

# Application of the WebQuest teaching mode in courses of civil engineering specialty

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**ABSTRACT:** With the popularisation of computers, especially the popularisation of campus networks, and an extensive application of the Internet, the research and application of network teaching has been developing at a high speed. In this process, a series of network teaching modes represented by the WebQuest teaching mode have gradually entered the classroom. The WebQuest teaching mode seamlessly combines inquiry-based teaching and network information technology. It complies with current teaching ideas on practicability and innovation. New course reforms place high emphasis on the improvement of network information applications. Research in civil engineering teaching can drive the implementation of new ideas into the courses, cultivate students' information technology abilities, and boost the standard of teaching and the professional achievement of teachers. In this article, the author outlines and discusses the implementation conditions, requirements and effects of the WebQuest teaching mode in civil engineering education.

## INTRODUCTION

In a nutshell, engineering education is about the teaching and learning of engineering science courses. There are several definitions of an *engineering science course*, but for the purpose of this article, the author finds that the following description is particularly useful: an engineering science course is fundamentally based on physics, applied mathematics and chemistry; it is a practical course which develops in combination with production practice [1].

At present, there are several research investigations that focus on the analysis of engineering teaching and the resulting improvement. Zhu maintains that China's engineering education has several problems, including adherence to traditional teaching modes and students' lack of practical ability. He put forward suggestions to improve China's engineering education from four aspects: government, school, society and international cooperation [2].

Yang et al proposed construction of an experiment teaching demonstration centre reform of traditional teaching, and exploration of practical teaching modes closely combined with engineering practice after investigations of the teaching status of universities of science and technology in Beijing [3].

Chen and Zhang outlined the construction of a teaching base for national engineering machinery foundation courses in Chongqing University and proposed to cultivate students for comprehensive engineering practice [4].

Qu et al advised referring to the MIT Undergraduate Practice Opportunities Program (UPOP), and they attached importance to the cultivation of students' practical ability and enhancement of connection and cooperation with social enterprises [5].

Gu et al proposed the EIP-CDIO engineering education concept oriented to engineering design, the main objectives of which should be cultivating personal ability, team ability, and system regulation and control ability, as well as the personnel training mode for practical and exploratory design projects [6].

It can be argued that compared with other professional courses, engineering courses show a certain amount of distinctiveness. Engineering teaching aims not only to impart knowledge, but also to deepen professional theoretical knowledge, occupational skills and career experience through the teaching and guidance from professional teachers. Therefore, the emphasis of engineering teaching is not really on *teaching*, but on *learning*. Only when students engage with enthusiasm, reach tacit agreement and cooperation with the teaching party can engineering teaching be fruitful.

WebQuest was initiated by Dodge and March in the mid-1990s, and it is an inquiry-based learning mode based on Internet resources [7]. It is a learning activity conducted within a network environment, where a task is presented in

a specific situation (there could be a task to be completed or a problem to be solved in that situation) [8]. WebQuest aims to advance students' cooperative learning ability, inquiry learning and practical ability. WebQuest emphasises the learner's subject knowledge, cultivation of the ability to analyse and solve problems, thinking and new knowledge construction. At the same time, it stresses the teacher's guiding role in the inquiry. The tasks include an introduction to the specific situation and context, resource supply, and task and process design. In the whole teaching process through WebQuest, teachers and learners have *leading-subject* relationship. Hence, it is called *leading-subject* teaching mode [9].

At present, the WebQuest teaching method is mainly applied in Chinese general teaching [10], computer teaching [11] and medical teaching [12], and some other areas. For example, Chen examined the impact of WebQuest learning activities on students' learning behaviour and cognitive change between two music appreciation courses, and proposed that it be used in music appreciation as a creative educational tool [13].

However, the application of WebQuest is not at all pervasive in engineering education. Hence, research on teaching design, implementation and application of WebQuest has great significance. This study introduces the WebQuest teaching method in civil engineering teaching as per requirements of a new curriculum standard for civil engineering.

#### TEACHING EXPERIMENT OF THE WEBQUEST TEACHING MODE IN CIVIL ENGINEERING TEACHING

*Experiment's background:* prior to the experiment, a learning status questionnaires relating to network learning and to students' innovation ability training in the civil engineering specialty were designed. Two hundred questionnaires were distributed to civil engineering students, and 173 valid questionnaires were collected. The result shows that most students majoring in civil engineering are willing to accept network independent learning. Hence, considering the student perspective, it is appropriate to carry out the WebQuest teaching mode for the civil engineering specialty.

*Experiment's subjects and period:* a total of 93 students in Class 1 (46 students) and Class 2 (47 students) of the 2012 civil engineering specialty in a Chinese college were chosen as the subjects of the study. The experimental period was four weeks (12 class hours) and the subjects were the graduate class in the fall of 2014.

*Experiment's method:* different teaching modes were adopted in the experiment process. Specifically, the WebQuest teaching mode and the traditional teaching mode were adopted for different classes. During his investigations, the author surveyed the innovation ability training and network learning of students majoring in civil engineering through a questionnaire survey, and carried out an experimental study. Students' learning interest in civil engineering and learning outcomes existing prior to the experiment were gauged through the questionnaire survey. After the experiment, based on the learning effects of the experimental class and control class, and questionnaire survey results, it has been verified that the WebQuest teaching mode can improve learning interest and enthusiasm of students majoring in civil engineering, and can help them to form various vocational abilities.

As shown in Figure 1, an earlier preparation is the first stage, where teachers are the designers and guides of learning activities, creating social situations similar to actual life for the purpose of study. The incisive design of challenging missions, related not only to the current study content, but also closely linked to the future, can motivate students to actively explore knowledge, clarify and definite exploration objectives, and provide related Web sites to help students improve their exploration efficiency (and to avoid blindly surfing the Internet). Moreover, it should guide students to find more valuable Web sites by themselves, and identify optimal search engines for exploring various resources, including a non-network type of resources.

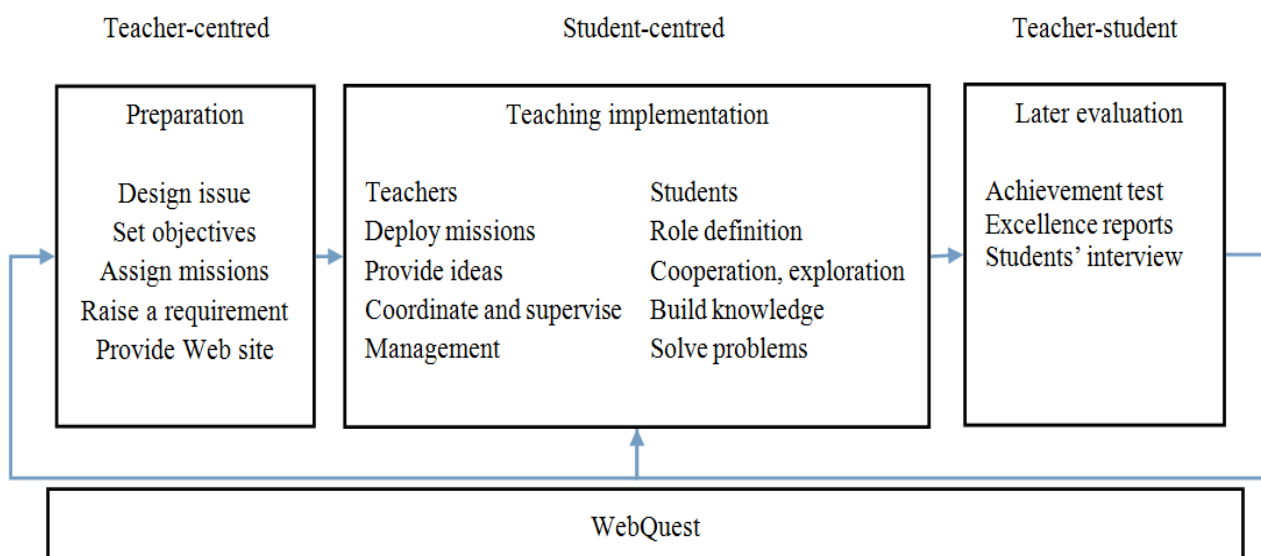


Figure 1: Steps in the teaching experiment process.

At the implementation stage, the role of teachers is converted into one as a participant, helper, coordinator and manager. This is a critical stage for students to engage into the initiative's exploration, build knowledge and complete missions. Teachers should provide appropriate *scaffolding* to help students deploy steps and tasks, give advice and coordinate group learning, while monitoring and managing the entire learning process. Under the guidance of teachers and through collaborative learning, students actively discover, explore and construct the knowledge required to complete the given task. On preparation, before analysing and interpreting the data, students must learn an effective, but general treatment method for the information they are about to collect. Students will consolidate this skill as part of their preparation before interpreting data files with their own unique approach.

In the third stage, both the teachers and students are the evaluators. In addition to the final study product (preparation before the interpretation of data files) and the overall learning assessment, there an *interpreting* test is conducted, with the purpose of allowing students to experience the direct impact of preparation before undertaking the interpretation of the actual results.

As far as the data file evaluation is concerned, the teacher carries out that evaluation, students self-evaluate, and there is a joint teacher-student evaluation in accordance with the standard discussed by both parties. Finally, the teacher selects outstanding files as a reference template for students to observe for future preparatory work before interpretation. Interviews are also held, mainly to understand students' achievements and experience during the process of network inquiry learning.

## EXPERIMENTAL PROCESS

*Comprehensively design exploratory problems:* exploratory problem sources in civil engineering courses are numerous. On the one hand, teachers can select problems by themselves according to teaching content; on the other hand, students are required to preview relevant texts and discuss the problems to be explored. However, the main idea is to highlight students' dominant role and demonstrate the student-oriented teaching idea.

After exploratory problems of civil engineering are successfully selected, the next task is how to design these problems within the WebQuest teaching mode. Generally speaking, problem design should effectively comply with basic requirements in three aspects: 1) comply with course standards; 2) comply with students' existing knowledge and thinking abilities; and 3) comply with problem design requirements. In addition, problem openness in conclusions, target location explicitness, and form interestingness and diversity should be fully considered.

In the exploration process of the WebQuest teaching mode, a resource module plays a key role. There are numerous resources, mainly including three types: 1) learning resources present by teachers according to the theme; 2) learning resource from selected Web sites; and 3) information resources from the whole Internet.

Based on the principle of *theme screening*, an exploration theme for the WebQuest teaching experiment at the College undertaking the experiment was confirmed as: *Survey and Analysis of Flood Control Project*. Class 1 of the 2012 civil engineering specialty in the College served as the control class taught with the traditional teaching mode the Survey and Analysis of Flood Control Project. Class 2 served as the experimental class, which adopted the WebQuest teaching mode. The process was as follows: the traditional teaching mode was adopted for Class 1, and with the help of investigation and analysis reports on flood control projects, major tasks, operational steps and basic activities were explained to students. Assessment was also traditionally arranged. Students were required to draw various charts, and write reports and papers as assignments.

The WebQuest teaching mode was used for the experimental class (Class 2). The specific course contents were the same as with the control class (Class 1). The teacher confirmed learning theme and tasks, and students conducted relevant surveys by all possible means to get to know the main contents of flood control projects and clearly define all possible problems. After that, cooperative learning and network independent learning were conducted to form solutions and the learning achievements were submitted in the form of report. Application effects of the two classes were gained through a questionnaire survey and individual interviews with students.

*Enhance teachers' guidance:* for inquiry-based civil engineering teaching supported by WebQuest, teachers must act as assistants, guides and directors during the students' inquiry-based learning process. In the teaching process, teachers should pay sufficient attention to the inquiry process and evaluation.

*Later evaluation:* as mentioned earlier, both the teachers and students are the evaluators. In addition to the final study product and learning assessment, the overall assessment also covers the teaching contents. Interviews are held mainly to understand students' perspectives (achievements, experience, views, etc) in the process of network inquiry learning.

## EXPERIMENTAL RESULTS

After the teaching activities were over, the teacher carried out a unified examination for students in the two classes. The examination contents were the same. The scores were as shown in Table 1.

Table 1: Examination scores after the teaching activities.

Score section	Control class (n = 46)		Experimental class (n = 47)	
	Number	Proportion	Number	Proportion
[0,59]	8	17.39%	1	2.12%
[60,69]	14	30.43%	7	14.89%
[70,79]	11	23.91%	12	25.53%
[80,89]	8	17.39%	17	36.17%
[90,99]	5	10.86%	9	19.14%
[100]	0	0%	1	2.12%

As can be seen from the test results, the failure rate of the experimental class was lower than that of the control class; students with medium performance rates came mainly from the experimental class as was the case for high performing students. So, when compared with the traditional teaching mode, the WebQuest teaching mode can better facilitate student achievement and improve course teaching effects.

Through analysis of the data from the experiment, the experiment's hypothesis has been verified. The application of the WebQuest teaching mode can effectively mobilise students' learning interest and enthusiasm, boost teaching effects and contribute to cultivating students' innovation and teamwork ability. Such a mode appears more suitable for specialised courses with strong practical attributes.

## CONCLUSIONS

The WebQuest teaching mode introduces higher requirements for the students, teachers and the teaching environment. It can effectively boost students' information technology capability and teachers' information-based teaching ability. However, it has to be mentioned that software and hardware facilities matched with the teaching environment should be constructed to form an application environment suitable for the WebQuest teaching mode. This is a basic precondition for WebQuest teaching.

The WebQuest teaching mode is not necessarily suitable for all civil engineering courses. For some of the basic teaching content of a professional technical course or an elementary course, WebQuest teaching mode may be adopted to fully mobilise students' enthusiasm and help them master practical operation ability, understand theoretical knowledge and cultivate their practice, innovation and teamwork ability.

In evaluation, resource supply, task design, theme screening and system design links of the WebQuest teaching mode, students' characteristics should be considered to form appropriate, targeted teaching. Many teachers cannot satisfy WebQuest's teaching requirements in terms of pedagogical and Internet skills, and subject knowledge. Many teachers have only a basic foundation of educational theory and practice, and have no WebQuest teaching experience.

It may appear that some potential teachers with strong information technology skills are not directly engaged in the profession of teaching, while professional teachers in civil engineering may not have mastered those skills at the desired level. Based on the present situation, it can also be concluded that although universities and colleges are equipped with a considerable amount of multimedia equipment, the existing resources cannot meet the demands of all teaching objectives.

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