and multidisciplinary forms of design education offer promising learning opportunities for students to seek and integrate multidisciplinary knowledge in environments with varying levels of complexity [5]. Few universities in China have made perceptive adjustments to their major offerings, but most have yet to take action. Therefore, in order to be able to adapt to the future needs of the changing society, educators need to constantly innovate the mode of art and design education and teaching, during which it is necessary to integrate the multi-faceted knowledge framework, and then establish a composite teaching system [6].

In today's new normal of variability, uncertainty, complexity and ambiguity, the needs of the design industry are increasingly diverse and complex. The

development of China's manufacturing industry cannot be separated from breakthroughs and innovations. According to Yan [7], the majority of innovations are not achieved by individuals working alone, but by a team comprising multiple members. The completion of design projects increasingly relies on teamwork to cope with complex and flexible work tasks and fast-changing external environments, while relying on the collective wisdom of teams to seek innovation [8]. Teamwork ability can significantly improve the creativity of design students. In the digital era characterized by variability and uncertainty, design thinking serves as a crucial tool for teams and organizations to navigate uncertainty and address competitive challenges. Understanding the mechanism of innovation from a team-level and learning perspective holds significant theoretical and practical implications, as highlighted by Fan et al. [9]. It can be seen that teamwork is one of the essential professional abilities for design students. Teamwork can not only help interdisciplinary teams to better collaborate on outputs and jointly realize innovative goals, but also stimulate the creativity and inspiration of team members and promote the collision of ideas and win-win cooperation.

Up to this point, the definitions of the three variables of this study are also more clearly and explicitly defined here. In terms of designing creative outcomes, creativity can be defined as the state of being and adaptation of an individual's skill set that enables the individual to synthesize new connections and express meaningful outcomes [1]. Within the realm of design disciplines, interdisciplinary competence signifies the capability to address intricate challenges that surpass the capabilities of a single design field by amalgamating insights from two or more diverse disciplines. This entails critiquing, exchanging, evaluating, and reflecting upon knowledge from varied domains to enhance one's cognitive skills, thereby cultivating a comprehensive understanding when confronted with multifaceted and diverse design issues [4]. Teamwork ability refers to the ability to build on the foundation of the team, play the team spirit, complement each other and help each other to make the team reach the maximum efficiency of work [10]. For students majoring in design, team collaboration refers to the ability to effectively work together with others in a group setting to achieve common goals and objectives related to design projects.

Meanwhile, there is a close relationship between creativity Promotion strategies, interdisciplinary and teamwork Competences. First, creativity Promotion strategies can help design students develop interdisciplinary competence. By using various

strategies such as brainstorming, reverse thinking and prototyping, students can learn how to integrate knowledge and skills from different disciplines into their work, thus improving interdisciplinary competence; at the same time, interdisciplinary competence has a positive impact on teamwork competence. When design students are equipped with interdisciplinary knowledge, skills, and perspectives, they are more likely to communicate and collaborate with team members and contribute to the team's goals. In addition, interdisciplinary competence can promote knowledge sharing and innovation among team members and improve the team's overall innovation ability; finally, creativity Promotion strategies also have a contributing effect on teamwork Competences. By applying these strategies, team members can better solve problems together, come up with innovative solutions, and improve the overall performance of the team. In addition, creativity Promotion strategies can also help team members build trust, enhance communication, and create a favorable atmosphere for teamwork.

However, although China's art and design-related fields have taken shape after more than 40 years of development, many scholars believe that China's art and design talent cultivation and education have not yet been finalized and matured. With the economic development and industrial transformation and upgrading, the current stage of art and design professional education presents a number of problems, which urgently need to be refined and upgraded [11]. Therefore, in the current field of design education in China, more and more scholars have paid attention to the need for design students to improve various competencies with creativity as the core, among which interdisciplinary and teamwork competencies are important indicators to improve creativity. At present, in the field of design in universities, there are not many literatures on creativity promotion strategies from the perspective of interdisciplinary and teamwork competencies, and there are not many researches on the correlation and matching degree between interdisciplinary competence, teamwork competence and creativity, and the current researches mainly focus on case analysis and case study. It also lacks the support of large sample size and quantitative research, and more empirical studies are needed to verify relevant theories and concepts, in order to establish a more solid foundation for the advancement of design education.

Through the investigation and analysis of the current interdisciplinary competence, teamwork competence and creativity of design students, this study summarizes the relationship between interdisciplinary

competence, teamwork competence and creativity and the related influencing factors, and combines the training strategies of existing design talents to find opportunities to improve them. Through the analysis and research, the corresponding creativity promotion strategies can serve as a theoretical foundation for nurturing creativity as the key competency of design professionals.

The beneficiaries of this study encompassed two main groups of design faculty and students. First of all, this study provides an important reference value for design teachers. By gaining a deeper understanding of how to more effectively cultivate students' creativity, interdisciplinary ability and teamwork, the results of this research can provide teachers with teaching strategies and guidelines for their professional development and improvement of teaching practice. This will further improve teachers' educational literacy and teaching ability and contribute to the improvement of teaching outcomes. Meanwhile, students, as another important beneficiary, directly benefit from the results of this research. Through this study, students can better plan and develop their professional competencies. The results of the study can also provide students with specific learning methods and practical experiences to assist them in improving their academic level and competitiveness in the workplace. As a result, students can benefit from interdisciplinary learning, creativity development, and teamwork, providing strong support and guidance for their future career development.

#### **OBJECTIVES OF THE STUDY**

This study identified the creativity promotion strategies, interdisciplinary and teamwork competencies of Chinese design students, and uses them to provide suggestions for talent development strategies for design students with creativity as a core competency.

Specifically, this study described the subjects' profiles in terms of sex, year level and major; identified the subjects' creativity promotion strategies in terms of creative learning environments, innovative thinking, and design abilities; determined the subjects' interdisciplinary competencies in terms of interdisciplinary skills, reflective behaviors, and recognizing disciplinary perspectives; and assessed the subjects' teamwork competences in terms of Collective efficacy and Communication, planning and coordination, trust and supportive behaviors, Establishment of group objectives and role definition, conflict management, and information matching and consensus building; tested whether there were significant differences in responses based on the

grouping of variables; tested the significant relationships among the three variables; and proposed a talent cultivation strategy with creativity as a core competency based on the results of the study.

## **MATERIALS AND METHODS**

### **Research Design**

This study employed a blend of descriptive statistical analysis, literature review, and questionnaire surveys to undertake a comprehensive investigation.

Descriptive research involves the elucidation and explication of prevailing phenomena, principles, and theories through validation, emphasizing the "what" over the "how" or "why" of occurrences (Siedlecki, 2020). This study aids the researcher in acquiring a profound comprehension of the research issue and enables them to present intricate data sourced from various outlets in a readily understandable format.

Following a comprehensive review and analysis of prior literature, and in consideration of the study's objectives, this research selected appropriate subjects for in-depth examination, ultimately delineating three key variables: creativity promotion strategies, interdisciplinary competence, and teamwork competence. Furthermore, ample sample data were gathered from diverse sources via questionnaires, subsequently collated, structured, analyzed, and presented in accordance with the research inquiries.

### **Respondents of the Study**

The study focused on Chinese design students ranging from freshmen to seniors, specializing in fields such as visual communication design, product design, apparel design, digital media art, environmental design, and architectural design. Selection was based on the participants' voluntary participation in the study.

The surveys for this research were primarily distributed to five universities located on the east coast of China, reaching a total of 5,000 students majoring in related design disciplines. A sum of 530 questionnaires were disseminated, of which 508 were returned, resulting in a recovery rate of 95.8%. Among these, 480 questionnaires were deemed valid for analysis.

### **Data Collection**

In this study, a four-point questionnaire was used to investigate the important competencies of university students in design majors, including the creativity promotion strategies measurement questionnaire, the interdisciplinary competency measurement questionnaire, and the teamwork competency

measurement questionnaire. The questionnaire was assessed utilizing a four-point Likert scale in the following manner.

The creativity promotion strategies measurement questionnaire source comes from the creativity related influences compiled by Ou (2022). The scale contains three dimensions of creativity learning environment, innovative thinking, and design ability, with 31 items to measure subjects' creativity. In this research, the questionnaire was further revised in alignment with the investigation on the correlation between interdisciplinary skills, teamwork competencies, and creativity. The final questionnaire scale contains three dimensions of creativity learning environment, innovative thinking, and design ability, with 23 questions.

The Interdisciplinary Competence Measurement Questionnaire was derived from the Interdisciplinary Competence Related Influences developed by Lattuca [13]. The scale contains three dimensions, interdisciplinary skills, reflective behaviors, and recognizing disciplinary perspectives, and 13 items to measure subjects' creativity. This study is based on Bestmeyer's research (2015) in "Cooperation, Interdisciplinary Thinking, and communication: Innovative Strategies for K-12 Ecology Education." and MacLeod (2016) in the article "Interdisciplinary problem-solving: Evolving Approaches in integrative systems biology", which has been revised again. Finally, the questionnaire contains 15 questions from three dimensions: interdisciplinary skills, reflective behavior and understanding of disciplinary viewpoints.

The questionnaire for measuring team collaboration ability was derived from the relevant influencing factors of team collaboration ability compiled by Alonso (2022). The scale includes Collective efficacy, Learning orientation, Planning and coordination, Performance monitoring, Supportive behavior, Establishment of group objectives, Problem solving, Conflict management, Communication. These nine dimensions, 30 items, were used to measure the subjects' creativity. In this study, 9 dimensions and 30 questions were integrated and partially renamed. Finally, the questionnaire included 30 questions in 6 dimensions: Collective efficacy and communication, planning and coordination, trust and supportive behavior, Establishment of group objectives and role definition, conflict management, information matching and consensus building.

The table 1 shows the composite Cronbach alpha values for creativity enhancement strategies, interdisciplinary competence, and teamwork

competence, the 12 dimensions of the three variables. The reliability coefficients range from 0 to 1.0, with alpha values greater than 0.90 for Recognizing Disciplinary Perspectives, Collective Efficacy and Communication, and Trust and supportive behavior, indicating that the scale is excellent. Creative learning environments, Innovative thinking, Design abilities, Interdisciplinary Skills and Reflective Behavior have an alpha value greater than 0.80, indicating that the scale is good. , indicating that the scale is good. In addition, two dimensions, Conflict management and Information matching and consensus building, have alpha values greater than 0.70, indicating that they are acceptable. Hence, these findings suggest that the questionnaire demonstrates strong internal consistency and is deemed appropriate for research analysis.

**Table 1**  
**Reliability Results**

Indicators	Cronbach Alpha	Remarks
Creative learning environments	0.878	Good
Innovative thinking	0.867	Good
Design abilities	0.853	Good
Interdisciplinary Skills	0.894	Good
Reflective Behavior	0.849	Good
Recognizing Disciplinary Perspectives	0.901	Excellent
Collective Efficacy and Communication	0.954	Excellent
Planning and coordination	0.801	Good
Trust and supportive behavior	0.947	Excellent
Establishment of group objectives and role definition	0.855	Good
Conflict management	0.788	Acceptable
Information matching and consensus building	0.774	Acceptable

*George and Mallery (2003) provide the following rules of thumb: “\_ > .9-Excellent, \_ > .8-Good, \_ > .7-Acceptable, \_ > .6-Questionable, \_ > .5-Poor; and \_ < .5-Unacceptable”*

**Data Gathering Procedure**

As the author was already overseas during the questionnaire preparation phase, this study opted for an online format to create, disseminate, recycle, and evaluate the questionnaire. This approach encompassed a sequence of procedural steps as well.

To begin with, the author employed a mixed approach to communicate with relevant leaders and professors from various colleges and universities in China's eastern coastal region. Through WeChat and long-distance phone calls, the author thoroughly explained the objectives and importance of this study, and requested their support to mobilize design students

to participate in completing the questionnaire. After thorough communication, five colleges and universities were selected to participate in the study. Secondly, to assess the reliability and validity of the questionnaire, the author initially distributed 86 questionnaires through the “Wen Juan Xing” platform, and confirmed that the questionnaire met the qualifying standards. Following this, a large-scale questionnaire was distributed to the selected universities via WeChat and Tencent QQ. Finally, the author exported all the gathered data in an Excel format using the data collection function of the “Wen Juan Xing” platform, and thoroughly reviewed it to guarantee its accuracy.

In order to guarantee the questionnaire's validity, the author applied the following criteria to filter and screen it. Firstly, a valid questionnaire was required to take no less than 150 seconds to complete. Any questionnaire completed in less time was deemed invalid. Secondly, if respondents filled out the questionnaire multiple times, only the first valid submission was considered, with subsequent submissions deemed invalid.

**Data Analysis**

In analyzing the data, a diverse set of statistical methodologies was employed. Frequency and percentage distributions were employed to delineate the demographic makeup of the participants. Furthermore, weighted means and rankings were employed to evaluate strategies for enhancing creativity, interdisciplinary competencies, and teamwork competencies. Consequently, nonparametric tests such as the two-sample Mann-Whitney U test for two groups and the one-way ANOVA F-test for three or more groups were utilized to identify noteworthy distinctions. Likewise, Pearson's correlation coefficients were utilized to examine significant associations between creativity promotion strategies, interdisciplinary competencies, and teamwork competencies.

The variables were evaluated utilizing the subsequent Likert scale: 3.50-4.00- strongly agree; 2.50-3.49-agree; 1.50-2.49-disagree; 1.00-1.49-strongly disagree. Additionally, all data underwent analysis via SPSS version 26 statistical software for additional interpretation of the results, employing a confidence interval of 95% and a significance level of 0.05.

**Ethical Considerations**

The ethical concerns in this study revolved around three fundamental ethical principles, namely respect for

participants, concern for their welfare and benefits, and the principle of justice. Furthermore, the operationalization of the research complied with the established ethical standards and norms within academia.

Upon the completion of the study, the findings and results were disseminated without charge to the interviewees and other relevant parties. The study demonstrated unwavering respect for the autonomy and inherent rights of each participant, ensuring the preservation of their dignity throughout the entire research process. Informed consent was obtained from all study participants, and the researchers acknowledged the inherent limitations of the methodology employed. Additionally, consent was sought from the authors for the utilization of the scale.

**RESULTS AND DISCUSSION**

**Table 2**  
**Creativity Promotion Strategies**

Indicators	Weighted Mean	Verbal Interpretation	Rank
1. Creative Learning Environment	3.10	Agree	3
2. Innovative Thinking	3.16	Agree	2
3. Design Abilities	3.26	Agree	1
<b>Composite Mean</b>	<b>3.17</b>	<b>Agree</b>	

*Legend: 3.50 – 4.00 = Strongly Agree; 2.50 – 3.49 = Agree; 1.50 – 2.49 = Disagree; 1.00 - 1.49 = Strongly Disagree*

The statistics in Table 2 show that Design Abilities scored the highest with a weighted average score of 3.26 and Innovative Thinking ranked second with a weighted average score of 3.16. Meanwhile, the Creative Learning Environment ranked last with a weighted average score of 3.10. The combined average of the three scores was 3.17.

Item 3, "design abilities", shows a mean score of 3.26 in the table, ranking first, indicating that respondents are highly satisfied with this item. Design ability is the ability to transform an idea into an actual product or service, which requires creators to understand user needs, analyze problems and challenges, and find innovative solutions. Therefore, the improvement of design ability is crucial for the development of creativity. Since fashion design education was incorporated into the higher education system in the 1980s, its purpose is never vocational training or skills training, but rather the comprehensive training of students, and its constant point of reference throughout its 40-year-long reform process is to inspire students to learn how to integrate research, process, and design with their personal viewpoints and perspectives [16].

Guo [17] believes that design ability is the kernel of apparel design education i.e. an important mark to differentiate vocational education, and builds the design ability judging standard by defining apparel design ability and structural module starting from three levels of research and study, design process, and personal perspective. Hu [18] analyzed several problems existing in the teaching of public architectural design principles course in depth from the three aspects of teaching objectives, teaching methods and assessment methods; then summarized the characteristics of architectural design teaching in the Department of Architecture of Sheffield Hallam University; finally, on the basis of comparing and integrating the teaching characteristics of the two schools, he put forward a teaching reform that combines the cultivation of design ability as the orientation, theoretical teaching and practical training. The program. It can be seen that design ability is very important in China's design education system, and the cultivation of students' design ability also provides the basis for the enhancement of creativity.

Item 2 "Innovative thinking", ranked second with an average score of 3.16. Innovative thinking is the ability to think outside the box, drive change and progress, create new value, and promote the integration of diverse thinking. Innovative thinking can inspire creators to innovate, help them break new ground, and produce unique and creative results. Innovative thinking is therefore essential to the enhancement of creativity.

However, item 1 "Creative Learning Environment" had the lowest mean score of 3.1 on this scale, indicating that respondents' satisfaction with this item was relatively low. Nevertheless, the provision of a conducive learning environment is crucial for fostering creativity. Studies have demonstrated that passion-driven learning, collaborative creativity, and an environment that embraces new ideas while recognizing mistakes as integral to the learning journey are all key factors in enhancing creativity [19]. Richardson et al. [20], through their study, characterized the creativity learning environment for design students as summarized into three areas: student involvement, the physical learning environment, and the atmosphere of learning.

In a standardized education system, it is important for teachers to support creativity in education because many teachers have realized the importance of developing creativity in their students, but they may lack teaching strategies that support creativity. It is important in the development of students' creativity to lead to a collaborative atmosphere where students can take reasonable risks and are not afraid to make mistakes.

Beghetto [21] studied classroom discussions and found that teachers tended to choose student responses that conformed to their preconceived notions rather than unique responses, and a significant number of teachers in his study found unique responses to be disruptive or intrusive. It was also confirmed in his follow-up study that teachers may want their students to learn how to balance originality and conformity in order to develop real-world based creativity, rather than demonstrate originality for the sake of originality. But this actually often leads to unnecessary obstacles that can actually stifle creativity. Educators who recognize the significance of creativity are more inclined to establish an environment that values innovative ideas [22].

However, it is not enough to encourage novel ideas. Pupils need time to develop their own ideas and to be helped to explore their knowledge in order to broaden their understanding and make connections. A teacher needs to develop good relationships with students and have an atmosphere of open communication, while genuinely accepting students and recognizing their individual interests; the setting should promote cooperation and respect. Within a creativity-supportive environment, the teacher is pivotal in facilitating, collaborating, posing guiding questions, and engaging in learning and experimentation alongside students.

**Table 3**  
**Interdisciplinary Competence**

Indicators	Weighted Mean	Verbal Interpretation	Rank
1. Interdisciplinary Skills	2.91	Agree	3
2. Reflective Behavior	3.17	Agree	1
3. Recognizing Disciplinary Perspectives	2.96	Agree	2
<b>Composite Mean</b>	<b>3.01</b>	<b>Agree</b>	

*Legend: 3.50 – 4.00 = Strongly Agree; 2.50 – 3.49 = Agree; 1.50 – 2.49 = Disagree; 1.00 - 1.49 = Strongly Disagree*

The statistical results of the data in Table 2 shows that reflective behavior was ranked first with a mean score of 3.17, recognizing disciplinary perspectives was ranked second with a mean score of 2.96, while interdisciplinary skills were ranked last with a mean score of 2.91.

According to Tang [22] of the Department of Philosophy, Nanjing University, interdisciplinarity is the use of integration between multiple disciplines to solve problems, not a blanket denial or subversion of the traditional disciplines, but should be understood as the

interventions, interactions, and integrations between two or more disciplines, which could be the academic perspectives, methodologies, and perceptions, as well as the disciplinary values, disciplinary systems, and even more broadly, disciplinary education and research.

China's higher education started late, and the interdisciplinary teaching model did not formally enter the substantive exploration stage until the early 1990s to the present [23]. Tang [22] of the Department of Industrial Design at the Academy of Arts and Design, Tsinghua University, suggests that excellent design exists between disciplinary boundaries on the premise of integrating the knowledge of all the disciplines involved. Liu [24], a scholar of interdisciplinary research, proposes to reflect the new situation of interdisciplinary synthesis of modern design in the development of the foundation and curriculum, and to cultivate composite design talents who are compatible with disciplines and interdisciplines. Tang [22] proposed that the cross and interdisciplinarity of design is innate, and the connotation of interdisciplinary education of design requires breaking through the barriers of disciplines, organically combining the theories or methods of multiple disciplines, and solving the complex problems that can not be studied in depth by a single discipline. It can be seen that with the development of design and interdisciplinary teaching mode at home and abroad, the interdisciplinary teaching mode of design has gradually been studied and practiced to a certain extent.

The primary outcome of interdisciplinary collaboration often involves resolving intricate issues, wherein diverse disciplines leverage their respective theories and methodologies to collaborate on addressing a shared problem. Through mutual support, cross-referencing, and mutual limitations, disciplines collectively arrive at optimal solutions [25]. Then, in design majors, the interdisciplinary teaching mode can expand students' knowledge in an all-round way, cultivate students with the integrated innovative thinking of "big design", enhance students' creativity, improve their ability of cooperation and communication, and solve practical design problems, and obtain the knowledge of design, sociology, culture, architecture and other disciplines through careful integration and fusion. They can also acquire a knowledge structure that integrates design, sociology, culture, architecture and other disciplines.

Item 1 "interdisciplinary skills" has the lowest mean score of 2.91, indicating that respondents' satisfaction with this item is lower than the other two. Art professionals are not talents who master only one kind of

skill, but should be talents with a certain professional skill, who need to master a variety of cross-disciplinary knowledge, and at the same time also need to flexibly apply the knowledge in the process of practice, without being restricted by a certain discipline [23]. Schools, as the organization of education, are more responsible for expanding the knowledge of students, so that it is planned and organized, so that all kinds of disciplines can be organically integrated to cultivate talents with the comprehensive ability of art and design majors.

However, the current design education model enrolls students separately according to art and science and engineering, but even the students in the design engineering class are only enrolled according to science and engineering, and design courses are taught, which is basically detached from engineering education. In Germany, the design master's degree program for engineers has been implemented for many years, and the industrial design (engineering) program offered by the United Kingdom has not yet been accepted domestically. The lack of cross-cutting knowledge hinders the effective communication and implementation of design [36].

Therefore, there is a need to develop an interdisciplinary collaborative innovation teaching mode for art and design majors that aligns with the characteristics and development needs of colleges and universities. and then break the barriers of too fine a division of specialties, the implementation of interdisciplinary thematic teaching, and constantly expanding the connotation of interdisciplinary collaborative innovation, but also need to actively face the community, face the industry, and set up a platform for industry-oriented art and design innovation, and embark on the road of interdisciplinary collaborative innovation to enhance the interdisciplinary skills of the students.

Table 4 provides a summary of team collaboration capabilities. The composite average is 3.03, which means that Chinese design students agree with the above indicators. Among the six items, "trust and supportive behavior" scored the highest, with a weighted average of 3.23; "Collective effectiveness and Communication" ranked second, with 3.07; The score of "information matching and consensus building" was 3.05, ranking third; "Establishment of group objectives and role definition" ranked fourth, with an average score of 2.98; The weighted average of "planning and coordination" was 2.97, ranking fifth. The weighted average for "Conflict management" was 2.87, ranking last.

**Table 4**  
**Teamwork Competence**

Indicators	Weighted Mean	Verbal Interpretation	Rank
1. Collective efficacy and Communication	3.07	Agree	2
2. Planning and coordination	2.97	Agree	5
3. Trust and Supportive Behavior	3.23	Agree	1
4. Establishment of group objectives and role definition	2.98	Agree	4
5. Conflict Management	2.87	Agree	6
6. Information matching and consensus building	3.05	Agree	3
<b>Composite Mean</b>	<b>3.03</b>	<b>Agree</b>	

*Legend: 3.50 – 4.00 = Strongly Agree; 2.50 – 3.49 = Agree; 1.50 – 2.49 = Disagree; 1.00 - 1.49 = Strongly Disagree*

In the collaborative ability of design professional team, the six factors of collective effectiveness and communication, planning and coordination, trust and supportive behavior, goal establishment and role positioning, conflict management, information verification and consensus building are interrelated and jointly affect the collaborative ability of design professional team. Increased collective effectiveness often relies on effective communication among team members, and when team members are able to communicate ideas and feedback clearly, they are more likely to collectively build confidence in the team's capabilities [27].

A team with a high level of collective effectiveness tends to plan and coordinate work better. Team members believe in each other's abilities and are more willing to work together to make plans and ensure that tasks are completed on time; The establishment and development of collective effectiveness requires mutual trust and support among team members. Trust and support behaviors among team members will enhance collective efficacy; An effective team needs to identify common goals and roles. Collective effectiveness can help team members better define their goals and understand their roles, thus improving the efficiency of team collaboration [28].



Teams that are more effective collectively are often able to deal with conflict more effectively. Trust and respect among team members helps resolve conflicts through dialogue and collaboration; Collective effectiveness helps team members play an active role in information collation and consensus building. Team members are more likely to share information, knowledge, and opinions, and to reach consensus together.

Therefore, the six factors interact and influence each other to determine the collaborative ability of the design professional team. Collective effectiveness and communication act as a link among these six factors, promoting collaboration among team members and the overall performance of the team.

Item 5 "Conflict Management" ranked last in the table, with an average score of 2.87. This indicates that respondents are not particularly satisfied with conflict management in the collaborative ability of design professionals. However, conflict is inevitable in any team [29]. Effective conflict management can help the team solve the problem better, improve the efficiency of decision-making, and improve the efficiency of the team as a whole. At the same time, moderate conflict can stimulate the creativity of team members. The exchange of different perspectives and opinions in a conflict helps to generate new ideas and solutions, thus promoting the team's ability to innovate.

Therefore, improving conflict management is crucial in the design professional team. Conflict management skills can be strengthened by establishing clear expectations and rules, improving communication effectiveness, training conflict management skills, establishing conflict resolution mechanisms, cultivating team awareness, and assigning roles and responsibilities to enhance the ability of design professionals to collaborate in teams.

Table 5 illustrates the correlation between strategies for enhancing creativity and interdisciplinary competence. It is found that there is a significant relationship between creative learning environment, innovative thinking, design ability and interdisciplinary skills, reflective behavior, and understanding of disciplinary viewpoints. This is because the resulting P value is less than the alpha level. This shows that there is an important relationship between the two, and also means that the better the interdisciplinary ability, the better the creativity.

Interdisciplinary cooperation has become one of the important ways to enhance team creativity. In recent years, interdisciplinary research teams have played an

increasingly important role in solving complex real-world problems [30]. Team creativity is the basis and source for interdisciplinary research teams to solve complex problems and realize innovation.

**Table 5**  
**Relationship Between Creativity Promotion Strategies and Interdisciplinary Competence**

<b>Creative Learning Environment</b>	<b>r-value</b>	<b>p-value</b>	<b>Interpretation</b>
Interdisciplinary Skills	.606**	0.000	Highly Significant
Reflective Behavior	.230**	0.000	Highly Significant
Recognizing Disciplinary Perspectives	.421**	0.000	Highly Significant
<b>Innovative Thinking</b>			
Interdisciplinary Skills	.550**	0.000	Highly Significant
Reflective Behavior	.317**	0.000	Highly Significant
Recognizing Disciplinary Perspectives	.453**	0.000	Highly Significant
<b>Design Abilities</b>			
Interdisciplinary Skills	.540**	0.000	Highly Significant
Reflective Behavior	.181**	0.000	Highly Significant
Recognizing Disciplinary Perspectives	.535**	0.000	Highly Significant

*Legend: Significant at p-value < 0.01*

Xie et al. [31] believe that interdisciplinary is not a simple stacking of disciplines, its essence lies in continuous improvement and innovation, and innovation is also the essence of scientific research, so it can be seen that interdisciplinary and innovation are closely related. At the same time, they believe that interdisciplinary integration often requires scholars to carry out interdisciplinary research at the boundary of disciplines, integrate knowledge under the background of multiple disciplinary knowledge, and produce innovative ideas. Especially in the international context of increasingly fierce innovation and competition, discipline integration is an important way to achieve breakthrough progress in scientific research, which can effectively stimulate the creativity of graduate students.

There is a mutually promoting relationship between cultivating interdisciplinary competence and enhancing creativity strategies of design students. From the perspective of creativity, the cultivation of interdisciplinary ability can provide students with the ability to flow and integrate knowledge between different fields, disciplines or majors, which is

conducive to students' use of multidisciplinary knowledge and methods in the design process, so as to better play creative thinking. From the perspective of open thinking and creative generation, the cultivation of interdisciplinary competence often prompts students to try new ways of thinking, problem-solving methods and perspectives that cross disciplinary boundaries. This combination of open thinking and cross-disciplinarity can stimulate students' creativity and prompt them to come up with more unique and innovative design concepts. From the perspective of multiple perspectives and design thinking, through the cultivation of interdisciplinary competence, students can be exposed to knowledge and perspectives from different disciplines and fields, thereby broadening their horizons and cognitive scope. This diverse perspective can help students to better design thinking, discover new problems and create new solutions through cross-disciplinary integration, thus enhancing creativity.

Table 6 shows the relationship between interdisciplinary skills and teamwork skills. Significant relationships were observed between interdisciplinary skills, reflective behavior, awareness of disciplinary perspectives and collective effectiveness and communication, planning and coordination, trust and supportive behavior, goal setting and role positioning, conflict management, information checking and consensus-building. This is because the resulting P value is less than the alpha level. This shows that there is an important relationship between the two, and also means that the better the teamwork, the better the interdisciplinary competence.

Clark [32] believes that there is a "commonground" in teamwork. Each communication and interaction in a team means that there is a common cognitive reference frame among the participants. The communication between the participants of different disciplines is based on their common disciplinary knowledge, belief and imagination. Through communication, an effective communication language system can be formed between the disciplinary personnel, and the knowledge system of the participants of other disciplines can be incorporated into their own disciplinary understanding. In essence, it is the process of cultural fusion of different disciplines, which is the process of forming a common cognitive reference frame.

Team members are trained with different disciplinary knowledge, and communicate with each other using different concepts, methods and terminology, so that a common cognitive foundation is formed for different disciplinary personnel.

**Table 6**  
**Relationship Between Interdisciplinary and Teamwork Competence**

Interdisciplinary Skills	r-value	P-value	Interpretation
Collective efficacy and Communication	.483**	0.000	Highly Significant
Reflective Behavior	.376**	0.000	Highly Significant
Trust and Supportive Behavior	.326**	0.000	Highly Significant
Establishment of group objectives and role definition	.589**	0.000	Highly Significant
Conflict Management	.344**	0.000	Highly Significant
Information matching and consensus building	.578**	0.000	Highly Significant
<b>Reflective Behavior</b>			
Collective efficacy and Communication	.338**	0.000	Highly Significant
Reflective Behavior	.172**	0.000	Highly Significant
Trust and Supportive Behavior	.126**	0.000	Highly Significant
Establishment of group objectives and role definition	.372**	0.000	Highly Significant
Conflict Management	.172**	0.000	Highly Significant
Information matching and consensus building	.423**	0.000	Highly Significant
<b>Recognizing Disciplinary Perspectives</b>			
Collective efficacy and Communication	.425**	0.000	Highly Significant
Reflective Behavior	.459**	0.000	Highly Significant
Trust and Supportive Behavior	.440**	0.000	Highly Significant
Establishment of group objectives and role definition	.475**	0.000	Highly Significant
Conflict Management	.336**	0.000	Highly Significant
Information matching and consensus building	.445**	0.000	Highly Significant

Legend: Significant at p-value < 0.01

Members exchange views of different disciplines based on common goals. In the process of mutual communication, different disciplinary personnel learn from each other and share experience with each other. Cooperation and communication promote the continuous flow, transformation, integration and application of knowledge of different disciplines, and ultimately promote the innovation of knowledge ability of teams within the framework of integration [33].

Therefore, teamwork takes complex engineering problems as the link, gathers resource advantages of different disciplines to organize members of different disciplines as the representation, and takes integration of disciplinary knowledge and promotion of higher-order thinking as the essence to realize scientific research and knowledge innovation.

In the design profession, design tasks often need to be completed through the combination of multiple skills and perspectives, and members of the design team need to work together to share resources and experience to achieve the best design results. Interdisciplinary competence is an indispensable factor in design work, which can help design team members better understand and solve complex design problems. Through interdisciplinary capabilities, design teams can combine their respective expertise to provide more comprehensive design solutions. As a result, the collaborative and interdisciplinary abilities of design student teams complement each other. Team members need to give full play to their professional advantages in the process of cooperation to solve design problems together. Collaboration promotes effective communication and collaboration among design team members, while interdisciplinary competence provides design team members with the ability to integrate knowledge from different fields, thereby helping them to design more creative and practical works.

Table 7 shows the relationship between creativity enhancement strategies and teamwork ability. Significant associations were identified between the creative learning environment, innovative thinking, design ability and collective effectiveness and communication, planning and coordination, trust and supportive behavior, goal setting and role positioning, conflict management, information checking and consensus building. This is due to the resulting P-value being lower than the alpha level, indicating a significant relationship between the two variables. This also implies that enhanced teamwork correlates with heightened creativity.

Zhang et al. [33] found in the practice of a professional design group in China that due to the different growth environment and education of the group members, they have different thinking modes. Each member puts forward his own ideas from his own perspective, and the collision of different creative points will generate new creative points among the team members. After discussion and deepening among members, a project can be better completed.

**Table 7**

<b>Relationship Between Creativity Promotion Strategies and Teamwork Competence</b>			
<b>Creative Learning Environment</b>	<b>r-value</b>	<b>P-value</b>	<b>Interpretation</b>
Collective efficacy and Communication	.575**	0.000	Highly Significant
Reflective Behavior	.469**	0.000	Highly Significant
Trust and Supportive Behavior	.355**	0.000	Highly Significant
Establishment of group objectives and role definition	.659**	0.000	Highly Significant
Conflict Management	.284**	0.000	Highly Significant
Information matching and consensus building	.434**	0.000	Highly Significant
<b>Innovative Thinking</b>			
Collective efficacy and Communication	.283**	0.000	Highly Significant
Reflective Behavior	.287**	0.000	Highly Significant
Trust and Supportive Behavior	.168**	0.000	Highly Significant
Establishment of group objectives and role definition	.433**	0.000	Highly Significant
Conflict Management	.155**	0.000	Highly Significant
Information matching and consensus building	.335**	0.000	Highly Significant
<b>Design Abilities</b>			
Collective efficacy and Communication	.393**	0.000	Highly Significant
Reflective Behavior	.399**	0.000	Highly Significant
Trust and Supportive Behavior	.371**	0.000	Highly Significant
Establishment of group objectives and role definition	.397**	0.000	Highly Significant
Conflict Management	.324**	0.000	Highly Significant
Information matching and consensus building	.339**	0.000	Highly Significant

*Legend: Significant at p-value < 0.01*

Zheng [34] believes that team diversity can provide teams with knowledge and insights from different fields, which is closely related to team creativity. Zhang et al. [33] believe that team members complement each other in terms of learning speed, learning methods, personality,

interest, attitude, etc. Reasonable knowledge and ability structure can effectively make up for the defects of individual students in single thinking mode, lack of persistence in tracking problems, limited energy, and lack of ability. A team capable of effective collaboration can maximize the initiative and creativity of its members, and all members adhere to the consciousness of open cooperation to actively learn, and ultimately form a strong innovation ability of the team.

In the design team, good teamwork ability can promote team members to better play their own advantages and work together to solve design problems. Through teamwork, the design team can brainstorm, absorb different opinions and viewpoints, and promote the collision and integration of ideas, thus stimulating the creativity of members and promoting the production of innovative design. Team collaboration is an important strategy to enhance creativity. Through team collaboration, design team members can inspire each other, learn from and stimulate each other, and jointly explore and solve design problems, thus expanding creative thinking and promoting the emergence of creativity. At the same time, in the digital age full of variability and uncertainty, design thinking is an important weapon for teams and organizations to cope with uncertainty and competitive threats, and it has important theoretical and practical significance to grasp its mechanism for innovation from the team level and learning perspective [9].

## CONCLUSION AND RECOMMENDATION

Among the respondents, the proportion of females is slightly higher than that of males, and the proportion of third-year students is the highest in the distribution of grades. However, in the distribution of majors, the majors are more balanced, and the industrial design major is slightly higher than other majors. In the variable of creativity promotion strategies, design ability has the greatest impact, which indicates the importance of focusing on enhancing design ability in the process of enhancing creativity. In the variable of interdisciplinary competence, reflective behavior is the most important influencing factor. This suggests that individuals or teams are able to think deeply about and evaluate their interdisciplinary practices, improve the way they work, enhance the integration of knowledge, and thus increase the level of development and enhancement of interdisciplinary competence. Trust and supportive behaviors had the greatest impact on teamwork competence, suggesting that building trusting and supportive relationships among team members is critical

to the development of teamwork competence. The three variables show significant differences when grouped according to year level and major. This reflects the abilities and characteristics displayed by individuals in different contexts, as well as the impact of differences in education and training on the development of students' abilities. There is a significant relationship between the three variables, indicating that the better the teamwork, the better the team's interdisciplinary competences and the more it leads to creativity. Training and development programs have been developed to help design students to improve themselves, so as to contribute more effectively to the building and development of the design profession.

Relevant departments of the university may implement credit transfer and mobility mechanisms to break the professional barriers between different colleges and universities, so as to promote the mutual integration of knowledge among design majors studying in different fields. The university may actively build an interdisciplinary communication platform, including the establishment of relevant studios, curriculum systems and practical investigation activities, so as to create a comprehensive development environment and provide interdisciplinary communication and learning opportunities for design students to broaden their horizons and stimulate creativity. Encourage the teacher team to actively expand their knowledge and conduct in-depth research on the interdisciplinary knowledge system through the teacher training program to improve their teaching ability. The teachers may advocate cooperative teaching and encourage students to conduct cross-professional and interdisciplinary group cooperation, so as to cultivate the interdisciplinary teamwork consciousness of students majoring in design. A training and development program for design students may be submitted for evaluation and implementation. Future researchers may conduct another study utilizing the impact of interdisciplinary and teamwork competences on creativity promotion strategies.

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