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Research Article

Research on Improving Manufacturing Practice Quality in Mechanical Industrial Design

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Abstract: In order to solve the problems existing in the manufacturing practice of mechanical industrial design, a series of methods and concrete measures are proposed, so as to improve the quality of manufacturing practice of mechanical industrial design. In this study, the problems existing in the manufacturing practice of mechanical industrial design are analyzed detailedly. And the methods and concrete measures including establishing the new mode of manufacturing practice of mechanical industrial design, improving the understanding to manufacturing practice and knowing the major role, establishing a professional characteristic base of manufacturing practice and strengthening the construction of instructor troops of manufacturing practice are proposed, which will certainly have a profound theoretical and practical guiding significance. On this foundation, the research conclusion on improving manufacturing practice quality in mechanical industrial design is done.

Keywords: Factory practice, mechanical industrial design, manufacturing practice

INTRODUCTION

In 2008, many enterprises that are depending on processing order in the developed costal area of China are facing many difficulties because of the global financial crisis, which in another perspective reflects the badly needed of self-design in China (Duan *et al*., 2012), while many talents in industrial design are wanted. However, the actual situation is that talents cultivated by most of colleges could not satisfy the demand of enterprises. Although the cultivating target of mechanical industrial design major is to bring up the designer who could create value for enterprise and is required by enterprise, actually it could not reach the goal. The reason is that in the education of mechanical industrial design integrating theory with practice, especially the teaching quality of manufacturing practice is relatively low, which leads to students the poor practical ability and the lack of engineering practice knowledge.

Manufacturing practice is a very important practice link to cultivate undergraduate of mechanical industrial design and is an important and effective way to improve the comprehensive application ability, practice skills and innovation ability of students for learned knowledge (Jia *et al*., 2009) and also is the only way to perfect the education development of mechanical industrial design. But in recent years, with the rapid development of industrial design in our country and college expansion, the number of industrial design student flourishes (Chen *et al*., 2011). As show in the survey, at the beginning of 2001, there are 192 colleges opened industrial design major among the country's 1166 colleges and by the end of 2001, graduates are about 30000. Today, the data is still rising rapidly (Duan *et al*., 2012). The scale of running college of industrial design especially mechanical industrial design unprecedentedly expands and the number of students is several times more than in the past, but the form of manufacturing practice is the same, which obviously could not reach the anticipated purpose (Wang, 2011a).

In addition, due to the market economy, the workers in the enterprises are focusing on economic profits and labor efficiency, who have less opportunities to teach students more practical manufacturing knowledge and also lack enthusiasm and responsibility to give instruction, which make the practice become a visiting and formality under most of circumstances. Manufacturing practice becomes a process which is unworthy of the name and it is difficult to see results about the cultivation and improvement of students' practice skills (Zhang *et al*., 2011).

Thus it can be seen that the link of manufacturing practice is the weakest link in mechanical industrial design major. How to do a good job in manufacturing practice and improving the quality of talents to satisfy the demand of enterprises is an urgent problem (Fu, 2011). So, to the mechanical industrial design, research on improving manufacturing practice quality has a profound theoretical and practical guiding significance. This study puts forward the method and the concrete measures about improving manufacturing practice quality in mechanical industrial design. Its purpose is to make students become the new type industrial design talents of good comprehensive quality which have the strong practice ability, the reasonable knowledge structure and the solid theoretical basis, so as to not only satisfy the demand of employing unit in the market, but

also accord with basic rules and basic requirements of training of undergraduate course.

MATERIALS AND METHODS

The problems existing in the production practice of mechanical industrial design:

The increasing number of students: In recent years, with the rapid development of industrial design in our country and college expansion, the number of industrial design student flourishes. In China, from1999, common higher colleges start expansion and the enrolling number from 1998 in 1.08 million to 2010 in 6.57 million, increases to 508% (Chen *et al*., 2011), which is shown as Table 1.

Table 1: The statistics of enrolling number in our country college in recent year

Years	Enrolling number (ten thousand)
1998	108
1999	160
2000	221
2001	268
2002	321
2003	382
2004	447
2005	505
2006	540
2007	567
2008	607
2009	629
2010	657

The scale of running college of industrial design especially mechanical industrial design unprecedentedly expand and the colleges have set up mechanical industrial design major one after another. Many colleges open mechanical industrial design major blindly, due to only see the good student resource and good enrolling foundation, in fact they do not have enough preparation of various aspects of education resources, such as teachers, equipments and so on Oleinik (2009). They stranded after the students are enrolled, as expanding blindly (Wang, 2011b). For this kind of practical discipline of mechanical industrial design, the practical ability of student is quite important. The problem that brought by blind expansion of mechanical industrial design major is that it already becomes quite difficult to carry through manufacturing practice for the enrolled students who are more than ever before in several times according to the past mode.

The outmoded form in manufacturing practice: At present, many mechanical industrial design students take a manufacturing practice with other mechanical major students and the form of manufacturing practice is still the traditional centralized manufacturing practice. This form of manufacturing practice is basically that the students of the same major who are taken by one or two teachers to a designated enterprise, where the safety officers give some safety knowledge or the engineers give a short lesson and then they just begin the visit practice. During the whole practice process, the students have never really participated in the production, only observing the process of production or looking up the technological document of the factory and then recording (Peng, 2008). Quite a few students even do not record and just view the flowers on horseback and watch the scene of bustle and many students who make record also do not really learn, just only in order to complete the mission. It is the traditional centralized manufacturing practice that will certainly trigger these disadvantages. Because the number of students is numerous, spreading to the factory, one or two instructors do not give enough guidance, plus internal noise, even if explaining and the majority of students also could not hear. So to the mid and late stage of practice, because of losing their curiosities and interests, the students begin to try to avoid the teachers or even just play for fun, which influences the practice effect seriously.

Many difficulties in contacting and fixing practice place: Due to the college expansion, the number of students increased, leading that manufacturing units are unable to accept so many students to come and practice. Too many students will increase the safety risk of a manufacturing unit and may also affect the normal production. Therefore, it becomes more and more difficult for manufacturing unit to accept the manufacturing practice of students. In addition, at present, the main unit of student practice is the state-owned enterprise, which is in an adjustment and restructuring period and does not welcome the student practice and some of which even refused. Even if accepting student practice, many manufacturing units also only allow students to do visit practice in green safe passage in a row. The green safe passage has a certain distance from the manufacturing equipment and this leads that the manufacturing practice more likes industrial tourism. It makes the quality of manufacturing practice to be sold at a discount greatly. Sometimes students of a few classes together go to practice at the same time, which leads that the practice team has more than one hundred meters long and the front team is already out of the workshop and the rear team has not entered the workshop (Zhang and Cao, 2011). So the student practice often is going process, entering in the front door and going out in the back door, which could not reach the teaching requirement of manufacturing practice and it is difficult to guarantee the quality of manufacturing practice.

Of course, it is a problem that contacting the practice place has many difficulties, but it is another problem that fixing the practice place that has been contacted also has many difficulties, because the adjustment and restructuring of enterprise may lead to the change of leadership and internal system and these may all result in the losing of original practice place. In addition, due to the factors such as the change of the personal relationship of the teacher to the enterprise or

work transfer of teacher, it is also difficult to fix some practice place established through relying on the personal relationship of the teacher to the practice place (Peng, 2008).

Student lacking of comprehensive understanding to manufacturing practice: A lot of mechanical industrial design students equate themselves with art industrial design students, thinking that they will be industrial designers in the future and it makes no sense to take a manufacturing practice with other mechanical major students to the manufacturing workshop, so during the whole practice process, with poor initiatives in manufacturing practice, they do not complete the task seriously (Belfi *et al*., 2012). Consequently, it becomes a vicious circle because they waste the opportunity and even leave bad impressions on the practice enterprise, it will hard for them to find a practice place in future (Wang, 2011a).

The weak instructor troops: Mechanical industrial design major is mostly put in the mechanical department. The Most of teachers of instructors troops are turned from the teachers of mechanical and electrical department and a few teachers come from the department of art design. While the teachers turned from mechanical and electrical department have not systematically learned industrial design and have also not engaged in design work, so it lacks of pertinence to guide manufacturing practice; the teachers coming from the department of art design have not learned mechanical courses, thus it appears powerless to guide manufacturing practice in manufacturing workshop, leading to the bad effect of manufacturing practice.

The methods and concrete measures:

Establishing the new mode of manufacturing practice in mechanical industrial design: Aiming at the numerous problems existing in the traditional centralized manufacturing practice, combining the major character and the development and change of society requirement, our subject team studies of a new suitable mode of manufacturing practice based on years of practical experience about the mode of traditional centralized manufacturing practice, as shown in Fig. 1. The new mode is divided into five modules (He *et al*., 2013). The first module is practice preparation, which is further divided into practice mobilization, professor topic lecture and network topic study. The second module is factory practice, which is further divided visit practice, theme operation and technical personnel topic lecture. The third module is making animation, which requires the students to make an assembling animation of some component that is seen in factory. The fourth module is writing reports, including writing manufacturing practice report of DOC format and argument report of PPT format. The fifth module is argument.

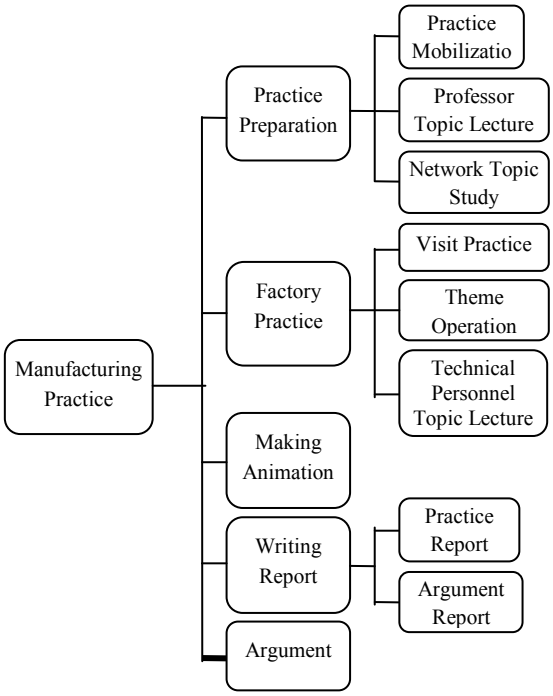

Fig. 1: New suitable mode of manufacturing practice

The explanation aiming at individual content of module is done:

- **Professor topic lecture:** The root reason why students do not practice seriously in workshop and try to avoid the teachers or even just play for fun is that the theory knowledge of manufacturing practice is not fully prepared, blind visit. In view of this, the practice preparation link increases the professor topic lecture. It could guide the student to integrate the knowledge that has learned to the practical knowledge and tell of students the key points and difficulties and the specific methods of practice.
- **Network topic study:** In addition to listen to professor topic lecture, students themselves must also get to the manufacturing practice site to learn, on which there are web site links of learning material and the video teaching, of which the content is rich, specific and intuitive (Youssef and Berry, 2012). In order to restrain students on the web site to study, teachers could examine student in asking questions way, not through the examination, one can not take part in the next module of factory practice.
- **Factory practice:** To the mechanical industrial design major, the factory practice is the principal part of practice. But with the college expansion, the number of students is increasing and the practice quality could not be ensured. In the new mode, the instructor leads the student to carry on the visit practice aiming at the practice content of every day

in the first and then divides group and sets theme for students and lets students to carry on the practical operation. Finally, inviting technical personnel make topic lecture. As this making pointed practice every day could make students get a bigger profit.

- **Making animation:** Mechanical industrial design major and art industrial design major are entirely different. It requires the students to understand the mechanical internal structure, to understand certain processing technology and process. So having students make an assembling animation of some component that is seen in factory would have the important meaning (Zhang and Gao, 2011). This not only can restrain students seriously and deeply practice, also can greatly increase students' computer level. Nowadays the enterprises have high requirement of computer ability for the students of industrial design, through this training, it could better meet the needs of the enterprise and lay a solid employment foundation for the future.
- **Writing report:** Writing reports not only contains writing manufacturing practice report of DOC format, but also contains writing argument report of PPT format. The manufacturing practice report is a complete review and summary the student makes to practice. But not as an argument report, the argument report should make an illustrated PPT format, at the same time, the animation that is made before should also link to it.
- **Argument:** Argument link is an important supply to objectively evaluate the manufacturing practice result of students. Instructors raise pointed questions according to the content of practice report, inspecting students the master degree to practice basic requirements and the serious degree of manufacturing practice. Finally according to the content of practice report and argument report, the making quality of animation and the argument situation, the result is confirmed.

Improving the understanding to manufacturing practice and knowing the major role: Some students think that they will be industrial designers in the future and it makes no sense to take a manufacturing practice with other mechanical major students to the manufacturing workshop. Students' point of view ignores the respective emphasis and the essential difference between the mechanical industrial design major and the art industrial design major (Dinther *et al*., 2011). The mechanical industrial design major especially requires students to understand the mechanical internal structure and to know certain processing technology and process, which is the foothold and the key strength for this major. Of course, students' point of view does not make no sense, after all, it is the industrial design major which is the base of cultivating industrial designer. So in addition to taking a manufacturing practice with other mechanical major students to the manufacturing workshop, it should also go to some industrial design enterprise or the manufacturer related to industrial design in which students could know the whole process of designing. Only students have the comprehensive knowledge and understanding the whole idea of programs from the original design of product to finally production and processing, can design a good product.

In view of this, it is necessary to have the experienced teachers do introduction combining the major characteristics with the enterprise characteristics and other stations, so as to enable students to have a comprehensive understanding to the manufacturing practice (Yu, 2012). At the same time, the theoretical foundation knowledge and the professional knowledge that have be studied and are related to this manufacturing practice should be properly concluded and summed up, so as to make students understand the purpose and the importance of manufacturing practice, correct the attitude of manufacturing practice and attach great importance to manufacturing practice from the thought, arousing students the enthusiasm of manufacturing practice.

Establishing a professional characteristic base of manufacturing practice: The industrial design especially the mechanical industrial design has a strong theoretical and practical feature, so the manufacturing practice teaching is fairly important for it. However the primary premise of strengthening manufacturing practice teaching is to establish the manufacturing practice factory of having the professional characteristics on campus, just like the Bauhaus school, which lets students enter into the factory and learn various practical skills after learning certain basic courses (Cheng and Jiang, 2010). At the same time, colleges could also set up the outside cooperative manufacturing practice base, which relies on the college, establishing the cooperation relations with surrounding related enterprise. But due to the uniqueness of this major, the outside cooperative base of manufacturing practice should be established with two types of enterprises and one type is the manufacturing enterprise in which students could learn certain processing technology and process; and the other type is industrial design enterprise or the manufacturer related to industrial design in which students could know the whole process of designing. For some areas in which the industrial design enterprise or the manufacturer related to industrial design is rare, schools should change ideas, based on long-term considering, trying to lead students to the industrial design enterprises of developed city to visit and practice. Industrial design students must broaden their horizon and have a good grasp of the latest things and only in this way can they become outstanding design talents in the future (Hennessy and Murphy, 1999).

Strengthening the construction of instructor troops of manufacturing practice: It should encourage teachers to walk out of the campus, entering enterprise to learn, so as to improve teachers' practice ability. Because the industrial design itself is a strongly practical subject and if the teachers do not experienced a lot of practice, it is very difficult to teach well the course of manufacturing practice (Jones and Moreland, 2004). And it can be tried to rotate post between the teachers and the engineering and technical personnel or the designers of enterprise, such as to not only train teachers, but also let the engineering and technical personnel who come from the first manufacturing line and have rich practice experiences carry out more intensive interpretation for students, killing two birds with one stone.

According to the characteristics of mechanical industrial design major dabbling multi-disciplinary, the existing teachers are put into two categories respectively, one kind is engineering and the other kind is the art. It is necessary to strengthen professional communication between two kinds of teachers, organizing mutual classes, learning from each other and trying to shorten the gap between the two disciplines (Jiang, 2011).

RESULTS AND DISCUSSION

- Perform the research and practice on manufacturing practice, build a manufacturing practice factory for the mechanical industrial design major at school. After learning some basic theoretical lessons, let students learn all kinds of practical skills at factory. So that the students' ability of practice can be improved and professional skills can be strengthened, in this way, we can really link theory with practice, which is also the needs of development and perfection of the subject itself (Jiang and Cheng, 2013). On the other hand, through manufacturing practice, the students' sense of organization and discipline will be enhanced, the spirit to bear hardships, hard work, cooperation and teamwork can be fostered. In this way, the comprehensive quality of the students can be improved.
- Perform the research and practice on manufacturing practice teaching, build a relationship with the enterprise and create a practice basement outside school. So that students can walk out of school and contact with the society, which not only can make the students have a better understanding about their own major and level of development of the relevant industries, but also can help them establish a correct outlook on life and values. Meanwhile, students can learn a lot of actual design process, access to new instruments, equipment, new methodologies and new processes which can't be learned on textbooks. It can effectively make up the insufficiency of class-teaching and lay a solid foundation for the study of the follow-up courses.

CONCLUSION

To the mechanical industrial design, manufacturing practice is the most important link in practice system and it directly affects the quality of training talent. Therefore, conducting the research on improving manufacturing practice quality is an essential aspect of mechanical industrial design education. This study puts forward the methods and concrete measures of improving manufacturing practice quality in mechanical industrial design, of which the purpose is to cultivate the designer who is required and could create value for the enterprise.

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