Research Article

Engineering Education Practice and Big Data Analysis--Graduation Design

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Abstract

To ensure the quality of the graduation project, it should have an effective planning and management in teaching for Computer Application Technology major students. The purpose of this study is to investigate the problems of graduation project, and then a systematic method was adopted to solve these problems. Where, it is based on the CDIO (Conceive, Design, Implement and Operate) concept, SE (Software Engineering) method, and the inspection team was introduced to exam and verify each step-in graduation project progress. At the end, the topics of graduation project were analyzed with big data analysis method. It was found that except to guarantee the quality of graduation project, the innovation of topics was also improved dramatically. Of course, the findings of this study could be used in other similar majors to ensure the quality of teaching progress.

Keywords

Graduation Project • Systematic Method • Big Data Analysis

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Graduation design is not only a component of comprehensive teaching process but also the last crucial part in learning phase of students in universities. In this teaching process, we wrap up and test the theoretical expertise and practical application capabilities grasped by students in past several years to help students know themselves more comprehensively and further enhance their professional literacy and overall qualities. In graduation design process, it is required to blend the expertise learned in the past to address a specific staggering problem in a targeted manner. Some graduation design results as required in different majors are often presented in the form of papers, objects, programs, etc., and required to reach certain standards, laying a solid foundation for students to take professional works in society.

Today, with the advent of the Internet, multifarious types of smart products are spring up. In the wake of swift development of science and technology, students majoring in computer face opportunities and challenges. To respond to these, students have to grasp basic expertise. They should be highly intellectual to adapt to the technology development trend, empower themselves with a high level of innovation capacity. In addition to the training in the classroom, students should require to strengthen the integrative cultivation for professional skills and innovative capacity in various practices, such as the computer specialty graduation design. Great efforts should be made to enable them to respond to the professional development better and faster.

In recent years, in response to the development trend of computer science and the education works for software development in graduation design phase, the instruction model for graduation design has been highly studied. It is found that there are some problems required to be solved in this process, and whether these problems are addressed directly affects the education quality in this phase.

Problems in Graduation Programs

As far as the full process of graduation design in software development is concerned, there are generally seven phases: topic selection, question examination, task assignment, opening report, software implementation, writing dissertation and defence session, each of which is crucial in the graduation design process. If one or more parts of work are neglected, the quality of the graduation design will degrade. The specific problems in each part are analyzed as follows.

Obsolete topics

Topic selection is a precondition for smooth graduation design process. Only when good topics are available can we lay the foundation for subsequent graduation program. During the current topic selection for computer graduation design, there are often phenomena that the topic is too old-fashioned, no survey is accompanied, the topic selection workload is not enough or far exceeding the limit that the individuals can independently bear. For example, in the topic selection, old topics often appear, such as "educational management system", "books management system" and "student management system". There is no new idea. Even if the system is implemented, there will be many defects, rough functions and disable application in practices. This kind of

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system is complex and challenging for individual students. In the end, students only implement some functions, which is inconsistent with the selection of the topic itself.

Unclear tasks

After the students and the graduation program instructors work together to determine the topics, the instructor will assign the tasks to the students. For those students majored in computer science, the tasks for graduation program include two parts: one is to accomplish the software or hardware design and implementation, and the other is to write the dissertations as required in universities. For software and hardware implementations, there are function and performance requirements, as well as default requirements in the domain. Dissertations requires a specific length, and should be written in sections in strict accordance with the format requirements. However, in the assignment of instructors, task descriptions are often inexhaustive, for example, they require students to implement a software function, but do not specifically tell students what standards it should reach in the test phase; or require students to write the dissertation, but what standards are also not emphasized. In this way, students will hang up the graduation design schedule in the later stage, affecting the quality of the overall graduation program.

Lack of standardization for design and code

For students in computer major, the software or hardware design and coding part is the soul of the whole graduation program. For example, the software is designed and encoded, the idea of software program engineering is to design the software after truly understanding the specific requirements of users, and on a good design basis, access the coding and testing phases. However, in recent years, the graduation programs of students in computer science in the design and coding phases still have great problems. First, the design is poor, most students can not capture the design concept, and allow the software part to directly access the coding process, resulting in frequent changes in design in the subsequent coding phase, thus directly spoiling the software performance; Second, they can not encode in accordance with the relevant specifications. In the coding view, there are names that are too arbitrary and have no any meaning, such as classes, methods, variables, etc.; the code is not written as required in the specifications.

Dissertation structure confusion

If there is no good text representation method, even perfect hardware and software design will be unideal, even ambiguous for users. From the dissertation composition in computer field, there are problems on three fronts: First, poor paper layout, structure chaotic, and contradictions are recurrent; second, the paper format has not been arranged as required by universities. third, the dissertation contents are reciprocally reversed.

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Unclear ideal of dissertation defence

Graduation defence is rather crucial for students in computer science. With excellent hardware and software design and perfect graduation dissertation, plus the logical explanation, the graduation design will be bound to be much better. However, in the course of the defence, there are also some problems, for example, unclear ideas, undefined priorities, and lack of focus, which will make a big discount on the quality of your graduation program.

Given the above, there are indeed many problems in the computer graduation design process. Therefore, it is required to take certain measures against them in order to actively improve the current computer graduation process and the graduation design process.

Related Works

From the current literature analysis, many universities have similar problems in the computer education and graduation design, and they have also taken certain measures.

There are reforms in all ways. Li, Peng, Chen, & Yao (2013) proposed relevant reform measures from the theoretical teaching, topic selection modes, instruction modes and management styles as applicable to practical situation of computer science. Wang *et al*., (2010) argued to give a comprehensive guarantee for the graduation process from the organization, ideology, practice, faculty, etc., in order to improve the quality of graduation programs. Xu and Liu (2007) made some explorations from design selection, construction of guidance teacher troops, instruction mode, and strengthening management. Gao, Fang, & Qin (2011) developed a more effective reform proposals from the management system and teaching program. Ni, Gu, & Lu (2014) discussed and practiced the graduation design of computer science from the instruction mode, and proposed the "3+1" reform proposal. Huang, Huang, & Luo (2009) worked out a set of effective reform measure involving management system and teaching programs based on the employment pressure in society.

There are reforms against certain parts in graduation design, Xu (2011) mainly carried out education reform on the topic selection and quality assessment of computer graduation design, including literature survey as an item for assessing the education quality.

There are also reforms against the education concepts. Li, Qu, & Yao (2010) specifies the graduation programs of computer science with the guiding ideology of software engineering. Qiao (2010) believes that the stress must be lain on the process management of the peacetime education and graduation design to improve the quality of computer graduation programs. Dong, Wen, & Shi (2008) argues that it is imperative to strengthen process management, and introduces the PDCA cycle in the computer graduation design phase to strengthen process management and establishes a graduation program framework for the purpose of standardizing graduation program management. Ma, Chen, Zhang, & Li (2011) proposed the improvement measures against every part of computer graduation process. In recent years, Li, Li, & Qin (2014) based on the CDIO concept, raised the responding measures to several areas such as design selection, time arrangement, teaching process, and graduation design evaluation. Lu & Yan (2015) applied the CDIO concept to divide the computer

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graduation design process into several phases. Inspired by the CDIO education concept, Chen, Cao, & Zong (2016) made a survey on the teaching methods to improve the quality of graduation program from the system construction, model reform and assessment system. Li & Han (2016) built a teaching method that integrates the CDIO concept with project-based instruction and applied it to the computer graduation design process for practices.

From the above, the current reforms for computer graduation design mainly target at specific education coverage, such as ideas, teachers, management, instruction mode and teaching programs; specific parts, such as topic selection, quality assessment, etc., and the teaching concepts, such as the idea of software engineering, PDCA cycle and CDIO concepts.

Strategies innovation for graduation project

Based on many years' experience of computer graduation instruction works and the existing teaching situation in universities, effective teaching reform has been carried out. The practice should be guided with the CDIO model, based on the idea of software engineering, and the reasonable check panel is organized for graduation design to conduct effective review and management. This reform measure has been applied to the computer graduation process in the recent two years, and borne certain fruits. The graduation design process after reforming is shown in Figure 1.
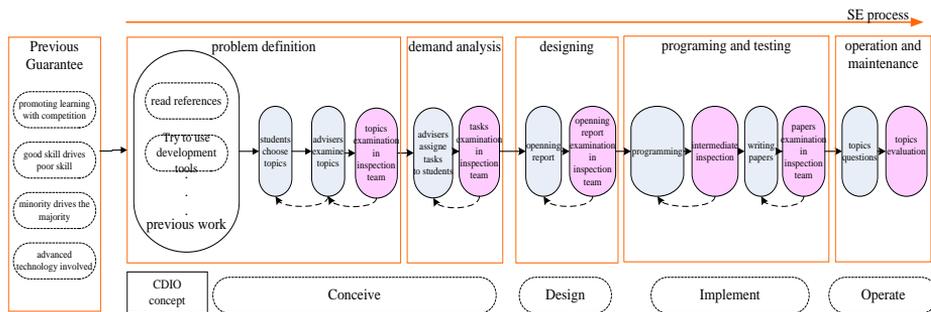
Figure 1. Reform measures against computer graduation design process

Previous Guarantee

In recent several years, we found that the practical experience of the undergraduates is weak in graduation project progress. This situation can not be changed in a short time. To make sure the quality of graduation projects in the near future, we take some actions to change this worse situation before the last semester. First, in this innovative method, we encourage students to participate in the competition which related to their field. After competition, they will find their weakness in their major. Second, we organize a students' team. In our team, we have students in different levels. Some of them have good skills, some have basic skills and some

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have no experience. By introducing this small scale and different level communication and learning, it makes the skills be passed from hands to hands. Third, we organize several meetings which are facing to more students in a certain time to affect more students to focus on their major. At last, in our organization, according to the student's learning situation, we involve the advanced technology in their major learning. This is the basic assurance before graduation projects. Through this innovative method, the quality of the graduation project can be improved.

Integrating the resources in graduation design process in CDIO mode

The so-called CDIO mode, i.e. Conceive, Design, Implement, and Operate, aims to build an integrated teaching system with CDIO project as the core to foster students' competences to conceive, design, implement and operate projects in engineering practices. Graduation design in computer science is characterized by stronger practicableness. In the graduation design process, students can be trained for comprehensive capacities such as engineering practice and operation. Therefore, CDIO mode full applies to the graduation design process of computer science. As shown in Fig. 1, the whole process of graduation design matches the CDIO mode. The thinking process of the students and the instructors about the topic selection, question review and assignment tasks can be regarded as the "conception" of the CDIO project. while overall and detailed design processes of students on the complete software in opening report can be regarded as the "design" of the CDIO project; the software implementation and dissertation writing phases are regarded as the "implementation" of the CDIO project; the defence can be looked as the "operation" of the CDIO project. The trivial work, as it is in the various phases of graduation design process, makes students hold a clearer idea in the whole process at the early time after the integration with the CDIO mode, and also facilitates the teachers' management for the graduation design process.

Guiding with SE method

Only with the guidance of the CDIO mode, it is not enough to complete a software development task. There should be more detailed methods that can lead software development. The SE (Software Engineer) method is fundamental to the computer software development curriculum. It is very important for students to master the SE method. We will always run the idea of software engineering through the theoretical education process of computer science, and use it flexibly in practical courses. From the software life cycle (Zhang and Lv, 2013), the development process of any software product can be divided into problem definition, requirement analysis, general design and detailed design, coding, testing, operation and maintenance. For graduates in computer software development field, the SE method should be applied to solve specific problems. Therefore, in the graduation design for the computer software development field, if students are expected to appreciate the charm of software development, the instructor must inspire them to develop the software with the idea of SE. As shown in Figure 1, each phase of the SE corresponds to that in the graduation design process, and can be integrated into the CDIO mode. In this way, students will fully access the development method of SE in the process of

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orderly graduation design, and also the instructors will be enabled to assign more specific tasks to students periodically.

Introducing the graduation design check panel mechanism

According to the CDIO concept, and guided by the SE method, students can access the phased specific tasks. In the traditional computer graduation design process, the phased tasks are unidirectional, and there is lack of phased review work, and thus assessment standards, so that it is difficult to guarantee the quality of tasks. In the graduation design process, we introduce the "Graduation Design Check Panel" mechanism, which will review the phased works after the graduation design until the quality standard specified by the graduation design is reached, so as to ensure the quality of the phased works. In 2016, the number of graduates in computer and software majors in our university added up to 183. After the effective management using this method, the quality of works in all parts of graduation design has been improved, especially the graduation dissertation writing.

RESULTS AND DISCUSSION

In the teaching process of standardized graduation design, more creative topics have ever emerged, such as big data analysis, social networking services, data mining and other basic topics. In 2015, there were 117 computer graduates, including 5 excellent ones, accounting for 4.2%; 42 software engineering graduates, including 3 excellent ones, taking up 7.1%; the average excellent rate was 5.65%. In 2016, there were 142 graduates in computer science, including 8 excellent ones, accounting for 5.6%; 35 graduates in software engineering field, including 3 excellent ones, accounting for 8.6%; the average excellent rate was 7.1%. In 2017 and 2018, under the more rigorous graduation system, the overall graduation design excellence rate in 2018 was 2.82%. Although it declines somewhat, based on the big data, from the topic analysis, and in terms of development tools and environment, Android development in 2016 has an absolute advantage. By 2018, Python-based development performs better than Android; from the topic content, management system and website development are still dominant, but only the presentation of relevant topics in the fields of big data analysis, visualization, knowledge map and so on. The weight analysis of the topic content is shown in Table 1. The results from the visual analysis are shown in Figure 2-4.

Table 1
Analysis of Topic Contents

Contents involved in topics	Weight (2015)	Weight (2016)	Weight (2018)
Management system	0.3903355352110930	0.2404117755076689	0.1948870598348408
Platform	0.0568816440991397	0.0738351070926520	0.0866561536770204
Website	0.086102097495	0.0663218859083108	0.0747858218242286
Visualization	0	0	0.0456841936771429
Data analysis	0.0140695117935223	0.0234808744121622	0.0355760906548734
WeChat	0	0.0201938640251689	0.0292769816397551
Data	0.0193577193457085	0.0242298480323818	0.0273220381622286
Knowledge map	0	0	0.0160656892104980

It is found from the above analysis that the mechanism of the graduation design check panel is established to effectively supervise and manage the computer graduation design process, as guided by the SE method, and based on the CDIO concept. Due to the constraints or pressure of the mechanism, the graduation design instructors or students will continue to innovate to inspire the students' potentials and allow them to appreciate the essence of the SE method in the graduation design process, have a good command of the hotspot technology and methods in the computer field, thus achieving a smooth transition to the employment in the later stage. The application of this method has realized the practical education in universities, and further enhances students' practical competence through continuous learning and improve the quality of graduation design. With this method, it is also possible to provide specialized guidance for future practical teaching and make clear the direction of professional education.

Figure 2. Analysis of 2015 topics   *Figure 3.* Analysis of 2016 topics   *Figure 4.* Analysis of 2018 topics

Conclusion

Graduation design is an important practical class and strong integrated course set up for students in computer science. To acquire the higher teaching quality in graduation design of this major, according to years of practical teaching experience, the SE-based CDIO model is proposed for the teaching in the graduation design process, and a check panel constituted by teachers has been established for graduation design to perform a careful examine and timely feedback on the works in each phase in order to improve the teaching quality of the graduation design. With the practical teaching application and Big Data analysis in the past two years, it is found that this method is feasible, and can lead the later practical teaching. However, there are still relevant problems in the teaching process, such as the further refinement of the phased quality standards, the reasonable composition and detailed division of duties of the members in the graduation design check panel, and the solution to the procrastination of students in learning process. Further study will be carried out in the follow-up teaching process.

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