Trinity teaching method for architecture majors at engineering colleges

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ABSTRACT: Teaching methods in higher education have become a significant area of research in recent years. In order to reform the teaching of engineering courses, the trinity teaching method was implemented using modern information technology. The teaching of engineering courses with the trinity teaching method and the structure of the trinity teaching for courses of an architecture major are described in this study. A trial course was used to verify the improvements resulting from the reform, as was a statistical analysis of student feedback. The author has verified the practical application of the trinity method. The improvement in teaching quality and the effects of trinity teaching were analysed from three aspects: teachers, students and teaching conditions.

INTRODUCTION

The Chinese Ministry of Education launched the Teaching Quality and Teaching Reform Project For Colleges to improve the quality of higher education [1]. Engineering courses occupy an important position in higher education. The rapid development of technology means the teaching content of traditional engineering majors does not satisfy the requirements for specialised courses. This means there is an urgent need to change the traditional teaching methods.

An architectural major in engineering was considered as the subject for this analysis and research [2]. A survey of Chinese and foreign schools of architecture reveal differences in their teaching methods. Architecture is concerned with creating a suitable environment for humans using advanced technology combined with art. Thus, how to cultivate architectural personnel is an important problem in architectural education [3].

In order to promote the development of higher education, the Chinese Ministry of Education proposed the use of the *trinity teaching method* in 2003 [4]. Publishing houses also started to publish trinity teaching materials, and trinity teaching is a trend in modern teaching and research [5][6]. Most research results are a brief introduction, history and significance of the trinity method. There is a lack of research into the use of the method, and there is no clear delineation of trinity teaching resources and material.

The trinity teaching modes, such as project case study and multimedia lessons, determine the teaching resources required, i.e. course and teaching material, and multimedia courseware. However, there is a lack of relevant material particularly related to the practical aspects of the teaching. As a result sometimes textbooks and courses are just copied. Advanced methods and 3D teaching are not yet fully reflected in the material.

For this study, an analysis was carried out of the trinity teaching mode for architecture majors; proposed is a teaching reform method, and examples are considered. Conclusions are drawn after a statistical analysis and an evaluation of the trinity teaching method. The 3D teaching effects are also discussed. Support is provided in this article for further broadening the use of trinity teaching at engineering colleges.

FEATURES OF SPECIALISED COURSES AT ENGINEERING COLLEGES

Specialised courses at engineering colleges emphasise practical applications based on theory. Apart from theoretical knowledge, it is necessary to understand the nature of projects. Generally speaking, specialised course teaching has the following aspects [7].

There is much difficult content with continuous knowledge renewal. Specialised courses in architecture include disparate subjects, such as mechanics and aesthetics, which combine the concrete with the abstract and require aesthetics and creative thinking. Knowledge learned in engineering courses will be applied in future practical work. Course teaching and practical use are inseparable. Given the rapid development of technology, the renewal cycle for specialised courses has become increasingly short. At present, teaching involves little interaction between students and teachers. In most colleges, engineering course teaching is dominated by *explanation by teachers and passive acceptation by students*, and it lacks timely and effective communication between students and teachers.

Students concentrate on theoretical knowledge and their practical ability is weak. Students' learning is evaluated through scores obtained in a final examination. Students only attach importance to theory in order to gain a high score. The following is common: memorise material at the last moment before an examination and, then, forget the material after the examination. Most students prefer novelty and practical projects. However, they often lack practical ability and cannot apply theoretical knowledge to practical projects.

The existing teaching mode for engineering courses has numerous shortcomings, including teaching quality, students' learning and teaching methods. Thus, it is necessary to establish student-centred teaching and combine teachers' guidance with students' independent thought. A new teaching mode in which students and teachers can interact is needed. With this background, outlined in this article is a comprehensive teaching approach based on the existing trinity course teaching method.

BASIC THEORY OF THE TRINITY TEACHING METHOD

Trinity teaching is a change from traditional teaching. Under teachers' guidance, students conduct independent study that combines theory and practice. There is interaction between students and teachers, and among students. Finally, the theoretical knowledge is selected for being realistic and useful; abstract problems are materialised for solving; the teaching methods are diverse; and the teaching content is layered.

The 3D teaching method has the following features:

- *Systematic:* 3D teaching content is in vivid layers, which can produce order from disorder.
- *Optimal education:* 3D allows teaching to be tailored for different types of student.
- *Practice interaction:* teachers guide and help the students in their learning. The 3D teaching combines theory and practice using dynamic and static material. Communication between students and teachers and among students is enhanced to achieve *zero-distance* communication between teachers and students.
- *Diversity:* trinity teaching uses multiple teaching modes, such as multimedia lectures, group discussion and project case analysis, with the teaching mode(s) used dependent upon the different course features and task requirements.
- *Comprehensive trinity:* trinity teaching uses traditional teaching material, network resources and multimedia resources to cultivate students' ability, with the mantra *theory, practice and innovation.* Such a teaching method changes the traditional single teaching mode into a *trinity* knowledge network. The basic content of the trinity teaching method is shown in Figure 1.

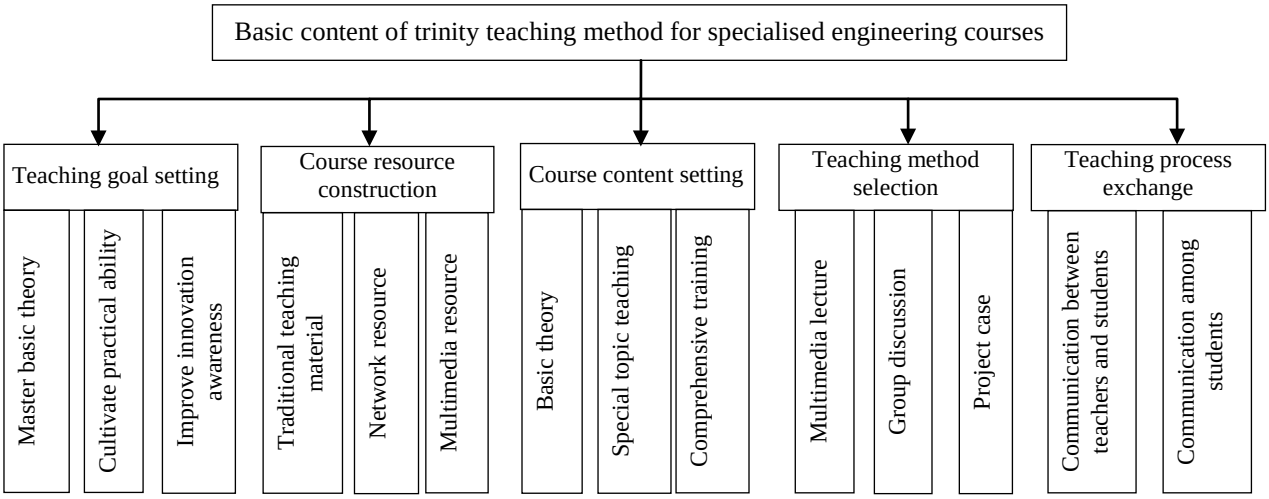

Figure 1: Basic framework of trinity teaching for specialised engineering courses.

The trinity teaching system includes: teaching objectives, teaching content, teaching method, teaching process and teaching evaluation. Thus, it is a comprehensive and systematical new teaching mode. Its combination of features make it suitable for teaching specialised engineering courses.

STUDY OBJECT

Next, a specific course was considered to which the trinity teaching method was applied. This course is from an architecture major as an example of a specialised engineering course.

Two classes of an architecture major in 2013 in a university were chosen as the objects of study. Class 1 served as the experimental group, and Class 2 served as the control group. According to statistical analysis, p factor of the students in two classes is greater than 0.05. Hence, it can be concluded that the two classes were comparable.

TEACHING METHOD

The teaching method was compiled as follows:

- *Analyse teaching content and set explicit teaching objectives:* teachers summarise the course content and develop course objectives in accordance with requirements of the teaching programme. Before the class, students have set reading to complete. Knowledge points are established, teaching objectives set and reference material identified. Setting clear objectives and highlighting key points promotes students' understanding.

- *Utilise multiple teaching methods to guide students' autonomous learning:* teachers provide students with reference teaching material and relevant learning Web sites. Mutual exchanges and discussion occurs between teachers and students, and among students. As well, co-operative learning occurs in groups. Difficult points, key points and questions raised by students can be addressed through the learning Web site. Questions and points that might arise include the theoretical basis of architecture, 3D construction principles and design. Finally, learning can be demonstrated in various ways, such as verbal explanation, PowerPoint presentation or a report.

- *Evaluate course learning:* evaluation of learning is an important aspect of 3D teaching. The evaluation process is mainly through course assessment, students' evaluation, teachers' comments and summary. Specifically, the following methods were used: mid-term and final written examinations; student communication in class about problems and solutions; course practical exercises and experiments, and internship reports. It is important to ensure that the knowledge and skills mastered meet the requirements of architecture.

TEACHING EVALUATION

Evaluation of the teaching method was carried out as follows:

- *Questionnaire survey:* a questionnaire was handed out to all students in the experimental class at the end of the course. In the survey, 150 questionnaires were handed out, of which 142 were effective.

- *Examination:* at the end, there was a written examination. The examination was marked out of 100.

- *Data processing:* SPSS 16.0 data software was used for data analysis. A *t*-test was carried out using R (a programming language and software environment). The confidence level was 0.05, i.e. result was significant if $p < 0.05$.

EXPERIMENTAL RESULTS

Comparison of examination results

The difference in average scores of the examinations in the experimental class and the control class was statistically significant with $p = 0.00028$, $p < 0.01$ with the experimental group having the higher average. Detailed results are shown in Table 1.

Table 1: Average scores of the students in the experimental class and the control class (score, $\overline{x} \pm s$).

Group	Average scores
Experimental class (n = 142)	80.14 ± 6.87
Control class (n = 142)	77.69 ± 9.25

Note: The difference is significant with $p < 0.01$

Comparison of Course Teaching Satisfaction

The difference in average scores for teaching satisfaction in the experimental class and the control class was statistically significance with $p < 0.01$ with the experimental group having the higher satisfaction. The statistical results are shown in Table 2.

Table 2: Teaching satisfaction of students in the experimental class and the control class (%).

Group	Satisfied	Basically satisfied	Dissatisfied
Experimental class (n = 142)	79.5	20.5	0
Control class (n = 142)	69.0	28.6	2.4

TEACHING ARCHITECTURE

Architecture is a subject with a theoretical core, requiring broad and deep professional knowledge. As a result, as the course teaching progresses, the difficulty and abstraction level increases. Students do not find it easy to understand the concepts and apply the knowledge gained. Architecture courses have a high level of abstraction, but are also founded in art. Students should give full play to creative thinking. So, for students to successfully study architecture courses, they must engage in a lot of practice. Trinity teaching is well suited for teaching courses, such as architecture.

THE TRINITY TEACHING METHOD

Demands on Teachers and Students

The trinity teaching method makes extra demands on teachers. Trinity teaching not only requires teachers to have good teaching skills, mastery of the course material and an ability to control a class, it also requires them to know students' learning situations and to rationally apply the appropriate teaching methods. Meanwhile, students should draw inferences about other cases from one case, find connections between knowledge, communicate with other students, maintain a high interest in learning and continuously improve their knowledge.

Teaching Materials

Teaching materials are the important vehicle that enables teachers to carry out teaching smoothly and is the first *stop* - the first place - for students to go to learn. Version updates for most existing architecture-related teaching material is slow and teaching materials are arranged based on chapters. Trinity teaching requires courseware videos. Students are expected to find material in books, reference materials, the Web page and from experiments. Therefore, high-quality teaching conditions should be provided in support of these requirements.

Student Learning

The trinity teaching method improves students' learning. Traditional teaching is dominated by written examinations. Often students do not carefully listen to teachers and, therefore, they make an effort at the last moment to *cram* before the examinations. Trinity teaching pays more attention to students' learning and practice throughout the teaching period. Therefore, students have an ongoing sense of the urgency of learning.

Student Outcomes

The trinity teaching method can improve students' professional qualities and employability. The trinity teaching method cannot merely strengthen students' basic knowledge, it also cultivates students' learning interest and boosts their ability to analyse and solve problems. It can also enhance self-confidence, communications ability and innovative ability. For example, groups communicate, discuss and co-operate for a common goal, cultivating team awareness and, hence, lay a good foundation for future work.

Trinity teaching pays more attention to cultivating students' practical ability, and makes students learn specialised knowledge on actual projects and apply knowledge to actual problems. Combining the theoretical with the practical cultivates students' operational ability.

CONCLUSIONS

The trinity teaching method transforms traditional passive teaching and creates a new student-centred teaching model. Under teachers' guidance, the emphasis is on innovation, exploration and independent study. As market competition

intensifies, the architecture major needs to produce all-round graduates who combine theoretical knowledge and practical skills.

To change the traditional teaching mode and cultivate qualified personnel suitable for the demands of the new times is the final aim of trinity teaching. The trinity teaching mode for specialised engineering courses can well solve the defects of the traditional teaching mode and can cultivate students' abilities. Thus, it is part of the reform of modern education. Computer, network and Web technologies provide convenient conditions for trinity teaching. This study has provided some new thoughts and analysis of the trinity method and, hence, contributes to improving teaching quality.

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