

The Impact of Design Thinking with Secondary Students in Shaoguan City Institute of Technicians, Guangzhou Province

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Abstract

This study aims on the integration of design thinking in the teaching practice of secondary vocational education, which requires the upgrading of clear talent training objectives, the optimization of systemic curriculum structure and the innovation of design thinking. In this research, we use face-to-face interview and observation methods to study 46 students' participation in the art and design training. The students study in Shaoguan Technician College, Guangzhou Province, China. We find that students gradually explore and realize their limitations according to the set of given tasks. In addition, participants prefer to choose contents that they are interested in or familiar with when given project topics. We also discover that students who are not very serious in class would be focused when they meet the contents that they were interested in. The results show that design thinking improve students' imagination, analytical ability, understanding ability and observation ability.

Keywords: Design Thinking, Secondary Vocational Colleges, Creativity, Art & Design Students, China

Introduction

Design thinking is an effective way to solve problems and the main means to cultivate students' creativity and innovation. According to the literal content, many people will mistakenly think that design thinking is a thinking mode exclusive to the art and design field. In fact, design thinking does not refer to specific design professional field. It can also be used in other fields such as business, engineering, history and many others. In fact, this thinking mode was originally created by engineers, and the whole mode has strong operability, which is of great help to improve a person's innovation and creativity. Moreover, according to Liedtka (2018), the process of design thinking also can "identify hidden needs by having the innovator live the customer's experience." This means that the bias of a customer's journey in experiencing design and products can be taken into account in the iterative design model.

The structure of design thinking was first developed in the 1950s when Fred Terman, Dean of the School of Engineering at Stanford University, modeled the teaching method from Bauhaus Art School in Germany to encourage students to innovate businesses and bring income to the school. In order to realize this idea, he proposed the establishment of Stanford Industrial Park, Stanford Research and Development Park to the school. It was John Arnold who proposed the concept of design thinking in 1959. Later, in 1969, Stanford University launched the first design thinking course. After continuous development in the 1970s and 1980s, design thinking course of Stanford University gradually became the most effective way for the academicians there to cultivate students' creativity and innovative thinking.

Our paper seeks to understand the mode of design thinking when employed for secondary vocational school. Our investigation employs the collaboration of 46 students from Shaoguan City Institute of Technicians, Guangzhou Province, China. The students' age ranged from 16-18 years old, consisting of 26 males and 20 females. The main method employed is interview and observation with reference to design thinking model. This paper is organized into two main sections; the introduction of basic design thinking and the analysis of findings from the interview and observation of the students' artworks. The paper ends with conclusion and recommendation for future outlooks for design thinking innovation in school.

Basic Design Thinking

From an industrialist perspective, design thinking is also a method that examines and services customer needs. The process of design thinking is usually iterative and non-linear (Dam & Siang, 2022). A such, designer continuously review and improve their products, from initial stage to final results. Generally, the design thinking model is roughly divided into five stages. They are *empathy*, *definition*, *prototyping*, *ideate* and *testing*.



Figure 1. Design thinking model, sourced from Interaction Design Foundation (2022).

a) Empathy

Empathy can be understood as emotional communication, or as emotional involvement. People in their work and life tend to think from the perspective of others when they understand a certain thing or a certain program. If two people have the same education background, it is relatively easy to establish empathy; However, if there is a big difference in educational background and teaching background between the two, it will be relatively difficult to establish empathy. The one with a higher education needs to actively balance its own level with a lower educational background, and trying to make the other side understand with the other side's way of expression. Of course, the content of empathy should not only take into account educational background and teaching background, but also try to perceive and understand others' feelings, emotions, thoughts and behaviors.

Therefore, in the process of experimental teaching, teachers should not only encourage the establishment of empathy between classmates, but also between teachers and students. The reason is that teachers and students themselves are in an unequal relationship, and it is difficult for students to open their hearts to communicate with teachers. Empathy can not only facilitate the communication between teachers and students, but also understand the most real psychological state of students through interviews and observation, so as to timely adjust the thinking training mode of the following definition.

b) Definition

Any questions and problems need to be understood in its initial progress, and this is where the phase definition comes in. Usually the definition stage can be understood in two ways: The first is the critical question of the research and the accurate grasp of the key words. The second is the basic ability of the team members and the psychological expectations of the final work of the team.

c) Prototyping

Prototypes is the basis for the establishment of the program and is also a professional part of the detailed interpretation of the whole research content. The prototypes that appear in design thinking include basic prototype, key prototype, dark horse prototype, Fangke prototype, functional prototype and final prototype. In the process of analysis, students should have a general understanding of the concept of each type of prototype and the correlation between prototypes.

d) Ideate

The completion of the program is the trial of a variety of possible models on the basis of prototypes. At the present stage, most students in secondary vocational schools do not have the ability to design schemes. The reason is that the completion of the schemes requires participants to have certain creative ability and students to break the original thinking logic and inherent understanding, which is a certain difficulty for them.

e) Testing

Participants in the testing phase receive feedback on information of the final output. Those students who studied in secondary vocational schools mostly lacking ability is self-denial. Because they do not have certain judgment ability to choose which programs are acceptable and which are not. When the model is tested after completion, the students themselves, as the first users, do not know the use of the feedback information. Some students think that the feedback process is useless, which is a problem to be solved today.

Current situation of education training in secondary vocational colleges in China

1). The basic concept of secondary vocational colleges

The general schools in China are provided secondary vocational education and students receive secondary vocational education after graduation. Most of their students come from junior high school graduates or personnel with the same education as junior high school. Just like the students who came from ordinary high schools. The basic length of schooling for students is three years. Secondary vocational education is vocational education carried out at the stage of high school education. Although secondary vocational education and high school education have certain similarities in curriculum arrangement, such as students need to learn

mathematics, Chinese, English, physical education and other basic courses, secondary vocational education will add many professional courses on this basis and focus on them. For example, design-related majors in secondary vocational schools will arrange courses such as font design, composition foundation or packaging design. In regular high schools, there is no relevant curriculum.

Now the education of secondary vocational schools is the main source of vocational personnel training in our country. The mode of running secondary vocational schools is becoming increasingly close. In the future, the state declares that it will gradually open the boundary of departments and promote the integration of various departments by means of reform, layout adjustment and resources integration. Secondary vocational colleges and universities include public and non-governmental ordinary technical secondary schools, adult technical secondary schools, vocational high schools, technical colleges and secondary vocational schools affiliated to institutions of higher learning.

II). Curriculum overview of secondary vocational school in Guangzhou Province

The goal of personnel training in secondary vocational education system is to cultivate professional and skilled personnel. Secondary vocational colleges are divided into mechanical colleges, agricultural colleges, cultural and art colleges and other colleges.

Most of the curriculum planning of secondary vocational colleges is based on the professional classification of higher vocational colleges and universities. This situation was resulting in the professional classification and curriculum arrangement of secondary vocational colleges similar to comprehensive universities. Of course, secondary vocational schools will call some strong majors as king majors according to their own development direction.

The overall core system of this kind of major is relatively complete, including a series of contents such as supporting skill teaching allocation, teacher allocation, internship arrangement and skill competition. These teaching advantages were assisted by comprehensive courses to jointly train talents. However, those majors that are not very prominent in secondary vocational schools are called "fringe majors". But both ace majors and edge majors contain comprehensive courses in the curriculum mode of talent cultivation. The difference lies in that ace majors have richer comprehensive courses. The so-called comprehensive curriculum refers to the curriculum model formulated according to the direction of social and economic development and skilled personnel training.

The teaching purpose of comprehensive courses is to cultivate skilled talents, and the curriculum arrangement should be related to the ability and professional technology that students really need. So as to combine theory with practice. At present, secondary vocational colleges pay more attention to the training of technical personnel, so most of the curriculum arrangement is based on practical courses, theoretical training as a supplement.

At present, the comprehensive curriculum construction of secondary vocational schools can be roughly divided into four steps. The first step is to take the market development as a reference and analyze the latest form of the market. The second step is to adjust the course structure according to the development prospect of the future students' graduation. The third step is targeted to a certain type of post personnel training; The fourth step is to strengthen the understanding, application of the learning field and language design.

The construction and development of comprehensive curriculum can be roughly divided into the following *two stages*. The *first stage* is establishing a comprehensive curriculum framework. This part mainly attempts to summarize the content taught by a major or a department as a whole. Taking design profession as an example. Regardless of whether

students major in graphic design or interior design, they need to have certain art foundation when learning design-related knowledge content. Therefore, sketch and color course can be set as the basic course of comprehensive curriculum framework. For example, plane composition, color composition and three-dimensional composition are the basic contents to help students quickly understand the way of doing a design project. And it is also appropriate to integrate them into the advanced courses of comprehensive courses. The *second stage* is to develop a comprehensive curriculum plan. In this part, specific starting time and ending time should be given for each course within the comprehensive curriculum framework. Each teacher should confirm the approximate time of his or her course stage.

The third stage is the construction of comprehensive curriculum resources. This part not only includes the hardware facilities of secondary vocational schools, such as teaching facilities and practice facilities, but also includes the construction of teachers, learning equipment and environment, which is the premise for the implementation of comprehensive curriculum. Among them, learning materials are those that provide students with direct help, including working pages, operating instructions, reference books and enterprise technical materials.

III). Issues of China's vocational education personnel training at the present stage

a). Secondary vocational schools pay too much attention to the demand for talents at the technical level and neglect the development of thinking. At present, Chinese vocational education mode is mainly based on skill teaching, personnel training in the form of practical teaching and software teaching, so as to provide professional talents for the society. However, due to the excessive emphasis on the technical level of students and the neglect of the cultivation of students' thinking, many students in secondary vocational schools now rely on teachers to a greater degree. It is difficult to analyze the subject content through independent thinking.

b). Secondary vocational schools do not have a clear understanding of the future employment prospects of their students. From the perspective of employment analysis, the technical training mode of secondary vocational colleges can quickly obtain employment opportunities after graduation. To some extent, they have certain advantages. With the increasing work intensity in the later period, they need to constantly learn new technologies through self-learning ability. These students of vocational school can carry out form innovation, structure innovation and concept innovation on the basic model through innovation and creation ability to adapt to the changing market in the future. However, most students in secondary vocational schools do not have these abilities. So that students gradually lose their original advantages during two to three years after graduation, and finally they will be eliminated.

c). The theoretical knowledge of secondary vocational schools does not match the knowledge reserve and comprehensive quality of students. The teaching mode of secondary vocational colleges is closely related to that of higher vocational colleges and comprehensive colleges. So that most secondary vocational colleges directly refer to college knowledge textbooks when formulating textbooks and reference materials. Compared with undergraduate students, students in secondary vocational schools have a big gap in their art foundation, learning ability, understanding ability and teaching background. Therefore, it is difficult to understand textbooks designed for undergraduate students.

Methods

This experimental study uses qualitative research and quantitative research to understand design thinking process of the 46 secondary students from Shaoguan City Institute of Technicians, Guangzhou Province, China. The preliminary researchers first carry out qualitative research to define the positive effect of design thinking on talent training in secondary vocational schools. According to the characteristics of design thinking and secondary vocational education, the researchers set up a teaching model suitable for the training of such talents. In the course of later experimental course education, researchers collect relevant data content of participants by means of data and draw conclusions.



Figure 2: Shaoguan City Institute of Technicians, Guangzhou Province, China.

a) Upgrading and optimization of talent training objectives

Nowadays, most of the training modes of secondary vocational education are aimed at cultivating professional and technical talents. Taking art and design-related majors as an example, the basic idea of talent training for teachers in most secondary vocational schools is hoping that students can understand the basic uses and methods of design software. Finally, they will be able to use it skillfully. The integration of design thinking requires re-examination and innovation of this talent training goal. It requires not only the cultivation of knowledge, skills and technology, but also the cultivation of students' independent learning ability, innovation and creation ability, understanding ability, communication ability and problem-solving ability. Design thinking requires students to transfer situations through empathy in the learning process, understand the real demands of demanders and express them in creative ways, and realize the upgrading and optimization of talent training objectives through thinking guidance.

b) Teaching optimization and curriculum model improvement

The most fundamental thing for design thinking to guide teaching innovation is that teachers should use design thinking to re-examine the knowledge and content system of the curriculum. Trying to sort out a curriculum structure framework that can be accepted by students of secondary vocational schools according to the basic curriculum structure system.

Teachers need to make clear the correlation between core concepts, knowledge points and conceptual hierarchy in the framework. They should try to integrate the summarized knowledge framework into the model of design thinking, which should take into account students' understanding ability, learning ability, artistic foundation, age difference and other factors. Whether in the restructuring of curriculum structure or the integration of design thinking and optimized curriculum framework. Teachers are required to have knowledge reserve and thinking understanding ability far beyond the course content, and have certain cross-border thinking. According to the model orientation of design thinking, teachers can

complete the module connection of course learning demand, course objectives and learning content through phased learning. Ensure the orderly integration between the two.

c) The basic model of talent training in secondary vocational schools under the guidance of innovative design thinking

Combining with the objectives of talent training and the content of teaching structure system optimization, this research puts forward the basic model of talent training in secondary vocational schools under the guidance of design thinking. The model is based on the innovative curriculum education thinking system with the design thinking guidance as the premise.

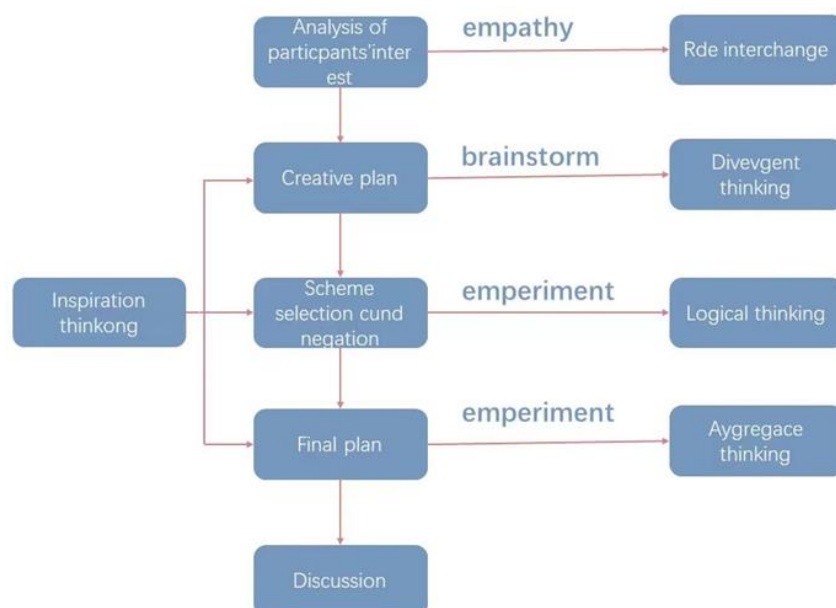


Figure 3: Design thinking model of this experimental study (Designed by Gao He Tian, 2023).

The core of this model is to define each link in the whole basic model. Each definition process is the participation of teachers and students. The steps of the overall teaching model are as follows:

(a) Before this research will start, teachers should firstly analyze the characteristics of students and understand their interests, hobbies, teaching background and other factors. Students in secondary vocational schools are generally 15-18 years old. At this stage, they are in a rebellious period. It is easy to have rebellious psychology on some content that they are not interested in. In order to ensure the smooth progress of the course, teachers should have the empathy to feel the mental state and changes of students and adjust the course in time according to this content.

(b) After determining students' interests and other factors, the two aspects need to be defined at the beginning. The first step is team composition. Students can form teams according to the above factors, which can better help students to communicate and exchange. The second step is the key content of the course. After the teacher collects the above information, he or she needs to make partial adjustments to the teaching content according to the information, and finally determine the key content to be taught in the course.

(c) After the key content has been established, teachers need to conduct guided teaching. They ask students to think actively by asking questions. However, this process still needs to be adjusted. For example, if the teacher asks a relatively academic question and the students do not understand it, the question needs to be adjusted according to the feedback information such as the students' expression and mental state. And then the question needs to be selected again.

(d) When students complete the understanding of the problem, they need to establish a trial scheme and develop a basic prototype according to the trial scheme. This basic prototype not only includes the conclusion of students' understanding of the problem, but also needs to comply with the basic requirements of the curriculum framework, which requires teachers to give appropriate guidance in observing the progress of each group.

(e) The final prototype should be based on both the basic prototype and the creative prototype. The structure of the creative prototype breaks some conventional logical restrictions and standards of the basic prototype, so the relevant scheme of the creative prototype is to divergent the thinking on the basis of the basic prototype, and the final prototype is to converge the thinking on the basis of the creative prototype. Finally, each member of the team is evaluated through the final prototype test. The status of each member in the team is obtained. So that every student can truly understand their own growth.

Case Analysis

The main purpose of this study is to determine whether design curriculum arrangement under the guidance of design thinking can improve students' innovative and creative ability. The survey included 46 participants, 27 male and 19 female, with a general age range of 15 to 18 years. This study lasted for ten weeks, and the research methods used were qualitative and quantitative. Participants' occupations, education levels and interests helped determine the range of growth.

The whole experimental research is mainly divided into three stages, each stage is to redefine students:

In the past, the formulation of curriculum objectives and tasks was based on the requirements of textbooks and teachers strictly followed the content of books. This model did not consider students' feelings. It was difficult to arouse students' interest. Therefore, in the first stage of the experimental course, I gave up the old course mode and adopted a new way to formulate the course tasks. The participants were initially defined by the researchers, which lasted about three weeks. In order to facilitate data collection. Firstly I asked all participants to form a team by themselves. The team form could be boys and girls playing together or boys and girls playing together. However, each group must explain the reason for forming a team clearly. Considering the number limit, it is decided that each group cannot be more than eight people, so there are eight groups in total.

In the task development and assignment phase, the past model of the curriculum was that the teacher first demonstrated the design content. Then students repeated it until they could proficiently complete the work. They have a strong dependence on teachers. It is difficult to develop innovative and creative ability and analytical ability for these students. In order not to make students dependent on the teacher, I gave them a high degree of freedom to complete the task after arranging the design theme according to their interests.

In the second phase, participants' abilities were redefined over a period of about three weeks. Based on the conclusions of the first stage, I determined the experimental direction for each group and planned experimental projects suitable for each group. Each project is designed specifically for the group and is designed specifically to improve one or more of the students' abilities. In this process, I will continue to track and observe each experimental group to understand the changes of students' thinking state at this stage.

The third stage is the extension and redefinition of the participants' abilities, which lasts about four weeks. This phase is mainly a test phase, each group will receive new experimental items. Compared with the second stage, this stage will be more freely. I will provide a general project type based on the performance of each group in the first two stages. As for the form, content, color and elements, they can be freely expressed as long as they conform to the basic logic of composition. This process is to test the creativity and imagination of all the experimental groups. In this stage, I added a content to expand the abilities of individual students, such as further stimulating them when they have basic creativity and imagination, and trying to improve their other abilities. I would like to introduce the enhanced abilities of the students: Software operation capability: Some students think that they have made certain improvements in the operation of photoshop, 3dsmax and Adobe illustrator, because they know that it may be easier and more time saving for them to finish their homework by using software, so they focus on learning software to complete the task. For them, how to use software to work together to complete the task is a challenge. This is student F using software to make an image of an ancient Chinese heroine.



Figure 4: Female hero design (Designed by student F, 2023)

Communication and communication skills: Some students think that their communication skills have improved during the course of design thinking experiment. They are usually introverted students who rarely communicate with classmates. The design thinking course is to help them share their plans and ideas, and then discuss the feasibility of the research plan according to the suggestions made by the team members. This increased ability to accurately express their thoughts helps build empathy and makes them more popular in the group.

Logical thinking ability: Some students think that they are more organized in the process of thinking about problems. Be able to accurately grasp the key problems that need to be solved in the design theme and propose appropriate plans according to these problems. The content

of the plan in their opinion includes what each team member should do and the steps to complete the plan.

Self-denial ability: Some students think that they have the ability of self-denial after participating in this activity. The ability to deny oneself here is the ability to face failure. Because in the process of team discussion, the plan they put forward may not be recognized and may even be rejected after discussion. The rejected students will reflect on the opinions put forward by the group members to understand why their plan was rejected, what are the reasons, and how to do the right thing.

Innovative and creative ability: Most students believe that they have the ability to innovate and create through course learning. But for this ability, many people describe the concept is different, some people think that their creative ability can accurately grasp the key words when facing the design theme. They can make some element association according to these words to get inspiration. Her design theme is the logo of a cafe. This is student D's brainstorming diagram and project diagram.

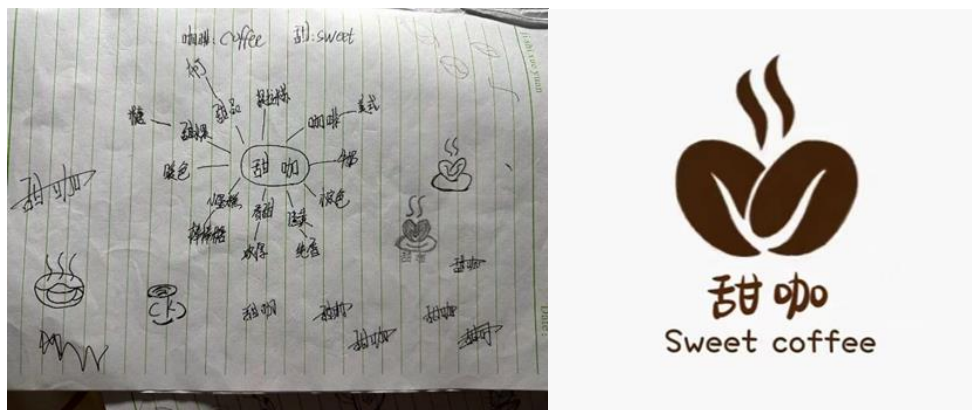


Figure 5: Student D's brainstorming (left) and logo (right). Designed by student D, 2023)

Some students believe that the ability to innovate and create means that they can propose original design schemes according to the subject content without plagiarism. This design scheme not only has its own design style, but also can solve certain problems in reality. Some students also believe that the ability to innovate and create means that their thinking mode of looking at things has changed, that is, the process of observing the essential changes of things. They are able to express certain phenomena and certain behaviors in a way that they are good at. This is student E's memory record of some fragments of his daily life on a certain day through drawing.



Figure 6: Student E's life fragment by drawing (Designed by student E, 2023).

Discussion

It can be seen from the results of experimental courses that design thinking influences students in many ways. For the object of this experiment, design thinking is more to improve students' ability in a way of guidance and stimulation. The improved ability can be students' innovation ability in the face of design projects, communication ability between teams and so on. The main ability has a very different impact on students in different age groups. For students in secondary vocational schools aged 15-18, it is an important stage for them to improve their comprehensive quality. The enhancement of any kind of ability will have a huge impact on their future development. Researchers determine the impact of design thinking on participants based more on closely observing the changes in their behaviors in the experiment. For example, student A was unable to accurately extract keywords from design projects in the first stage, but in the third stage, he was able to quickly make some design schemes while trying new design projects. This positive influence from scratch proves that design thinking is beneficial to students, and also proves that design thinking has a positive influence on training design professionals in secondary vocational schools.

Of course, we also encountered some difficult problems in this experiment teaching. The first problem we encountered was that some students were mostly based on the good or bad relationship between each other in the grouping process, which resulted in some students with poor comprehensive ability forming a team. The team may barely complete the task in the first stage, but in the second and third stages, they did not have a leader who can direct the direction of the team. Finally, this team could not complete the task. The second problem is that some students have certain mental diseases, such as depression, autism and so on. They have a hard time sharing their ideas with others. What's more serious is that they can't face failure. when others deny their plan, they will have too much bad emotions and eventually lose the ability to think and cannot continue to complete the design experiment teaching.

Conclusion

Design thinking is a systematic idea, process, tool and method to guide the training of innovative talents in secondary vocational schools. In view of the problems such as immature training mode of innovative talents in secondary vocational schools, slow changing of teachers' thinking and insufficient understanding of curriculum knowledge. This research

focuses on how design thinking innovates teaching and the teaching advantages of design thinking for talent training in secondary vocational education. The thinking mode constructs a basic model framework for innovative talent training of students in secondary vocational schools.

From a macro level, we have realized the improvement of teaching objectives and curriculum model, and from the micro level. we have changed the real demands and behaviors of my students. Design thinking guidance is a training mode for innovative talents. It not only trains students to analyze problems in a new thinking mode, but also changes teachers' teaching philosophy and optimizes teaching and curriculum structure. Of course, this mode of design thinking guidance needs practical guidance and continuous iterative process. Teachers also need to constantly update the model structure and optimize the design method according to different situations.

We believe, from the research done so far, design thinking curriculum model has the following positive effects on general China's secondary vocational education:

1. Help students develop empathy and improve their teamwork ability.
2. Compared with the technology-oriented curriculum mode in China's vocational education, the design thinking oriented curriculum mode can cultivate students' independent thinking ability and stimulate their potential more easily.
3. In the process of continuous design attempts by the team, students can have a clearer understanding of themselves with the help of other team members. Through comparison, they can understand their own shortcomings and keep growing.
4. Teaching experimental courses based on design thinking can also improve teachers' design ability. In fact, the questions raised by students in the process of design projects are random, and some of them even go beyond the knowledge in the textbook. In the process of answering students' questions, teachers review their design knowledge and indirectly improve their design ability.
5. For the current development of Chinese design, the curriculum mode of talent training based on design thinking is helpful to cultivate their innovative and creative ability, and provides theoretical guidance for the cultivation and transportation of high-quality talents in China.

This study concludes the significance of design education for training innovative talents in secondary vocational schools as they provide systematic ideas for teachers to better train students' self-learning ability, observation ability, innovation and creation ability, and provide an effective attempt for the reform of China's secondary vocational education in the future.

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