Training Outstanding Engineers by Co-operation Education between University and Corporation

Abstract:
The basic content to instruct graduation design (thesis) through co-operative education of university and corporation is to develop and improve the overall quality of students’ integrated capabilities and focused on employment competitive ability.
This pattern fully uses school and society that are two kinds of different education environments and resources as well as in talented persons raising aspect with the different respective superiorities.
By combining with the classroom instruction knowledge from primary school and the direct knowledge that is from the production practice, and the scientific research, which obtains efficient and better result in students’ education raising process, and comprehensively improves student's specialized quality and the humanities quality.
This paper mainly focuses on the feasibility of this model, structure and implementation of related issues, through our school years practice experiences, it shows that the model can help students improve their political and ideological qualities, engineering capabilities, and enhance their employment competitive abilities. Meanwhile teachers’ exercise and practical engineering capabilities have been improved, which helps to make up for lack of teaching resources in schools. The model is very good and efficient way to train innovative and talent people and develops implementation of outstanding engineer training plan.

Key words: Cooperation education of university and corporation ; Teaching pattern ; Graduation design (thesis).

1. Introduction
Graduation design is an extremely important practical teaching part of higher engineering talent training plan, the students use all the basic theory and expertise in the four years’ learning in the university under the guidance of professional teachers, conduct independently scientific research and solve practical engineering problems. It is integrated creative activities. "on the strengthening of universities and colleges graduate design (thesis) work", which created by Ministry of National Education, China clearly states: "Graduation Project (Thesis) is an important embodiment of the combination of education and productive labor and social practice, and an significant part to develop ability to innovate, practice capacity, and entrepreneurship of the students, and it is also considerable to measure the level of teaching management."

With the rapid development of Chinese higher education, higher education changes from
elite education to mass education, so that the number of students increases sharply. Graduation project (thesis) teaching resources are relatively tight, and the severe employment situation forces the students in the graduation project (thesis) phase consume a large amount of energy in finding employment and other reasons. These lead to a serious decline of graduation project (Thesis), while schools and students are both awkward for this. For the problem appears during the graduation project (paper), explore and study "co-operation between university and corporation" guide Graduation Project (Thesis) model. The practice results indicate that it enhanced the awareness of innovation and engineering capabilities, employability and competitiveness of students. The model has important practical significance for exploring the reform of the teaching content and practical ability training system, and for cultivating applied creative talents under the popular education.

2. Main text: Combination of school and enterprises guide Graduation Project (Thesis) model
2.1. Effective model of training application creative talents

Shanghai Institute of Technology in China is an ordinary high school training the application talents which merged three old colleges having fifty years history with a strong industry background. According to the orientation "build a high level, applied subjects, industry-based, multidisciplinary distinctive college, becomes the cradle of training engineers", the college proposes the goal: "cultivate the high-level application engineers and technical personnel that have innovative spirit, practical ability, and with international vision.” stress the basic principle that "solidification foundation, widen caliber, enhance capacity, strengthen application ". School adheres to carrying forward the fine tradition of relying on the industry, encourages the teachers to carry out school-enterprise cooperation in education. In the history school co-operated closely with big and medium-sized enterprises in metallurgy, chemical industry, and light industry, laid a good foundation for school-enterprise cooperation in education.

School-enterprise cooperation in education is an effective model to train application innovative talents, and its basic content focuses on developing and improving the overall quality, integrated capabilities and competitiveness in employment of students. Full use of two different educational resources and educational environment between school and society, and respective advantages in training personnel, impart knowledge to the students combining two methods, one is from classroom-based school education and the other is to obtain direct knowledge from production practice and scientific research.

Application innovative personnel training can not achieve the desired objectives only reforming the curriculum and updating teaching content system with no corresponding teaching methods, and can not guarantee the quality of education and learning. The school has always been focused on how to make full use of education environment and resources of society and enterprises, integrating school-enterprise cooperation system of education into the school curriculum, reform and innovation of teaching content and methods, forming a new training model. The school-enterprise
cooperation in education in the process of guidance teaching Graduation Project is essentially a meaningful reform and innovation of teaching methods. So starting from this orientation, school enhanced intensity of the school-enterprise cooperation guide Graduation Project (Thesis) work and used the work as the annual assessment indicators of school (department), and also introduced the corresponding incentives.

2.2. The structure and related issues with school-enterprise cooperation guide Graduation Project (Thesis) patterns

2.2.1. Constitute of school-enterprise cooperation guide Graduation Project (Thesis) patterns

Most of the traditional guide models of Graduation Design simulate research, development, and duplicate the subject that has been studied. The design are often biased towards the application of own expertise, and related comprehensive knowledge is narrow, the results only remain in the design drawings and Instructions, whether the design is correct and the implementation can be carried or not is difficult to test, so that the graduate design (thesis) can not close to engineering practice. For lack of teaching resources such as teachers, laboratory equipments and space, it is difficult to achieve "one person one question", this affected the ability of students to work independently. The main place to do graduation design is in the school, and the relevant conditions are difficult to meet the needs of application Talents.

Combination of school and enterprise guide Graduation Project (Thesis) model is combining the graduation project (thesis) and research or production needs of enterprise, and then the graduation project (thesis) is arranged to enterprises, so that students combine the theory with production practice in a real environment. Constitute of the model: (1) Graduation project came from the first line of production or scientific research; (2) Enterprise assigned experienced engineers to guide, or help school teachers to instruct; (3) School and enterprises are responsible for the management of the students graduation project; (4) School is responsible for monitoring the whole progress and quality of graduation project of the students; (5) Enterprises provide design space, product samples, technical data, design manuals and other working conditions; (6) The assessment of the graduation design participated by the joint of school and enterprises, the score are got by joint review, the experts review and graduation graded reply.

2.2.2. Issues related with combination of school and enterprise guide Graduation Project (Thesis) model

The first is the choice of a graduate design topic. It is a critical link to implement requirements of the graduation, to ensure the quality of graduate design, to meet the business needs. The subjects of graduate design of students are general from research projects of the teachers and cooperation projects between schools and businesses, or students who have entered into employment agreements with the companies or achieved
employment intentions, use the subjects of the companies. When translating the scientific or the actual production problem needed be resolved in business into graduation project (thesis) topic, teachers must pay attention to the selected topics should meet the following requirements: (1) subject is comprehensive, that is to say: content of the design can apply science expertise more fully, and meet the requirements of training basic skills comprehensively. (2) the size and depth of the topic is appropriate, if it is too small, too simple, it is difficult to achieve the purpose of training students; if the subject is too large, too difficult, it is not able to fulfill in a short time, both of this are not appropriate to be a graduate design project; (3) advanced and practical, As questions are from teachers’ research or business, most of them can meet this. It should be pointed particularly that students bring their own business questions, there are often two cases, one is subject is too simple, there are more transactional components and enterprises use students as "labor" and the title does not meet the general requirements; the other is student’s jobs don’t correspond with the discipline, the subject content do not match requirements of teaching and training program. It’s important to strictly review, to find points of integration by communicating with the companies, to reduce the gap between training requirements and business needs for identifying the content of graduation design.

Followed the place for the graduation design is usually within the school or enterprises. If the process is in school, it is easy to be conscientiously implemented because the school has a sound graduated design requirement, specification and management system. If in the enterprise, students graduate design and the corporate induction training are carried out at the same time, its problems is sites, time, information for design, guaranteeing of the instructing time of the corporate guidance, as well as the daily management for students, monitoring of design process and personal safety issues. Therefore, attention should be paid to strengthen the ideological education and safety education of students, and ensure that school monitors the whole process of graduated design work from the system. Students who completed graduation in business can not participate in the normal registration and call name in school, but they must participate in starting graduation design examination, mid-term examination, rectification of the problem found in the inspection, all of which are organized by school, complete the task of graduation design according to the required time. At the same time the school should strengthen communication with business mentor, keep abreast of the guidance situation during the graduate design was going on; grasp firmly the progress and quality of graduate design.

The third is the composition of the instructors, and its composition in the three forms: university teacher guide separately, technical personnel of enterprises guide individually, enterprise technical personnel cooperate with college teachers guide together. For the technical personnel of enterprises guide separately, they should be aware of the problem that is for the reasons of the professional, technical personnel of enterprises are not familiar with the requirements of the graduation design and the relevant system and provisions of school. So it’s necessary to provide a teacher who is familiar with all aspects of the graduation design in the school, the teacher is responsible for the management of graduate design to ensure the progress and quality of graduation design. For school-enterprise cooperation common guidance in the form of "double teacher", despite its "common guidance", a clear division of labor should be implemented,
and they are duty to their own familiar territory. In general school instructor in charge of the argument of graduate design topic, the progress and quality control of the whole process, and business mentor is responsible for specific guiding the content and details of the design, give full play to its engineering experience and practical ability, and other areas.

3. Practice effects of the combination of school and enterprise guide Graduation Project (Thesis) mode

3.1 political and ideological quality of students improved

In the process of the school and enterprise combination graduation design, students are in the first line of primary production, experienced job training and learned from the business guidance staff’s words and deeds. When saw their hard-working, conscientious spirit, the students will be influence profoundly on thoughts and character. As further understanding of the enterprise, students see what kind of personnel enterprises and the community welcome. It enhanced the students’ social responsibility, and it is helpful to re-position their own value.

As school and enterprise combination guidance graduation design issues are all from teachers’ research or the actual enterprise project needed be solved, the students are very aware of their work that must be completed and resolved, resulting in a strong interest and responsibility in the work, in the graduation project process, seeking truth from facts, serious, solid norms work style and rigorous academic style of students are trained, so that the political and ideological quality of students has been greatly improved.

3.2. Engineering capabilities of students have been fully trained

In the combination of school and enterprise guide Graduation Project (Thesis) mode, the situation is: "one person, one question, practical problem, do it yourself", the students change from the completion of "student work" to "engineering apply" in a short time. In practical engineering environment, you can always ask technical personnel of enterprises and the old master for advice, and can learn a lot of experience in engineering practice that can’t be got out of class. During the process, the technical and economic concepts of students are consciously trained due to daily hear and see the real engineering environment, all of this enable them to pay attention to feasibility of the technology and economic analysis from the early time. At the same time the skills of application computer, the abilities of logical thinking and writing have been fully trained and improved.

Combination of school and enterprise guide Graduation Project (Thesis) mode is more useful to bring up the students’ ability to solve practical problems independently, and more useful to comprehensively train engineering capabilities of the students. The traditional graduation project (thesis) guidance mode can not compare. The ratio of the outstanding graduate design (Thesis) in previous Graduation Project(Thesis) was 42%, quite a lot of articles published in the
relevant publications, many results of graduate design (thesis) research been applied to practical industrial production, or obtained scientific and technological progress awards given by Department, province or municipality, or applied for a national patent. Such as:

Teachers of Department of Mechanical and Automation Engineering have guided 24 students in 2004-2007, three grades to research and develop "core technology of continuous drawing machine of research and development application," which is project funded by research Fund of Shanghai Education Commission, and lead students to work in actual situation: common access to documents, investigate in product place, let technical personnel of enterprises teach their classes, discuss, analyze, make the overall program, divide the labor so that each student independently complete a specific section. Guide them to complete all design calculations and drawings of "multi-functional continuous drawing machine", which is products of scientific research. This product has been manufactured by force of Heavy Industry Co., Ltd. Shanghai, and obtained good economic and social benefits. The project has won the "Chinese universities outstanding exhibits Grand Prize" given by the Shanghai International Industry Fair, "Shanghai Scientific Progress Award", "China Machinery Industry Science and Technology Progress Award" and "Shanghai School Cooperate with Enterprises Excellent Project Award." The engineering capacities of 24 students have comprehensively trained, and they got a 100% employment rate.

The teachers of Materials Science and Engineering Department cooperate with technical staff of Shanghai XinXing Machinery Factory to guide two 2006th session students, who participate in the subject "comparative research effect of three antirust" and "non-mechanical exploration of stress treatment to 6061 (LD30) of aluminum". The results was directly used to guide the actual production by companies, and it improved product quality, had a significant effect to reduce production costs.

The teachers of Art and Design Department cooperating with designer of Shanghai Liu Via Packaging Design Co., Ltd. instruct the 2007th session students to finish eight Steering package graduation project, combine the materials, technology, production and creative, design and the market demand, focus on hands-on abilities of design practice, production and others, and ability to master the computer graphics operations, the results are significant, more than twenty pieces of packaging designs received design patent of country.

3.3. Enhanced the employability and competitiveness of students

Combination of school and enterprise Graduation Project (Thesis) mode improved the rate of first time employment and satisfaction to their job of students. Employment situation of students developed under this model is very good. As the model trained students’ awareness of innovation, organization and discipline, responsibility, practical application skills, teamwork abilities, the students greatly enhanced their employability and competitiveness, and students are greatly welcomed by employers. For example:

The teachers of Mechanical and Automation Engineering Department guide two 2006th
session students, who participate in the subject "electronic control design of two transmission billet flame cutting machine" and "electronic control design of slab flame cutting machine", the subjects were contents of research projects "research and application of great arc billet continuous cast steel core technology", which is commissioned by the YaXin continuous casting Engineering Co., Ltd.. the design results have been applied by the company, and the company signed with them as regular employees before graduated reply. The same project trained the other two 2007th session students signed with the YaXin continuous casting Engineering Co., Ltd. before graduate.

The teachers of Materials Science and Engineering Department cooperating with technical staff of the Shanghai Institute of Architectural Science guide the 2006 session students to participate in the subject "research of polyurethane exterior insulation system", and the polyurethane thermal insulation material that developed has greater flexibility, more prominent integrated performance, laid a good foundation for enterprises research and the industrial of products, GaoYu is hired by the company.

The teachers of Urban Construction and Safety Engineering Department cooperating with technical staff of the Shanghai Modern Design Geotechnical Engineering Group guide the 2007th session students to join in the project "application of high energy dynamic compaction in the Chinese oil 'processing 10 million tons of crude oil' project". The results of design were adopted by the businesses, and the student was hired by the same company.

The teachers of Fragrance Flavor and Technology and Engineering Department cooperating with technical personnel of Shanghai ShouYuan Food Co., Ltd. guide the 2007th session students to join in "research of a new high content of lecithin tablets preparation technology", developed a new type of preparation process that can received high content of lecithin. The content of phospholipids can reach 70%, and lecithin is higher than content of the current similar products, and has crisp texture, the student has been hired by the company.

Combination of school and enterprise Graduation Project (Thesis) model effectively solves the conflict between stage of students graduate design and internship of the employer on the time. At the same time, the process of students do graduate design (thesis) in company is also the process to be familiar and comfortable with enterprises, so the students have the opportunity to select enterprises. Students come into enterprises in advance also enable enterprises to have a full range of inspection on students, then to select of the appropriate graduates. At last it reaches a result that the schools, company and students are satisfied.

3.4. Teachers got exercise and improved

Combination of school and enterprise Graduation Project (Thesis) mode makes college teachers get exercise and improve, especially for young teachers. In recent years, colleges and universities introduce a large number of young teachers with doctor’s degrees, and
most of them are from school to school, lack of practical ability and experience in social practice, which requires creating opportunities and places for them. Combination of school and enterprise Graduation Project (Thesis) mode create such conditions for young teachers, through their cooperation with technical personnel of enterprises in the guidance, they join the actual production, broaden their horizons and achieve combination of theory and practice, enhance their projects awareness and innovation, so it exercises and sharpens young teachers.

3.5. Make up for lacking of teaching resources in schools

Since the leapfrog development of Chinese higher education, it changes rapidly from elite education to mass education, the number of students increased dramatically, and the model "one person, one question" is needed to train students to solve practical engineering problems independently, resulting in the teaching resources of graduation project (thesis) in school is relatively tight. In the combination of school and enterprise Graduation Project (Thesis) mode, many students complete their graduation projects in the enterprises, and technical personnel in the company as teachers of students in the graduate design, as well as laboratory equipment, materials, and funds are provided by the companies, which alleviates the current pressure of inadequate situation of teaching resources to some extent.

3.6. Consolidated and developed relations between schools and enterprises

Through the combination of school and enterprise Graduation Project (Thesis) mode, enterprises realized that school-enterprise cooperation in education not only promotes reform of higher education, develops the students who can better adapt to social needs, but also provides high-quality personnel for the enterprises, promotes the progress of science and technology and production development of enterprises. Referring to the consensus "mutual benefit, two-way participation, common education", schools and many business units establish a production and research group. Currently the school has built more than two hundred stable base places for practice teaching with the Shanghai Federation of Industrial Economics, Shanghai (Huayi) Group Company, Sinopec Shanghai Petroleum and Chemical Corporation, Shanghai BaoSteel Group, Shanghai Electric Group, Shanghai Environment Group Corporation, Shanghai Modern International Exhibition Co., Ltd. and others, and they have signed agreement for along-term cooperation. The school-enterprise cooperation model in personnel training came into a virtuous circle. The relationship between schools and enterprises has been further consolidated and developed.

4 Conclusions

In recent years, the ratio of school-enterprise cooperation guide graduation project (Thesis) has increased annually in our school. In the 2006th session, the number of school-enterprise cooperation guide graduation project (Thesis) was 213, accounting for 8.8% of the total school subjects; the 2007th session the number of this Issue is 360, accounting for 15%; the 2008th session the number of this Issue is 462, accounting
for 22.67%; the 2009th session the number of this Issue is 585, accounting for 30.45%.

Effects of school-enterprise cooperation guide graduation project (Thesis) model proven that the model set up a bridge between the Higher Education School and Society, strengthened the links between colleges and the national economic construction and social, provided students with a broad space for combining theory with practice, promoted students in the innovative sense, improved the engineering practice ability of students, it will help students enhance their employability and competitiveness in the current severe employment situation. On the other hand, the subjects in the model are problems of research and technical production needed to be resolved rapidly, so it has been supported by the companies. Therefore, school-enterprise cooperation guide graduation project (Thesis) model is to an effective way to implement outstanding engineers training programs, cultivate applied innovative talents for university.

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