Towards a Generic Education Pattern of System Analysis and Design Courses: An Empirical Study

Jitong ZHAO\textsuperscript{1,a}, Buyang CAO\textsuperscript{1,b} and Yan LIU\textsuperscript{1,c,*}

\textsuperscript{1}School of Software Engineering, Tongji University, China
\textsuperscript{a}1410787@tongji.edu.cn, \textsuperscript{b}caobuyang@tongji.edu.cn, \textsuperscript{c}yanliu.sse@tongji.edu.cn

*Corresponding author

Keywords: Software Engineering Education, System Analysis and Design, (Sino-English) Bilingual Teaching, Empirical Study

Abstract. System analysis and design plays an integral part in the development process, which makes it a mandatory and important topic in software engineering education. However, the diverse design concerns and activities involved in design process make it a great difficult to deliver system design topic effectively. To enhance the learning process, we utilized the mission guides style teaching in our system design course. Students are required to analyze and design a package delivery application system by using suggested open materials and tools. Positive feedbacks are received on stimulating students’ interest.

To explore a more generic education pattern for system analysis and design education, we conducted an empirical study based on the information and reflection collected during course delivery process. Students’ presentation performance, assignment quality, final reflection and professor’s evaluation were summarized and analyzed. In this study, we found that (1) teamwork can stimulate students’ learning interest and passion, making class atmosphere active; (2) scenario-based modeling practice can help students improve the understanding of knowledge more quickly and easily; (3) most students prefer (Sino-English) Bilingual teaching method to gain a more professional education. These results indicate the key factors towards a generic education pattern of system design course. It is also expected to be utilized on better courses preparing.

Introduction

Software system decisions are usually made in the early phase of software development life cycle, and have a vital influence on indicating demands and shaping construction [1]. It determines the quality of software system to satisfy a diversity of functional and nonfunctional requirements. Therefore, system analysis and design holds an essential position in the education of software engineering. However, there are so many issues (e.g. availability, sustainability, and scalability) to consider in the process of designing a software system, what’s worse, large number of complicated events and activities are also involved in [2]. All these make it a great challenge to instill in students a thorough understanding for system analysis and design.

We conduct an exploratory study to investigate how to improve the efficiency of classroom teaching, arouse students’ enthusiasm in learning, and promote the full-scale development of software education. Students from the system analysis and design course were chosen as participants, whose assignments and presentations were reviewed and graded by the researcher. Statistical analysis of information and reflection collected from 75 students reveals the mission guides style teaching is an effective method to improve a student studying thoughts and efficiency, which provide guidance on how to hence the learning process and better system analysis and design course planning.

This paper presents a generic education pattern for system analysis and design courses. We conduct an empirical study to explore key factors towards an efficient and flexible education pattern.
In section II we explain our research design. Study results are analyzed also in this section. Section III shows discussion on implications for research and conclusions.

The Empirical Study Research Design

Research Goal. To understand how the learning process happens and what influences it, we set out to answer the following research questions (RQ):
- RQ1: What key factors impact on learning process?
- RQ2: What makes students feel difficult to understand professor well?
- RQ3: Whether (Sino-English) Bilingual teaching can help students grasp knowledge better?

This research design followed guidelines for systematic empirical investigation presented by Given and Lisa M [3] and Bryman A [4]. Qualitative methods are expected to be combined with quantitative method, which is applied to this research. The data are collected by means of questionnaire, interview and classroom experiment. Drawing upon this, we expected our methods would make us earn a rich and contextualized understanding of key factors influence teaching, and the ways to make the teaching process better.

Research Preparation. We design a research study participating with 75 students from the same system analysis and design course. The course aims at teaching students what the system should do and how to accomplish the objective of the system, including (1) gather data to specify the demands of a system; (2) design system components and environments; (3) build general and detailed models to assist developers in implementing a system [5].

In order to enhance the learning process, the professor utilized the mission guide style teaching method in the system analysis and design course. Students are requested to perform tasks in teams and submit assignments in time. There are 4 teamwork assignments in a semester, which are designed to help students skillfully use open educational resources and better understand knowledge.

Assignments ask six students in one group to finish the system model task together. Most of the assignments centered on designing a package delivery application system, aiming at helping students to be familiar with use case modeling, architectural analysis and so on. Also there are 2 individual reading assignments asking students to read research paper and related references.

Research Process. Our study in this paper was carried out following the research protocol showed in the Unified Modeling Language [6, 7] (UML is a general-purpose modeling language in the field of software engineering) activity diagram in Fig. 1.

Figure 1. Research Process Overview.

This research chooses quantitative and qualitative methods to gather evidence for our study. We also intend to focus on mining the deep meanings of in-depth interviews, designing open-ended questions to increase understanding of the education pattern.

Research Results and Analysis. This section shows the results results and makes a summarization and analysis, including (1) learning quality analysis; (2) questionnaire analysis; (3) reflection analysis.

Learning Quality Analysis. The students’ assignment, test scores and professor’s evaluations reveal learning quality from various aspects. We can draw a conclusion that, (1) students do better and better on practical system model analysis and design as the course progresses. Scenario-based modeling practice can help students understand knowledge more quickly and easily; (2) students gain
a higher score in teamwork assignments compared with individual assignments. Teamwork can stimulate students’ learning interest and passion, making class atmosphere active.

**Questionnaire Analysis.** Participants were asked to fill questionnaires on the course experience of (Sino-English) Bilingual teaching. We heard from 72 students at last. Information collected from the questionnaire indicate that most student prefer (Sino-English) Bilingual teaching and benefit a lot from this teaching model.

Questionnaire results show that, half of the students feel a little difficult to understand the English textbook, while the other half thinks the difficulty is moderate. Only 5 students answer the textbook is too easy or difficult to them. Happily, almost all the students can understand what the professor teaches, and think the speed and difficulty of the class is modest. Only 3 students find it a great challenge to follow the professor, and grasp less than 30% what they learn in class. Also, most of the participants are satisfied with (Sino-English) Bilingual teaching model and prefer this model to Chinese one. It is interesting that merely 26 students think it helpful to teach in English, 28 ones find limited effect, even 15 ones consider this teaching method may reduce the learning efficiency. Faced with the question that, which partition of the class do you feel the most difficult, 45 ones choose the class learning option, 27 choose the assignments and presentation option. What are the reasons for you to choose (Sino-English) Bilingual teaching classroom.

When asked these question, students give various answers. Some want to study aboard for further study, this kind of teaching can help them be familiar with English-teaching environment earlier. Some want to study international excellent textbook, master more professional knowledge. Also it greatly helps students to know glossary better. A small part of students regard it a fashion thing, and want to experience different classroom atmosphere.

According to the results, we can inductively conclude that, (1) The majority of students have good English skills and show great interests in (Sino-English) Bilingual teaching method; (2) students with various English skills backgrounds also differs in their assignments and presentation, poor English students may find it confused to understand class and finish assignments, however, this only happens in rare cases; (3) To better instill in students, professor should speak clear and simple English in order to make the lecture easy to understand.

**Reflection Analysis.** Participants were also asked to submit a report which summarized their project evaluation and self-reflection, including what they have learned during the class; how it will assist they in achieving professional goals, other project self-reflections and so on. According to the information collected from 75 participants, we conclude the general reflection as follows.

During this term, students learned how to built a package delivery application system from scratch, utilizing Unified Modeling Language to practically analyze and design requirements and models. They learned step by step to decompose a full-scale system into pieces. For instance, a system model can be divided into layers with different functions on architectural level, and can also be separated as different subsystems on functional level.

Participants firstly considered a practical process in the system as a use case with logically abstract interpretation and simplification, rather than a contract daily routine. The process can be interpreted and described as unified modeling language through various types of diagrams. This kind of model thinking makes them view things more organized and systematically.

In the later period of study, students gradually learn to piece constructed use case model and diagrams into an architecturally refined system. It sounds strange to first break down a system then piece them up. However, it teaches them to consider a system as an entirety, instead of disorganized pile of components. They found ways to achieve a high cohesive and low coupling method to arrange all the parts separately and suitably.

Thus far, they have mastered an agile way in the process of system development. This can not only guide them in constructing the design and management of the life cycle of a system in a more organized way, but also inspire them in dealing with the architecture of all the programs and projects.
They could come up with a more precise and feasible plan when making the schedule of processing a project.

**Conclusions**

This empirical study explicates which key factors influence students learning efficiency, and how to enhance teaching process. We come to the conclusion inductively based on the results analysis given in former section, and provide guidance as followings: (1) Teamwork can stimulate students’ learning interest and passion, making class atmosphere active. Group assignments can help students grasp what have learned in class more efficiently and thoroughly; (2) scenario-based modeling practice can help students understand knowledge more quickly and easily. Learning by doing will help the students get the skill soon. Paying attention to practical system model design exercise is fundamental and necessary; (3) most students prefer (Sino-English) Bilingual teaching to gain a more professional education. To better instill in students, professor should speak clear and simple English in order to make the lecture easy to understand.

**Acknowledgements**

This project was financially supported by Tongji University for (Sino-English) Bilingual and English Courses, and China Scholarship Council.

**References**


