Balancing Academic and Industrial Needs in RE Courses

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Abstract

As people start to realize how poorly documented and managed requirements can affect the success of a software project, requirements engineering education start to attract growing attention in software institutes and companies in China. This paper reports our considerations regarding course materials selection, course projects design and evaluation to better balance the needs of training future requirements engineering researchers and software engineering professionals at undergraduate and graduate-level, as well as software professionals.

1. Introduction

Due to the rapid growth of information technology and the prevailing application of software in almost all areas in people’s life and national infrastructure, requirements related skills have become a must for all related parities, including software practitioners, customers and users for software related products, and members of the management team for both the development organization and the customer organization.

In China, by the end of 2001, 475 higher education institutes are offering Bachelors of Computer Science or Engineering, and there were 2,946 PhD students, 16,654 Masters, about 566,000 undergraduate students major in computer, 7.5% of all undergrad students at that time. At present, the overall number of students at school has grown into 25 million, which is expected to reach 30 million within the next 2 to 3 years. The current curriculum of computer science program aims towards training researchers in computer science, so it puts more emphasis on training theoretical computer scientists. However, the majority of the graduates will go to the industry and start off as software engineers.

Since June 2000, after the Chinese Ministry of Education approved the strategy of promoting IT development, 35 Schools of Software were established in major universities as a consequence. The target is to produce high quality personnel to satisfy the demand of the industry. This is a very important move national wide, and the software schools have the freedom to practice their own philosophies and operational policies. Thus, there is no strict standardized curriculum, but only guidelines and common objectives. Still, there are a small portion, about one fifth- eighth, in our experience, of these masters of software engineering will continue their study and apply to PhD programs in China or abroad. Thus, it is our duty to provide an RE course that can better balance the needs from academia and industry.

In this paper, we first give a brief summary to the current requirements education statues in major Chinese graduate schools in Beijing, then a catalogue of course modules that can be tailored and packaged to fit for different education purposes is introduced. Then the effectiveness of various evaluation criteria will be discussed. Finally, we conclude the paper and discuss possible future directions.

2. Requirements engineering course material organization

Not very different from education in the world, in Chinese universities, requirements related knowledge is normally taught within a single lecture in software engineering courses at the undergraduate level, and topics related to requirements are often covered in information systems analysis and modelling courses. At the graduate level, there are often two kinds of courses, one kind is designed for training researchers major in computer science and software engineering, the other is designed for masters of software engineering, who will become practitioners in industry right after two to three years formal education at school.

Most schools have started RE courses around 2004, which means graduates from first tier Chinese universities since last year should have already
received formal training on requirements. And if we check the contents covered in such courses, we will see that materials are organized according to the Requirements Engineering processes and activities in a sequence. For example, the recommended textbook [4] by MSE education board of committee includes 24 chapters, categorized into five modules:

Module 1: Fundamentals of software requirements: introduces basis requirements issues and requirements of different abstraction levels.

Module 2: Requirements engineering and RE processes: introduces RE in relation to product life cycle;

Module 3: Requirements Elicitation and Analysis: introduces general elicitation techniques, user requirements identification, setting system scope, understanding customer needs, managing customer, requirements modelling, structure analysis and modelling, object-oriented modelling, business modelling, use case modelling and prototype development.

Module 4: Requirements documentation and validation: introduces requirements specification, requirements validation and requirements inspection.

Module 5: Software Requirements management: requirements management tasks, requirements management models, change management, requirements risks management, requirements traceability, requirements management tools.

As we can see, this has much in common with an engineering handbook. For the one fifth MSE who will pursue a PhD domestic and abroad, this isn’t so adequate for them to understand the state of the art RE research.

On the other hand, there are also RE researchers [1] who have been giving courses organized according to the mainstream methodologies in RE research and their latest developments, for example, KAOS, i*, Use cases, Problem Frames, Alloy, etc. Who may lose the overall picture of which RE activities are covered by each of these approaches.

As a consequence, we propose to cross reference the two orthogonal dimensions as we teach them. As shown in Figure1, the two dimensions are orthogonal. When we teaching the relevant contents, RE activities are interweaved together with particular RE methodologies, so that students can obtain a thorough understanding to both the requirements processes, the different methods and the relationships of the two dimension. Moreover, soft skills and cultural perspectives specific to China will also be brought to the attention of student during the course whenever appropriate.

![Figure 1. Two orthogonal dimensions of RE knowledge](image)

### 3. Requirements engineering course project design, selection and evaluation

Just like any other engineering courses, only listening to lectures is not sufficient for student to grasp the basic skills of requirements engineering. Carefully designed course projects are critical for enhancing the learning experience. However, the background of our students is quite a variety. There are part-time Master students working in software companies, who have already accumulated rich project experiences, who expect to learn advanced skills from the academia; there are also master students major in computer science, who want to pursue a PhD after graduation; and there are master students who study software engineering.
engineering as a second major, especially for those whose previous major were most likely from electronic engineering, management school or automation. We finally defined three different kinds of course projects for the students to select according to their different background, experience and plan for future career.

The first category (A) is large scale, real world projects with complex requirements that a student can have access to. Examples include: An Electrical Marine Chart Information System, The London Ambulance Case Study, Stored Value Smart Card System of China Mobile, etc. In this kind of projects, the major tasks for the student will be requirements elicitation and analysis. Major evaluation points include: elicitation, domain knowledge acquisition, conceptual modelling and analysis, object-oriented analysis and design. Considering the scale of the project, practising requirements skills taught in the course can satisfy students’ thirst already. There were 13 out of 57 groups (23%) of students selected Projects of Category A.

The second category includes small to medium scale project, requirements are comparatively straight forward, and comes from domains students familiar with. Examples include management information systems for library, supermarket, warehouse, or human resource, etc. For such projects, students should finish following tasks: requirements specification, object-oriented analysis, modelling, design of the complete system, and also the implementation of a few modules. This is mainly for students learning software engineering as a second degree, who wants to use this course to experience the process of a complete software project. There were 33 out of 57 groups (58%) of students selected Projects of Category B.

The third category includes small, classical problems, whose requirements are given. For example, elevators control system, meeting scheduler, etc. The major tasks given to students are to produce the formal specifications of such problems, design and implement the system prototype, conduct testing and formal verification. There were 11 out of 57 groups (19%) of students selected Projects of Category C.

Evaluating the performance of a student in an engineering course has to sum up many different parameters. We feel that it is feasible to distribute the hundred percent marks among a close-book exam on RE knowledge (50%), group course project (30%), individual home assignment (10%) and oral presentation (10%). For group course projects and oral presentation, we also take the evaluation forms from other team members, collaborating teams and competitor teams into consideration.

4. Conclusion and future work

In summary, this paper reports our considerations regarding requirements engineering course materials selection, course projects design and evaluation to better balance the needs of training future requirements engineering researchers and software engineering professionals at undergraduate and graduate-level, as well as software professionals. We suggest relating specific RE methodologies with the particular process and activities it applies to. Course projects should be categorized and tailored according to the background and interest.

In future, we will continue to improve the proposed academia and industry integrated design of requirements engineering course, at the same time, incorporate other successful teaching techniques such as role playing [3], Investigation-based study[5], online communication media enabled study[6], etc.

Reference