



CAD Education of College Students with Engineering Practice and Team Work

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ABSTRACT

With research direction refinement and information globalization, knowledge economy puts forward higher requirements to high-level talents. University education is very important to cultivate high-level talents. For students of mechanical-related majors, the cultivation of college students' comprehensive application ability has become an important problem to be solved urgently. In view of current CAD comprehensive training of college students, environment for engineering reality is provided difficultly. This paper sets the development of "Standard Parts Library of Rolling Bear Based on SolidWorks" as an example to illustrate that mechanical engineering students make teamwork and collaboration to complete the standard library research and development and cultivate their CAD comprehensive ability in research project. Through the application of practice, we find that the proposed training method can not only be applied to senior students, but also to lower grade college students, and it also creates a new educational model in cooperative environment.

Keywords: college education CAD comprehensive ability, engineering environment, cooperative environment

INTRODUCTION

With the advent of the era of knowledge economy, knowledge and information have become decisive factors in national, business and individual competition. Society's demand for high-level talents is also increasingly urgent, especially for high-level talents, and college education is facing unprecedented opportunities for revolution and development (Wang, et al., 2016). Meanwhile, along with the detailed division of social labor and research (Feng, 2008), and information globalization and network, the knowledge economy puts forward higher requirements for high-level talents in ideological quality (Zhu, et al., 2014), knowledge structure and comprehensive ability etc (Yu, et al., 2015). As high levels of education system of student education, huge challenges always exist, which are shown as follows:

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State of the literature

- Students on CAD education of college face unprecedented opportunities and unpredictable development in recent years. The main aim of these studies is to cultivate more high-level talents at college to meet social demand and increases the integrality of high level education system.
- Based on engineering practice, methods of cultivating students' comprehensive application ability and quality of CAD are studied to make students participate in scientific research activities efficiently.
- We set the development of "Standard Parts Library of Rolling Bear Based on SolidWorks" as an example to illustrate that mechanical engineering students make teamwork and collaboration to complete the standard library R & D and cultivate their CAD comprehensive ability in the research project.

Contribution of this paper to the literature

- The significance of the present study can not only be applied to senior students, but also to lower grade college students, and it also creates a new educational model in cooperative environment.
- We have set up the activity mechanism of an inter-promotion between teaching and researching and students participating in scientific research projects.
- The process management method of student CAD capacity and quality training and the measurement standard based on engineering practical requirements are formed.
- We published 9 papers, including 1 SCI / SSCI to be checked, 6 EI searched papers, and 1 EI paper to be published.
- We develop 4 sets of three-dimensional model library of manufacturing information.

- At all stages of the university, college students have different degrees of exposure and use to methods, techniques and tools of CAD (Bodein, et al., 2014), but there is still a far cry from the engineering practice of jobs they are facing.
- How to speed up and deepen the comprehensive application ability of college students in the university is a very important problem of college education now (Zhang, et al., 2016).
- In contradiction with the CAD comprehensive ability training, it is difficult to provide a completely practical environment for engineering practice in the current university, which can provide a variety of training opportunities for college students. This is not the current difficulties faced by our school, but current problems faced by universities all over China.
- Team work and comparative learning gradually become the mainstream of modern work. It needs to explore how to cultivate students in college education in a cooperative manner

Therefore, the student's learning cannot just the accumulation of knowledge, and the student's education should be based on the ability to cultivate (Kessler, et al., 2010). Research ability and innovation ability of students should be cultivated; moreover, more education should pay attention to teamwork spirit and CAD comprehensive ability training (Barker, et al., 2015).

In this paper, we set the development of "Standard Parts Library of Rolling Bear Based on SolidWorks" as an example to illustrate that mechanical engineering students make teamwork and collaboration to complete the standard library R & D and cultivate their CAD comprehensive ability in the research project.

METHOD

Necessity of Student CAD Comprehensive Ability Training

With the globalization of economy and information, social development has entered the coexistence era of competition and cooperation. Scientific development puts higher requirements forward interpersonal communication and cooperation (Ostrom, 2000). A new work mode for people is more open, group and network, rather than a closed, small-scale and decentralized way. Individuals cannot work in isolation, but to communicate

with people. For instance, multidisciplinary special researchers are gathered to solve some significant research problems. The scope of cooperation extended from individual, department to country, the form of cooperation is also varied (Chiriac, 2014). At present, team has become one of main forms of cooperation, CAD comprehensive ability of team members is a key factor to impact on the entire team work efficiency or research results. Comprehensive ability is reflected in many ways, such as mutual tolerance, mutual trust, mutual cooperation, and mutual concern (Yuan, et al., 2010). Therefore, training of students' comprehensive ability of CAD is both the development of times and the need for research activities. On the other hand, students need their own development in cultivating their comprehensive CAD abilities (Xiao-Rong, et al., 2010). Learning and research activities are mental work, with the characteristics of individual labor. Most students focus on personal striving, who have a strong sense of independence and self-centered consciousness, but they are also lack of accepting and adopting different opinions and suggestions, leading to weak collective consciousness, low team spirit and poor comprehensive ability. This is not detrimental to the improvement of student professional quality, also hindered their own humanistic quality development, And what is worse is, graduates, who cannot match social needs, fail to meet requirements of employers.

Performing Organization and Method

1 Main Research Contents

- We study how to cultivate students' comprehensive application ability and quality of CAD based on engineering practice (Hsueh, et al., 2016).
- We study how to enable students to participate effectively in scientific research activities, and to form scientific research-driven teaching mechanism.
- We study how to measure the standard of students' comprehensive application of CAD.

2 Method

- We use scientific research projects to drive students CAD ability, so that students are in a team by various levels of engineering staff to experience the real environment of engineering practice.
- We improve the standard of CAD training for students, in accordance with real requirements of engineering practice.
- We choose the mainstream commercial CAD system as a tool for students' CAD ability training directly with the engineering practice, according to the practical needs of engineering practice.

REQUIREMENT: According to the enterprise engineering practice environment on the needs of CAD capacity, we focus on the CAD drawing, three-dimensional modeling and parts assembly to exercise in accordance with actual standards of engineering strict requirements.

ENVIRONMENT CONSTRUCTION: According to the national "Eleventh Five-Year" e-publication planning project - Resource-based design, manufacturing method libraries, and resource library implementation requirements based on standard configuration (Li, 2017). We carry out the task decomposition, which will be allocated to undergraduates of CAD capacity requirements, so that students integrate into the research team (Virtic, et al., 2016).

TOOL SELCSTION: We use current domestic and foreign commercial CAD systems: NX, Pro/ENGINEER, CATIA, SolidWorks and AutoCAD (Oncu, 2015).

3 Organization

- According to the enterprise engineering practice environment on the needs of CAD capacity (Gok, 2017), we focus on the CAD drawing, three-dimensional modeling and parts assembly to exercise in accordance with actual standards of engineering strict requirements.
- According to the national “Eleventh Five-Year” e-publication planning project - Resource-based design, manufacturing method libraries, and resource library implementation requirements based on standard configuration. We carry out the task decomposition, which will be allocated to undergraduates of CAD capacity requirements, so that students integrate into the research team (Lee, et al., 2016).
- We use current domestic and foreign commercial CAD systems: NX, Pro/ENGINEER, CATIA, SolidWorks and AutoCAD.

4 Characteristics and Innovations

- We use scientific research to promote teaching, and to provide a real engineering practice environment (Pan, et al., 2016).
- We are demanding at high standards. Competency training standards come from actual engineering requirements and publishing standards.
- Through the development of the three-dimensional model library of manufacturing information, we have enabled students to actually integrate into the development of real digital products (Zhou, et al., 2015).

Cultivating Students’ Comprehensive CAD Ability with Core Scientific Research

In the process of student training, some learning courses, which often focus on theoretical knowledge and basic professional competence training related to the profession, are arranged, but team spirit and CAD comprehensive ability cannot be cultivated through these courses. In addition to learning courses, students spend more time on participating in the research group or research team under the guidance their mentors, so the mentors’ research topics have provided necessary conditions for the cultivation of students’ comprehensive CAD ability. Research group or research team is a free academic group, a clear research direction with a clear research direction and a common research objective, and such research objectives often cannot be completed by independent individuals. Because research requires a certain amount of research time, students can usually participate in the study of certain stage according to research progress. Because of the common research goal in the process of carrying out scientific research, the research group is easy to form an equal, free, democratic and active academic atmosphere. Students as members of the team will plan and combine their own research strengths to participate in the different divisions of the subject, so that members formed a relationship between divisions of labor. At the spiritual level, members need to achieve mutual trust, mutual tolerance, mutual cooperation and to work together to pursue overall performance. In the practice of research, members should always talk about academic issues, exchange ideas, compare and judge different views, and integrate and innovate methods. In the search for answers, members should help others to enhance the ability analysis, to overcome their own limitations and understand of biases, to improve the ability to get along with others, seek common ground while reserving differences, exchange and cooperate.

Take the development of “Standard Parts Library of Rolling Bear Based on SolidWorks” as an example. In the mechanical product design, rolling bearing standard parts, with many types, large amount and different forms of structure, are often involved in drawing or modeling work, which will lead to work cumbersome, and needs to repeatedly consult the manual. For this feature, we establish a common standard parts library of rolling bearings.

The library is a software system, in which the information all kinds of frequently used rolling bearing standard pieces is stored together, to have a management system and the corresponding CAD standard interface. These library designs allow designers to extract the required part information by querying, retrieving, or accessing the standard parts library to generate required bearing models for use in the design, manufacture, and so on.

The standard library system with large load is difficult to develop. According to the staffing situation, we decided to adopt a modular design approach through repeated discussions and analyses of our group. The overall can be divided as following: system management module, standard parts model library, standard parts relational database and engineering document data module.

From design content, we classify frequently-used rolling bearings with type, and then from the perspective of modeling, bearing with same modeling method is set as a classification. The standard parts relationship data library is created by division of bearing types. The project documentation module is established taking into account overall and local structure. In order to facilitate the management of system development and give full play of teamwork spirit, according to the interrelationship between modules and student learning characteristics, we will arrange students to participate in the basic development of each module respectively. In other words, the Microsoft Access is used to build a relationship data library for a certain type of bearing. And we use SolidWorks to complete bearing modeling to make a sub-model library, and engineering document data of the type of bearing is also completed. Each module is independent and interrelated; therefore, members form a working relationship, which is independent on co-existence, in the process of development. The development of the bearing standard parts library system is guaranteed to be ordered and coordinated.

Cultivate Students' Comprehensive CAD Ability Combined with Practical Application of Engineering

Scientific research projects cannot be separated from the actual project, and research project development process is bound to the practical application as a starting point. In the development process of "Standard Parts Library of Rolling Bear Based on SolidWorks" system, we cannot get away from the actual project from beginning to end, otherwise, practical value of the development system will be greatly reduced. This requires the combination of engineering applications to determine data standards, system development platforms and design tools, and the system must have a certain forward-looking and scalability.

In the subject research, through discussions and communications on research methods and research contents between members, we have achieved the most comprehensive of bearing design information grasp in the existing environment. Through detailed analysis, discussion, extraction, classification and finishing of the design information, the text information and data information are formed, which meet both engineering design needs and standard library characteristics. Through this practice, on the one hand, students can fully grasp bearing classification, selection and other basic information of the latest national standard to ensure the design information is up-to-date, integrity, and in line with the latest national standardization requirements, on the other hand, members can share information, increase mutual understanding, and easy to form a solidarity and mutual academic atmosphere.

When the bearing model library and the standard parts relationship data library are built, structural shapes and geometrical dimensions of the bearing model are determined by bearing standard data, which come from design manual, national standard data and manufacturer. After analysis and collation of data, an engineering document data library is formed. Then we use Microsoft Access software to build different datasheets for each type of bearing, and the bearing standard parts relationship data library is formed for modeling. Finally, the bearing model library and the standard parts relationship data library achieve a one-to-one correspondence between model and data, which can ensure that the developed system executes accurate query, retrieval and call the required bearing model and information.

This subject-"Standard Parts Library of Rolling Bear Based on SolidWorks" builds a bearing standard parts library through system integration. In this process, students play the individual initiative, creativity and flexibility,

and complete the development of sub-modules in a bearing model independently; also, each team members including students should be more collaboration and mutualization to ensure the exact link between model and Data, and to establish the relationship between sub-modules quickly and comprehensively. The bearing standard parts library will have integrity, systematic and engineering science.

RESULTS

Popularization and Application of Research Result

- The project is currently aimed at high grade students in their graduate design stage. From the length of time, the time is short, and they face graduation when the ability needs further improvement. Therefore, in order to increase scope and depth of the study, we would extend it to the lower grade.
- The next step, taking advantages of ministry of science and technology and software system company training standard systems, we enrich and improve the current research system.
- The establishment of CAD teaching resource platform system will help to expand contact surface and application time of students, but also contribute to the accumulation and improvement of high quality CAD teaching resources.

Breakthrough Progress in this Project

- We have set up the activity mechanism of an inter-promotion between teaching and researching and students participating in scientific research projects.
- The process management method of student CAD capacity and quality training and the measurement standard based on engineering practical requirements are formed.
- We published 9 papers, including 1 SCI / SSCI to be checked, 6 EI searched papers, and 1 EI paper to be published.
- We develop 4 sets of three-dimensional model library of manufacturing information.

DISCUSSION, CONCLUSION AND SUGGESTIONS

- The project is targeted at senior students, especially in the graduate design phase. In fact, by adjusting and properly selecting CAD drawings, 3D modeling and application object of assembly, we can get good results. The methods and processes used in this project can be extended to lower grades.
- The CAD capacity of the project is mainly for CAD drawing, 3D modeling and assembly. In fact, CAD comprehensive ability is a very broad category. Methods and processes used in this project can be developed in other areas, such as CAE and NC programming.
- The project uses a vertical project to promote students' comprehensive ability of CAD training, and methods and processes adopted by appropriate adjustments and improvements also can be extended to actual project problems in conjunction with the subject of research process.

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