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# Warp and Woof Method --- An Approach to Creativity

Yunfeng Huo<sup>1,2</sup>

<sup>1</sup>Huodesign, Toronto, Canada

<sup>2</sup>Mechanical Engineering Department, Tianjin University, Tianjin, China

## Email address:

huodesign@163.com

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**Abstract:** Since design education gets more importance nowadays a more effective teaching and learning model enhancing students' creativity becomes badly in need. The division between two categories of design schools also adds to the complexity of the given challenge towards innovation. To tackle this task many thoughts were collected and one special means developed to bridge the gap between theories and practice in design schools, namely the "Warp and Woof Method". The warp and woof method trains designers in a practice-focused learning process, where theories and knowledge acquired separately are organized for findings and building new products. New courses are fitted inside existing curriculum to transform it into trans-disciplinary one. The STEM course forms the missing warp in a curriculum of art and design schools, while a project-based creative course serves as a strong woof building up the fabric of designer training for all design schools. The applications involved examples and feedback from universities in China. STEM course was carried out in BIT in Zhuhai and the project-based design course was done in Qilu University of Technology in Jinan, China. Both cases involved teaching with Warp and Woof Method combining lecture and practice. Students' feed back were very positive and open to improvements.

**Keywords:** Warp and Woof Method, Creativity, Innovation, STEM, Trans-Disciplinary

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## 1. Introduction

The topic of design is no longer new in the world today. Since the Bauhaus was founded in Weimar, Germany in 1919, design schools grow all around the globe. [1] The kernel course in design education, innovation teaching, should be a common practice now. [2] But in reality we see the contrary in schools, and the high status of "design thinking" is the proof of this doubt. During my recent visit to and teaching in design schools I could witness that teaching innovation is still the hard part of any design education. All schools are carrying curricula with parallel courses for teaching. In China, there are no design courses until the second year; while the fourth year equals off-campus practice and final work on the thesis/project. Across the whole studying period, there is limited practice in finishing a complete project, since resources and motivation are not available for the work unless there is an extra incentive. Theoretical courses are done around certain areas of interest, just as a market research course will be focused on methods of market study. The focused course thus deals with only a

part of the design process.

Even greater impact comes from the division of school system. It is known that design schools generally comprise two types: academies of fine arts, and poly-technical schools. The art-based schools admit students according to their notes on language, knowledge about culture, and their artistic abilities; while engineering schools admit people of strong background in mathematics, physics etc., with little requirement for other talents.

Result is: the former students can make in a limited way designs as cultural products, and the latter students study technologies but do not know how to apply them for innovation. They have a common problem: something is missing in their education.

However there is attempt in the world where industrial design has been taught as a new art of engineering and thus driven by new thinking towards trans-disciplinary innovation. [3]

## 2. Theme Study: How to Raise Students' Ability to Innovate

### 2.1. "Dimension Upgrading"

First of all, language is a big restriction to our thinking. Therefore other dimensions of tools are needed! What is language? Here its meaning will be limited in an oral and written system of meaning for human communication. There are thousands of those systems since early human beings developed meaningful media to express and understand each other. Upon major languages people created civilizations in material form and leave us cultures as heritage to learn and follow.

Great philosopher Ludwig Wittgenstein wrote: Never has my language helped me to successfully express things I wanted to say; actually, less than half, or practically a little more than one tenth did so. (translation from Chinese) [4]

Why does language restrict our thinking to this extent? I analyzed it and found the following:

- 1) Languages need to be logical and understandable by people who are reasonable and normal;
- 2) Languages should obey a linear dimension, follow a right sequence according to their rules, and are more or less strict according to the chosen language;
- 3) Languages use words which need to reflect things with names and qualities, without exceptions;
- 4) Language following logic, using limited terminology and along one dimension must be very restricted;
- 5) There are so many regional and official languages, and poor translation causes problems.
- 6) To further explore the language problem, we should examine other tools, and explore ways to break out.

On studying the subject of dimensions a hypothesis was developed as "Dimension Upgrading": The capability to innovate can be strengthened when the dimensions of the tools used are raised. Let me explain as follows:

- i. Dimension of language: as mentioned before, it is one dimension only. But there are exceptions, like poem or verse. The language of verse follows the linear axis of time, but it will change lines from time to time, thus making many parallel lines and building a table-like matrix that is two dimensional. Moreover, there are links between those lines, according to rhythm, tones (as in Chinese) and other 2D rules. The difficulty of poem writing owes partially to its being multi-dimensional.
- ii. Dimension of mathematics: it is one dimensional, as language is; for reasoning is a lineal activity of the human brain and obeys the same laws as language. But modern mathematics has algebra which deals with N dimensions using matrices and builds models of N dimensions.
- iii. Dimension of diagram/drawing: diagrams and drawing are two dimensional and contain more space and much more information. They are more schematic and direct, but less capable of expressing concepts. The recent

trend of visualization is using diagram to make human recognition easier in daily life.

- iv. Colours and Dimension: coloured 2D pictures have more than two dimensions of information; the colour alone has more than one dimension of changes. Full colour has three primaries, and constitutes 3D messages, this is proved by the colour TV mechanism. Thus colour enriches 2D pictures greatly.
- v. Dimensions of thinking are influenced by the tools we use. Logical thinking uses one D, mathematical thinking uses 1-N D, visual arts uses 2-3 D, and design thinking uses 3-4 D, considering the extra dimension of functional considerations by design.
- vi. Creative thinking needs hypotheses; hypotheses need space, especially for unconventional outcomes! According to this idea, providing more space and possibilities equals more potential to innovation.

Adding dimensions of tools for thinking means increasing space and information capacities needed for thinking, and it thus creates more opportunities.

Sofar the hypothesis "Dimension Upgrading" is supported by the reasoning.

### 2.2. Lateral Links Build Ways

Beside language, another big obstacle is the conventions. However lateral links build ways to new situation.

Following conventions belongs to all cultures. Breaking down conventions, building anti-logical relations, so-called "lateral links" leads to innovation. That means going not along the lineal path, but extending outward sideways like the branches of growing plants. A designer can run into dead ends where all ways are blocked out. He can do nothing but give up, for his brain has stopped producing any possible new ideas. When he does stop however, his brain will not halt but runs secretly and freely. Suddenly there comes inspiration or a great idea seemingly irrelevant. What mostly happens is lateral link being built in his brain without any effort consciously. This kind of giving up becomes most productive and sometimes crucial for projects to succeed. This phenomena is no invention but empirical observation and experiences which are shared by many creative people including me; my contribution is merely to explain the mechanism and try to involve this nature into methodology to help students. Lateral links exist in human thinking; their function in the innovation process is true to creators and proved by their long time experiences. The "lateral link" is proposed for building links between objects of different qualities and foster divergent and free thinking. To build lateral links people should exhaust parallel ways and relax, letting the brain work for its sake. Building lateral links can also be used actively to break out of deadlocked situations in the design process.

By the way, this lateral link has essential differences to the "lateral thinking" invented by Dr. Edward de Bono who developed the method to find ways to bypass an obstacle. Lateral thinking is more concerned with the "movement value" of statements and ideas. In his lateral thinking

techniques there are following tools involved: 4 (or 6) alternatives; focus; (challenge; random entry; provocation and movement;); harvesting; treatment of ideas. [5]

In short he stresses ways to change direction of thinking purposely.

The two discoveries as mentioned above lead to the following suggestions or principles:

- i. To raise the dimension of tools, like adding a drawing activity to thinking, or adding model making to drawing etc.;
- ii. To allow lateral links, like breaking out when you get stuck or to link seemingly irrelevant motifs;

After exhausting all means, to pause thinking and start doing anything except the work, relax;

### 2.3. Redesign Curriculum

Another obstacle to innovation is the weakness in the dual-system of design curriculum.

As mentioned, students in art-based design schools learn too little about technologies. Their main skill relevant to design is graphics, either manual or via computer, resulting in very limited choices in professional career. It is by no means wise in an era of prevailing technologies.

Poly-technical schools separate students from craft-based design and offer them broken experience in project work. The knowledge learned in technologies suffices merely for passing exams.

New teaching approach therefore is towards the following:

Since art-based design students got their methods from craft heritage and their practice, the most needed is a new curriculum including science, technology, engineering and some mathematics. In engineering schools more urgent is setting new courses to develop students' creative capability. Here we need more practical courses in design, art, etc.; what is badly needed is learning by doing.

What shall be done to give students the missing parts of their education?

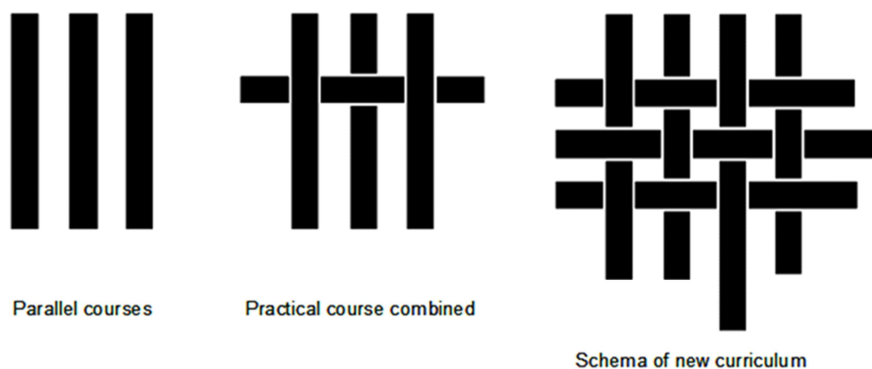


Figure 1. Schematical models of different curricula.

In principle we are combining activities “learning” and “practising”; theories can be tested in practice. This process gives students true knowledge and abilities. [7]

Confucius once said: “To learn and then practice, is not that a pleasure?” He described the satisfaction that practice will give learners some 2500 years ago. [8, 9]

## 3. Methodology “Warp and Woof Method”

For the question above the “Warp and woof method” was designed to improve the education in design schools. Let me explain the principles first. Warp and woof are terms used by the textile industry and they are the key part of weaving technology. The warps are the parallel threads which constitute the cloth longitudinally, while the woof is the line of latitude which weaves through the warps on the loom. The organization of warps and woof is made by the crossing movement of the shuttle which carries the woof to and fro, fabricating cloth with different patterns, colours, textures, and other surface qualities. [6]

Our method uses the warp and woof as metaphor, where warps are the parallel theoretical courses taught at the design schools, and woof should be the special course for practice in schools. These practical courses need to be carried out as living projects along with given procedure.

In short, theories make the warps while practice drives the woof. The crossing of warps and woof means here acquiring true knowledge. It guarantees applications of theories in practice through projects as a guarantor.

In order to fully build creativity we need many warps, many parallel major courses, and also strong woofs, namely new courses carrying fresh projects. Each crossing is a point of organization where theory is applied and practical problems are solved. This model ensures successful training in creative professions.

For example, it is possible to introduce in design schools from the first year one practical course each term; the courses contain projects, with gradually increasing scale. Every such course builds links to a few theoretical courses. By the moment of their graduate thesis, the students will acquire project experience and practical abilities 7 times.

As to the difficulty of creative design, the focus is within a certain period of projects, namely the conceptual phase. During this phase it is recommended to introduce the methods mentioned before as increasing dimensions of tools; as lateral links; and pausing the process to acquire new ideas. Certainly a teacher is still needed here for controlling

progress and giving advice as well as demonstration.

Repeating new courses or woof will give the student after 3-4 years greater capability, just like the cloth made.

## 4. Applications

"How to understand and benefit from the fresh experiences derived in trans-disciplinary practice with new technologies and how to discover their universal principles are questions for design educators on curriculum reform." Xin Xiangyang [10]

### 4.1. Case One: STEM in BIT Zhuhai

There second year design students were given the first course in Science, Technologies, Engineering, Mathematics during the fall semester of 2017. This is an art-based design school inside a 4 year university curriculum. The students have little knowledge in sciences and mathematics, but they did attend my course of design basics a year ago.

This time a few warps are introduced, which are the part missing in their courses so far, namely engineering basics and DIY ability.

The contents of the STEM course:

1. Mathematical review;
2. Basic material science; and mechanics;
3. Safety and electricity;
4. Machines part one, dynamics;
5. Machines part two, information technologies;
6. Basic manufacturing and 3D printing.

Each section takes a half day and theory takes 1/3 of the time, leaving 2/3 for DIY practice. Except mathematics all other contents are related to practice. For instance student groups were asked after the second section to build in a light structure using chopsticks and string, being able to hold 3 bottles of drink water, and bridging a gorge of 40 cm span. A simple radio with only one diode should be built after the third section; and a small cart driven by three rubber rings to be made after the fourth section; and finally after the fifth section every group should build a module of LED lights controlled by an ARDUINO micro-processor. The last event, visiting the industry, was not realized.

All students followed the course with interest as well as difficulty.

The results of DIY need to be mentioned, as they were mostly fruitful. Looking at the practice, 4 out of 5 projects were successful, except the radio, which was made but did not work. Big hit is the last one with ARDUINO where students showed great interest and the best result appeared despite existing difficulties.

The feedback came from 58 students who took part and all have given feedback. A survey was designed for information containing key words: personal gain; math; mechanics/material; electricity; micro-computer, and free commentaries.

Result calculated as follows:

- i. "course": 95% of them say they gained a lot or gained some from the course;

- ii. "math": 29% of them put math as just right, others say difficult or not understandable;
- iii. "mechanics/material": 64% of them accept and say interesting, or easy to make;
- iv. "electricity": 50% of them want to learn more about it;
- v. "Miro-computer": 53% of them think it is useful, 22% think not enough time was given for it.

21 people have commended, among them 2/3 hold positive attitude, and 1/3 express inability. Quotations of 3 commentators: "Teaching combined with practice, only this way will let us integrate really into it." "Useful stuff is boring, however it became ours after we learned it." "We have few blocks left for math and stuff, we are being trained as art students..." This result comes as optimistically expected. I thought the students in the art-based design school would still accept and understand some technology, and they did. Although math and physics seemed to be less comprehensible for many of them.

The STEM course we made was quite short and basic, however it had several important warps present as constructive subjects. The DIY project each time served as a dynamic woof that effectively links theory and practice.

This experiment proves that STEM courses are applicable in classic design schools.

### 4.2. Case Two: DESIGN METHODOLOGY in QILU University of Technology

Not long ago I was asked to teach Design Methodology for graduate students in Jinan, China. My idea was to introduce project focused design teaching in poly-technical schools with engineering backgrounds.

Design Methodology is often treated simply as typical theory. I have purposely turned it into learning creative thinking in the design process.

This course lasted 4 weeks, working with the theme "green logistics: packaging". This was to facilitate students' research and also for its social meaning in China today.

Students were divided into 2 groups for discussion and competition, while each student still needed to present their own ideas for a final presentation. The purpose is to teach students the big method of the design procedure, with different thinking skills in each phase. The focus is conception where divergent thinking is fostered. This is a mini model of the warp and woof method, where the warps of relevant theory and woof of project requirement to innovate came across. To put it simply, the task was to link creativity theory and packaging concept inside 4 weeks of project. Within 4 weeks the concept design project was carried out successfully. While one of eight students did not finish due to private reason, all others completed the work and presented their creative results.

In January 2018 I received feedback from all of the 8 participants.

Here is the summary:

- i. Achievement is: I learned process (5 people), methods (2), and habit (1);
- ii. Impression is: 7 say "practice over theory", one person

says it the opposite way;

- iii. Feeling: 6 people put divergent thinking, one gets excited, one feels precision;
- iv. Critique: 5 people “too little time”, and 3 say “too little theory”;
- v. Commentary:
  - 1) Almost all people agree, above all they learned the whole design process;
  - 2) They got training in divergent thinking and design practice, knowing design thinking in application;
  - 3) Many wish to acquire more methods and theory, which they may need in practice;
  - 4) Time seemed to be too short for them to finish project satisfactorily.

These graduate students involved are from industrial design, with one exception from mechanical engineering. This course was very helpful in building experiences using divergent thinking.

The original goal was reached and the feedback supported this conclusion.

## 5. Conclusion

The “warp and woof method” is a kind of wisdom applicable in many ways. It is not an invention but a tool derived from craft culture. Culture is understood as any form of human creation that is not material but inheritable. These new courses are still under testing condition. Even so they have broken the convention that no STEM course was taught in classic design schools. They did impact design students positively and evidently. The project-focused course in engineering schools stressed creativity training and divergent thinking. It also summoned up designers' consciousness in students' minds and amplified their ability to innovate. This kind of courses could be a model for creativity training, benefiting other engineering schools.

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