Application of Blended Learning in Data Structures and Algorithms Course Teaching

Xiaojing Liu, Xiaoying Wang, Rui Wang

Department of Computer Technology and Application, Qinghai University, Xining, 810016, China

email: 645020710@qq.com

Keywords: blended learning; E-learning; data structures and algorithms; project-based teaching

Abstract. Data structures and algorithms course is a core foundation stone in a computer science curriculum. But there are many complicated algorithms in it. In order to help students to master the algorithms, this paper describes the use of blended learning in data structures and algorithms course teaching. This blended learning model is realized as a combination of teaching methods mixed, project-based teaching, E-learning, course experiment and design mixed, process evaluation and overall evaluation. From the obtained results with performed experimental evaluation, the realized blended learning model may provide more effective and efficient educational experience.

Introduction and Description of the Course

Data structures and algorithms is a substantially important foundation course in computer science for computer programming students on account of learning fundamentals of data structures and algorithmic approaches used in software design and development. Basic data structures and algorithms in this course are used to solve problems in various fields of computer science. For examples, multi-dimensional arrays, generalized table, scattered list and phrase logical tree are used in language compiling; linear table and multi-list structure are used in operating system; some complex data structure such as tree, diagram and generalized table are used in artificial intelligence.

Data structures and algorithms is also important for students to have ability and vision to design and develop fast, active and stable software. This course also gives students a chance to learn more specific algorithms developed for different programming techniques. By the theoretical studying and practicing in this course, students can master the basic data structure and its inherent logic relationship and storage expression in computer, master the sort and search algorithm, which can improve the capacity of program design, and then master the basic methods of analysis and solve problems.

However, this course includes both more abstract concepts, algorithms and programming ideas, a number of precursor knowledge of the course, but also has certain requirements of program practice. So the teaching is very difficult. And students often feel difficult in learning process, and even produce emotional weariness. Thus we design and develop blended learning model in data structures and algorithms course teaching.

Blended Learning Concept

With the development, application and popularization of computer technology and Internet, we have been in E-times. And E-learning education is one of those innovations. Essentially, it is about the transmission of learning content using information technology and often refers to delivery using Internet. It involves a learner using a variety of computer and networking technologies to access training materials[1,2]. With new technologies emerging, the E-learning system can't adapt to new technology. Knowledge management, interpersonal communication, and other soft technologies are to be further developed. And thus comes blended learning.

Blended learning is an education model that contains different types of learning strategies. As Mortera-Gutierrez[3] outlines that blended learning has been defined in different ways in literature but in general, it is the combination of multiple approaches to learning, combining several different

delivery methods, such as collaboration software, web-based courses or computer communication practices and traditional face-to-face instructions[4,5]. In contrast to teacher-centered, rote-learning approaches, blended learning environments provide multiple ways to access content and to demonstrate mastery. As a result, they lend themselves more readily to differentiation of content and process. Today, blended learning is a rapidly growing education model at the nexus of education and technology.

In this paper, we use blended learning model in data structures and algorithms course teaching. And the framework of blended learning is shown as Figure 1.
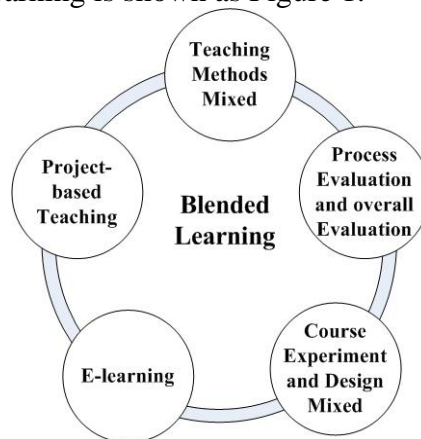

Fig.1. The framework of the blended learning in data structures and algorithms

Blended Learning in Data Structures and Algorithms Teaching

A. Teaching Methods Mixed

From the teaching experiences in these years, we have found that the key problem is to let students understand the storage mode of data structures and algorithms. It is easy for data structures with only one kind of logical structures and storage structures. However, it is difficult for the data structures with more than one storage modes[6].

In order to provide students a depth understanding of the fundamental data structures and algorithms, in the first class, teachers can recall with students: dining in the queue, the process of joining students' union, the shopping experience of going out, and the final exam of each semester. Through the progress, data structures and algorithms may come naturally.

We can use linear list and string to show the student status table, use queue to realize the process of the queuing process, use tree to achieve the organizations of students' union, use graph to realize the cost of time and distance of shopping, and use searching and sorting to show the test case. This may let students feel the course is closely related to their study and life, and may stimulate students' study enthusiasm[7].

Sorting can be introduced into class by role-playing. The process of students' participate may cultivate the students' interest in learning. In the interpretation of specific algorithm, we not only introduce the algorithm itself, by also to enhance the students' perceptual knowledge through the vivid animation. Thus it will make students understand the theories more deeply.

There are many complicated algorithms in the class. In order to help students to master these algorithms, dynamic demo system of data structures and algorithms is developed in teaching, which is shown as Figure 2. These complicated algorithms could be performed step by step. The output and variables in the algorithms can be observed based on these algorithms at the same time. Because the system is very vivid and interesting, more and more students are tried to use it after class. It not only inspires students' enthusiasm for learning this course, but also promotes them in programming.
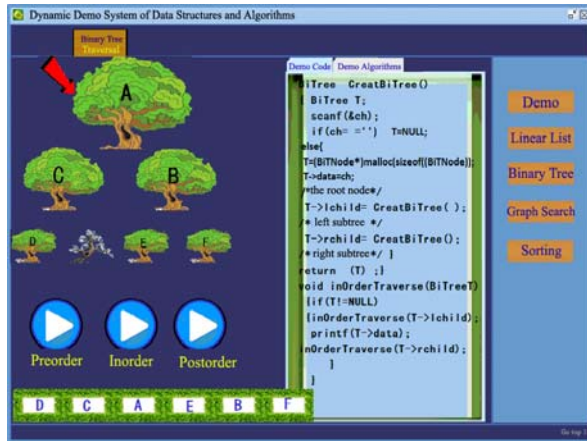
Fig.2. Dynamic demo system of data structures and algorithms

B. Project-based Teaching

As paradigmatic of educative innovations, introduction of new technologies, it is a shift to a student-centred educative process.

Project-based teaching in data structures and algorithms class emphasizes on student-centered, group cooperative learning and self-learning. And it focuses on training professional technical ability, teamwork communication skills, systems engineering analytical skills and self-improvement ability. So we decide to drastically change the design of the practical coursework and adopt the project-based teaching approach. The case system interface is shown as Figure 3, and these three cases can include most data structures and algorithms of the course.

Fig.3. The case system interface

C. E-learning

After class, students may study the course from the education online of the course. They can understand teaching plans, terminology, classical algorithm, video, and in-depth study with many teaching resources (Figure 4).
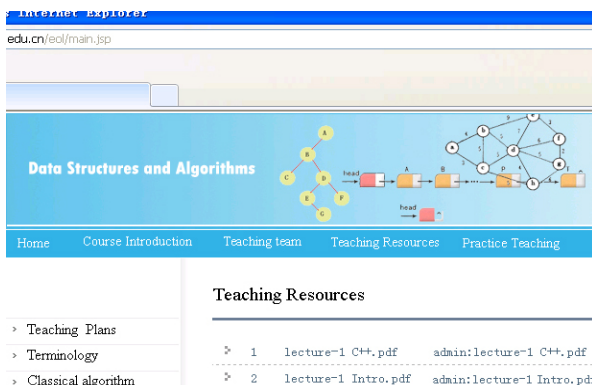

Fig.4. The education online of the course

E-learning gives more control to students over their learning and assessment process, and generates personalized and adapted content to each student.

D. Course Experiment and Design Mixed

Through practicing on the computer of this course, we achieve to get students a deeper understanding of the logic and physical characteristics of the data, the basic elements of data structures, and flexible application in algorithm designing. Meanwhile, strictly and systematically train students in program design methods, basic skill of computer practice and scientific style; cultivate the needed practical ability of software development.

In the course design, we divide students into different groups. And each project leader is responsible for the division of the labor. In curriculum design, students look up information, conceive as a whole plan, design algorithm, code, run, and sum up. They think, communicate and discuss the problems with each other and then find the solutions. Each link can exercise the students' communication skills, problem-solving skills and teamwork spirit.

E. Process Evaluation and overall Evaluation

The course will be evaluated based on attendance and participation, course experiment and design, together with a written paper.

In addition, we use homework similarity detection system to verify the originality of students' reports during teaching, which can help us quickly detect the plagiarism.

Experimental Results

Experiments are carried out to evaluate the effectiveness of the blended learning in data structures and algorithms course teaching. Eighty students are randomly selected from different classrooms. They are divided into two groups. We select tree, graph, and sorting algorithm as the experiment content. The teacher teaches the students of the first group with traditional teaching method in classroom. And the second group of other students study in blended learning.

We test the two group students with the same paper. The scope of scores is shown as Table 1.

Table 1 The scope of scores of the two groups

	The Scope of Score				
	0-59 point	*60-69 point*	*70-79 point*	*80-89 point*	*90-100 point*
the first group	5	11	9	13	2
the second group	3	5	10	15	7

According to Table 1, we can find the comparison chart in Figure 5. From the comparison of each group's scores, we can see that the blended learning can achieve better results.
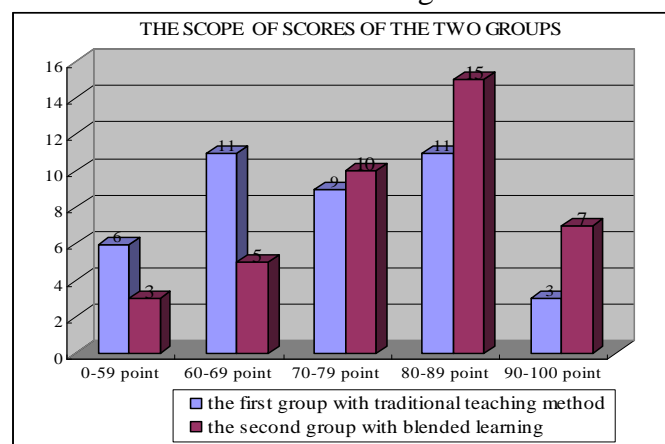

Fig.5. The comparison of each group's scores

Conclusion

Data structures and algorithms is a computer software basic course. Computer science in various fields including the structural elements of computer systems and computer application are related to various data structures.

From the teaching work in these years, we deeply feel that the data structures and algorithms course is so important for students in the study of computer science and technology. How to turn this course from a difficult and boring course into an interesting course is becoming an urgent issue.

In this paper, we introduce the blended learning in data structures and algorithms course teaching. According to obtained results with experimental evaluation, the realized blended learning model provides more effective and efficient educational experience than traditional teaching method.

Acknowledgement

References

[1] Sun Duo, Lu Xue Song. An E-learning System based on Affective Computing, 2010 ISECS International Colloquium on Computing, 2010, 360-363.

[2] JinHua Xu, YinXiao Ma. Application Research of E-learning System in Course Study. 2010 Third International Conference on Education Technology and Training, 2010, 258-262.

[3] Mortera-Gutierrez, F.J. Faculty best practices using blended learning in E-learning and face to face instruction. 20th Annual Conference on Distantance Teaching and Learning.

[4] Osguthorpe, R.T., &Graham, C.R. Blended learning system: Definitions and directions. Quarterly Review of Distance Education, 227-234.

[5] Omer Deperlioglu, Utku Kose. The effectiveness and experiences of blended learning approaches to computer programming education. 2010 Wiley Periodicals, 328-342.

[6] Zhi Liu,Huaguo Jia, Shanshan Han. Research on the Teaching Method of Combining the Theory and Practice in Data Structure Course. The 9th International Conference for Young Computer Scientists, 2501-2506.

[7] Xiaojing Liu, Xiaoying Wang, Yuanyuan Xue, Lihua Fan, Rui Wang. Teaching data structure and algorithms with funny way[J]. Journal of Qinghai University, 2011, 95-97.