

Study on How to Cultivate Students' Design Thinking Through Woodworking Classes in k-12 Education

Dehua Yu^{1,a}, Jiping Yue^{2,b} Dehua Yu^{1,a} and Jiping Yue^{2,b}

¹ Beijing Institute of Technology, No. 5 Zhongguancun South Street, Haidian District, Beijing, China

²Kede College of Capital Normal University, No.10 Yuxiang Road, Yufa Town, Daxing District, Beijing, China

^ayudehuabit@163.com, ^b56806649@qq.com

Abstract

Design thinking is a systematic and learnable innovative thinking. In China, design thinking has been used in primary and secondary education and acquire some active experience. The combination of design thinking and woodworking classes can give an active attempt to cultivate children's design thinking and creation. Two programs of woodworking are chosen to study, one is "A Home for Light", the other is "A Place to Show Time", from which we study the creation process.

Key words: design thinking, woodworking classes, k-12 education

Introduction

Design thinking first came from design concepts, which is solution-focused thinking to solve design issues[1]. These years design thinking has been used widely in business, computer science and even education, especially K-12 education[2]. As one of the most important parts of STEAM(Science, technology, engineering, art and mathematics) education, art refers to art and design, in which design thinking plays an important role to inspire students to seek innovative ways to solve problems of the real world. In China, design thinking has already been introduced into primary and secondary education these years. How do we cultivate students' design thinking in primary and secondary education in China? That is a good theme. Woodworking Classes can be a way to accumulate the experience.

What is Design Thinking

Design thinking has narrow and broad connotation. The narrow connotation of design thinking is that designers obtain innovative design works through scientific design procedures and methods which is the method and means of art and design. The broad connotation of design thinking is not confined to the field of art and design. Innovative talents with design thinking are needed in all disciplines' fields. Design thinking is a way of thinking with people as the core, multi-disciplinary as the perspective, problem-solving as the orientation, and sustained and stable innovation as the goal. Design thinking is a kind of high-order thinking mode which can make innovative thinking come into being continuously and steadily and can be acquired through training. Design thinking is a growing thinking mode.

In the continuous training of design thinking, individual ability is constantly developing, promoting and improving.

A. Human-centered Focus

Design thinking is a human-centered way of thinking, solving people's problems around specific groups of people. Think from the user's point of view, to discover users' explicit and implicit needs. Design thinking must continually consider how what is being created will respond to the clients' needs[3].

B. Creativity

Design thinking is a kind of scientific and innovative thinking, which emphasizes solving problems creatively and guarantees the continuous and smooth occurrence of innovation through scientific procedures and methods.

C. Interdisciplinary Perspective

Design thinking is different from the single-dimensional perspective of single discipline in the past. It is an interdisciplinary and whole-disciplinary perspective and deal with problems comprehensively. When setting up a team, it pays attention to the multi-dimensional perspective of interdisciplinary and multi-disciplinary, so that the creation of innovation is not subject to disciplinary or professional restrictions. Therefore, it can obtain more comprehensive innovative choices, and ultimately obtain the most appropriate innovative results.

D. Team Work

In a team, we need both individual creativity and teamwork. Team cooperation can avoid the shortcomings of individual professional restrictions and single skills. It can explore the scheme from multiple perspectives and achieve the positive effect of team $1 + 1 > 2$.

E. System Design

Design thinking pays attention to the integrity of the task, considers comprehensively, and adopts scientific thinking and implementation process. It is not linear throughout the process, but the organic combination of each process node. It can jump out of the conventional process at any time, return to any node, dig information points in a deeper level, and develop iteratively to achieve the final. Optimize the achievements of innovation.

F. Metacognition Cultivation

Metacognition[4], known as "cognitive cognition", is the understanding and management of cognition, which is higher

than cognition. Metacognition can be simply understood as knowing what you know, understanding what you understand, and conscious of what you are aware of. Meta-cognition is the embodiment of design thinking process. At any stage of design thinking process, we should know our position, development trend and goal. This requires team members not only to know what they are doing, but also to know how to do it better and how to improve the method. With a view to doing better in the future.

Present Situation

In recent years, design thinking cultivation in primary and secondary education of China has been paid more attention to and developed well. In the 13th Five-Year Plan for Educational Informatization issued by Ministry of Education of the People's Republic of China in 2016, which pointed out that: "Conditional areas should actively explore the application of information technology in new educational modes such as maker space, interdisciplinary education, STEAM education, and creative education, to enhance students' literacy, innovative consciousness and innovative ability. We should foster the habit of digital learning, promote the all-round development of students, and support training of information technology to cultivate high-quality talents for the future." From the government, the importance of innovative consciousness and innovative ability in education has been formally put forward. From top to bottom, the cultivation of design thinking in primary and secondary education has been guided.

In 2014, Beijing started a program that take physical education and aesthetic education in universities and social forces to primary schools (referred to as "University to Primary School"). Some colleges and universities with design background actively participated in the work, bringing design thinking and innovative thinking to primary education, which achieved a multi-purpose effect.

In 2017, Tongji University of Shanghai cooperated with the Huangpu District Government, established Tongji Huangpu Creative Middle School. Based on traditional curriculum education and teaching, it introduced an expanding and research-oriented curriculum with an international perspective, which extends the creative design training learned by universities to junior high schools and senior high schools, aiming at promoting the cultivation of innovative and creative talents.

With the support of government and society, design thinking has been paid more attention to in primary and secondary education of China. It is a better way to involve in the current basic education, rather than drastic reform. There are several parts of classes from both school education and out-of-school education where design thinking can intervene.

In school education, labor technology course, information technology course, general technology course are the common classes in which design thinking program can be involved to cultivate students' innovative thinking. We can also transform traditional general technology classrooms into new design thinking program classrooms and combine design thinking program and traditional general technology together.

In out-of-school education, there are more fields to welcome the design thinking program, for example, science and

technology museum, youth palace, education company, community and even family classes.

Design Thinking Cultivation in Woodworking Classes

We will take the woodworking classes as example, to study the process of the design thinking program. In a 10-day autumn vacation, we invite 8 children to join our program, who is 6-12 years old, and is the first time to try woodworking program. So first day, we taught all the children to learn how to handle the tools (e.g. Fig.1) and how to make what they wanted. After that, the program would be shown to them.

Two themes have be used in the program, one is "a home for light" which is not about lamp but light, the other is "a place to show time" which is not about clock but time. From the two themes, students are guided to find an easy or wicked problem[5], which is the beginning of the program and also the important part of the program. Centered around the problem, students are eager to acquire the related informational knowledge by themselves or their teams. After a period of conformation and transformation of informational knowledge, the team will have brainstorm to obtain various methods to solve the problem or deal with the projects well, in which the real solution might be hidden. And when the team work continues, "the aha moment[6]" (a sudden comprehension that solves a problem) might come, which is what we want most.

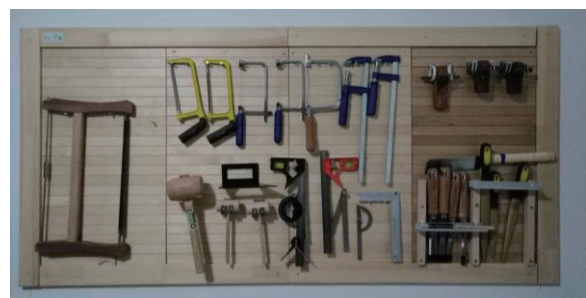


Fig. 1 Parts of basic tools of our woodshop

A. A home for Light

The Theme "a home for light" is not about the lamp but light. If a student entered the woodworking shop, he just made a lamp, finally he finished a lamp which might be the same with the one at home. From the process, he just learned how to make a lamp, and how to use the tools. That is the basic skill and not enough for the student to learn from the woodworking classes. He can learn more than that.

In this theme we study manmade light, which is different from natural light. What is manmade light? How do we use manmade light? Where do we use manmade light? All the questions would be discussed in the program. You can also tell the problems of the light in your life, and how to modify it to be what you like. You can find the problems around yourself, study on it, and try to find a better solution of the problems. You should learn how to make your thinking real with the help of tools in the woodshop.

Fig.2 "A cheese light" is designed by 8-year-old boy who does not like cheese really. First, he just wanted to try triangle shapes with different materials. When he mixed the several

triangle shapes together, he suddenly said he would try the cheese space for mice. The light was fixed in the triangle space behind the transparent plastic paper to give the mice the light to find his cheese. The switch of the light was also fixed in the box, which can be controlled by a thin line. He was so proud of the works and showed all his friends.

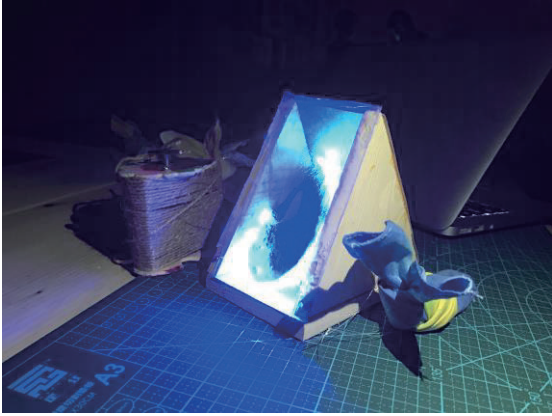


Fig. 2 A cheese light designed by 8-year-old boy

Fig.3 “warm light with hemp rope” is designed by 10-year-old girl. She planned to design a light for her bedroom which can company with her at light. So he chose a yellow and warm light and all the box and light was twined with hemp rope. The light is bluar and warm. That is what she wanted.



Fig. 3 A warm light with hemp rope designed by 10-year-old girl

Fig.4 “Parking light for cars” is designed by 6-year-old boy, who is fan of cars. He was focus on parking place for his favorite cars. He thought the parking lot should look like a car, so first he drew a shape of car, and cut them along the lines of the car. Then he added column and roof to set up a parking lot inside with the light.

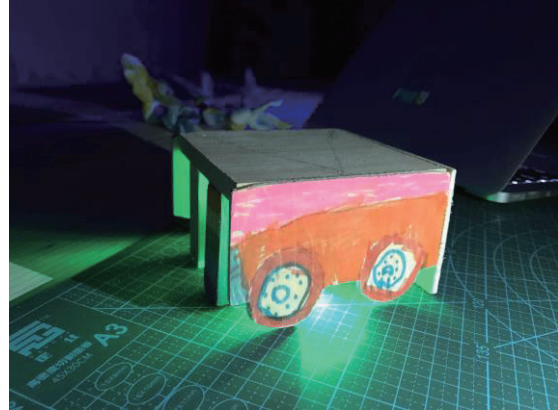


Fig. 4 Parking light for cars designed by 6-year-old boy

B. A Place to Show Time

Time is the eternal topic of art. The prominent Spanish surrealist Salvador Dali’s works “The Persistence of Memory” is one of the most famous works of time. The Theme “ a place to show time” is not about the clock but time.

First, children are talking about time. What is time? What is the use of time in our life? What is the problem of time in your life? How to design for your own time? Then children would be thinking what the time is he really wanted. In the process, all the thinking is welcome, and nothing is impossible. That would encourage children to think freely and try to achieve what they really think.

Lily (10-year-old girl) said time is moonlike which can change the size over time. Michael (8-year-old boy) said my time can be divided to sleeping time, play time and study time, and he hoped play time is much longer than the other two parts. Jack (12-year-old boy) said all the second hand, minute hand and hour hand of the clock is absolutely changed, which can be round with different sizes, and we can distinguish the change only by secret signal.

Finally, all the children had their own time to enjoy (Fig. 5).



Fig. 5 Works of time from 6-12-year-old children

Conclusion

One of the boys of our programs called Jack who is 12 years

old, because of the primary education of 4 years, he knows something is possible and something is impossible, something is right and something is wrong, and everything has only one right answer. What a pity! Four years' school education restricted his thinking, and he dared not to think freely and boldly. When he got the theme "It is not about the clock but time", he directly denied any possibility of the imagination of time: "The clock is just recording the exact time, and it is already enough for time. What I can do is just a clock, and the theme is really about the clock." When he was asked "How do you do if you want to record the most exciting time? How do you reflect the flowing time you are cherish?" Then Jack was lost in thought and he was thinking a new way to express his own precious time.

From woodworking classes, proper programs can inspire children' active thinking. The theme of the program is the beginning and most important, which determines whether the children are interested and glad to enjoy the program. Furthermore, the theme of the program also determines whether the children can be guided to inspire the creation. Children should be guided scientifically and followed the basic process of design thinking and modified their thinking and the way to solve the problems. Finally, they would acquire continuous and steady creation.

References

- [1] Destination, Imagination and the Fires Within: Design Thinking in a Middle School Classroom. *International Journal of Art & Design Education*, 2010, Vol.29(1), pp. 37-53.
- [2] T. Brown. Design Thinking, *Harvard Business Review*, 2008, pp. 86.
- [3] Owen C, Design Thinking: On Its Nature and Use. *Design Research Quarterly*, 2006, pp. 24.
- [4] JH Flavell, Cognitive Development: Children's Knowledge About the Mind. *Annual Review of Psychology*, 1999, pp. 21.
- [5] Buchanan, R, Wicked Problems in Design Thinking. 1992, *Design Issues*, pp. 5-21.
- [6] Beeman K M, The Aha! Moment: The Cognitive Neuroscience of Insight. *Current Directions in Psychological Science*, 2009, pp. 210-216.