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Teaching Reform of Object-oriented Programming Curriculum based on Contextual Teaching Method

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Abstract: Object-oriented programming is the core professional course offered by artificial intelligence major in most colleges and universities. As an important compulsory programming course, how to let the students quickly master complex abstract grammar knowledge, have good practical coding ability, and to apply their knowledge to analyze and solve basic problems in the field of artificial intelligence, need scientific and effective exploration and practice for the teaching mode. Combined with the practical teaching implementation, we take C++ programming course as an example to discuss the teaching reform ideas and practical effect of object-oriented programming curriculum under the guidance of contextual teaching method.

Keywords: Course Reform; Contextual Teaching; Object-oriented Programming.

1. Introduction

Object-oriented programming course is one of the important courses offered by all computer science majors and even other science and engineering majors [1]. The main goal of teaching is to make students master the basic grammar knowledge of programming language, possess the preliminary practical programming ability, and to gradually cultivate the formation of professional quality and humanistic spirit. In this paper, we take C++ programming course as an example to discuss the teaching reform ideas of object-oriented programming curriculum under the guidance of contextual teaching method. Also, combined with the practical teaching process, the specific implementation of the course is elaborated in detail. The effect of the practical teaching shows that the teaching reform ideas proposed in this paper have wide reference values in object-oriented programming curriculum, which is worthy of further promotion.

2. Course Orientation and Students' Analysis

The curriculum reform idea proposed in this paper is mainly aimed at the object-oriented programming course of artificial intelligence major, which requires the students to have learned the basic programming courses such as C programming course and have certain programming skills. The students in this learning stage have mastered certain computational thinking. They are full of curiosity and eager to explore the unknown. However, the object-oriented programming language has varieties of abstract concepts and complicated details. As beginners, students have some difficulties in mastering it. In addition, students are usually unclear about the relationship between the programming language and their professional field. Based on the above course orientation and students' analysis, we put forward the following course reform ideas based on the contextual teaching method.

3. Reform of C++ Programming Course

C++ language is a typical object-oriented programming language, whose grammar is complex and changeable, which have high requirements for students' practical ability. Using the traditional teaching mode is not conducive to improving the students' enthusiasm for learning, which is difficult to achieve the ideal teaching effect. In the long-term teaching work of object-oriented programming courses especially C++ programming course, we find that the teaching mode under the guidance of contextual teaching method can help students master the corresponding grammar knowledge and programming skills more quickly, and guide students to establish better logical thinking ability and scientific innovation ability.

Contextual Teaching and Learning (CTL) is defined as a way to help students relate the learning process to the real-world situations, and to construct new knowledge from the analysis and synthesis of this learning process [2]. It emphasizes the process of full involvement of students in order to find material and its relationship to the reality of social life. Constructivism is one of the most important components in contextual teaching, which means that learning must be packaged into a process of "constructing" rather than receiving knowledge [3]. Therefore, the contextual teaching method places special emphasis on the design of learning situations. By providing students with a problem-related context that can be perceived in life or experience, it can help to give full play to students' initiative in the learning process, and to reduce the gap between knowledge and problems, so as to achieve the purpose of constructing knowledge actively. In the practical teaching, the reform mode of object-oriented programming curriculum is explored under the guidance of contextual teaching method, which is designed for the theoretical part and the practical part respectively, paying attention to the natural integration of learning scenarios.

3.1. Design of Theoretical Teaching

The teaching design of the theoretical part is divided into three stages: "independent exploration" before class,

"collaborative inquiry" in class, and "summary and reflection" after class.

(1) "Independent exploration" before class

Teachers should provide learning materials and fully consider students' thinking mode and cognitive characteristics at this stage. Complex learning tasks can be decomposed and explained by integrating background of easily perceived experience in life, so as to achieve "concept contextualization". Students will conduct an "independent exploration" based on the learning materials provided by the teachers.

(2) "Collaborative inquiry" in the class

In the class, students are emphasized as the center, and teachers and students jointly conduct "cooperative exploration" on the problems generated by the learning before class. Teachers should refine and sublimate the knowledge points, and pay attention to the integration of ideological and political elements, so as to cultivate students' consciousness of inquiry and innovation, constantly improve students' humanistic quality, and stimulate the positive energy and humanistic spirit.

(3) "Summary and reflection" after class

After class, the effects of students' learning should be measured by the online tests and homework, so as to guide students to summarize the knowledge they have learned, and help teachers continuously improve the teaching process. At the same time, it pays attention to guiding students to expand the application of the knowledge learned in class. Through the "application contextualization", students can explore the correlation between the knowledge points learned and the practical application, so as to achieve "learning to know" and "learning to use".

3.2. Design of Practical Teaching

The design of the practical teaching can be divided into three parts: primary "experiment verification", advanced "comprehensive applications" and group "collaborative promotion". The traditional practical teaching mode often consists only of the first part, and here we sublimate the teaching process through the other two parts.

(1) Experiment verification

The programming experiments are designed mainly based on the type of verification. Although there exists a certain context, these experiments are still far from the practical application, which is only used for students to consolidate and improve the theoretical knowledge they have mastered. Therefore, this stage has the feature of "virtual context".

(2) Comprehensive applications

In order to let the students really understand how the programming knowledge applied to the practical application, the "comprehensive applications" part is designed in the practical teaching. Through selecting and adapting comprehensive cases that are closer to the practical applications of their major, students are guided to appreciate and improve the code of these cases, so that students can further experience the course characteristic of "realistic context" in practical learning.

(3) Collaborative promotion

The tasks of the "experiment verification" stage can usually be completed by the students independently. However, the tasks of the "comprehensive application" stage is more difficult to complete by personal strength alone. Therefore, at the primary stage of "experiment verification" and during the transition to the advanced stage of "comprehensive applications", students should be guided to find and cultivate team members suitable for themselves, and carry out "collaborative improvement" in group. Through simulating the process of teamwork when solving practical problems, students can experience the characteristic of "collaborative context".

4. Implementation

4.1. Implementation of Theoretical Teaching

(1) Preparation before class

At least one week before each class, students are provided with classroom teaching objectives and difficult points through the online learning platform, so that students can clarify the learning scope of knowledge. At the same time, learning materials and short videos of important knowledge points are pushed to students, so that they can study in advance and complete the primary construction of the knowledge framework independently. In the actual teaching, xuexitong is selected as the online learning platform. The concept explanation in the short videos should pay attention to the combination of the real context. For example, when it comes to the concept of class and object, the car, housing or school in life are analogous, which are all composed of different components; the encapsulation is analogous to the hardware devices, such as mobile phones, computers, cameras, etc., all of which hide the internal complex components such as circuit board, and only provide keys or touch screen as interface of internal and external interaction. This kind of contextual design is quite reflected in the content of short videos, which better reduces the difficulties in understanding the abstract concepts. In the pre-class learning, students are required to summarize and arrange the problems and confusions encountered in the learning process, which are regarded as the key point of the subsequent teaching.

(2) Teaching in class

In the class, the case teaching method is usually used to introduce the course theme and explain the relevant knowledge points. The teaching in class does not mean the repetition of the knowledge in the short videos again, but more attention to the series of concepts to form a complete and continuous class. In the explanation of each concept, xuexitong is used to complete the communication and interaction with students. Taking the problems encountered by students before class as the teaching points, teachers and students cooperate to explore the essence and solutions of the problems, so as to help students realize the deep understanding and internalization of knowledge.

In the process of teaching in class, we pay special attention to the introduction of ideological and political elements, which can not only be introduced as a part of the case, but also be subtly integrated into the explanation of concepts in class, so as to moisten things silently and realize the "ideological and political contextualization" teaching. For example, in the introduction of "inheritance", the part of reused code is analogous to the inheritance of excellent traditional Chinese culture, while the part of new code is analogous to innovation, so as to guide students to understand that only by innovating on the basis of inheritance can better inheritance be achieved.

(3) Summary and reflection

After class, students are required to complete the self-test and assignments, summarize the knowledge points in time, and form immediate feedback on the learning effect;

xuexitong or chat software are used to answer students' questions, and help students to find the deficiencies of learning and enhance the learning motivation in time, so as to complete the further construction of the knowledge framework.

4.2. Implementation of Practical Teaching

(1) Experiment verification

In the practical teaching, the topics of programming exercise are well-chosen, so that the students can master the basic programming operation of C++ and carry out the basic experiment verification. The original intension of the designed experiments is to consolidate and improve the theoretical knowledge. The context of these experiments is often virtual and far from the reality. Most of the experiments can be completed by students through independent exploration, and a few problems can be solved by communication between students. In this practical teaching stage, teachers are mainly responsible for summarizing some common problems that students encounter to explain, or giving individual guidance to the problems that students cannot solve, so as to guide students to quickly improve their basic programming ability. After practical teaching, students should accomplish the experimental report based on the process of each experiment.

At this stage, the communication behavior is gradually arised between students, so that they can find suitable teammates for the cooperation in the next comprehensive application stage in advance.

(2) Comprehensive application

In the last two weeks of the semester, the students have completed the learning of most of the knowledge points of the course, and have the theoretical basis for comprehensive application. At this time, a slightly difficult comprehensive applications will be arranged for students to solve in groups. The selection and design of these applications comprehensively consider the students' AI professional background, so that students can further understand how the C++ knowledge applied in their professional field. In the setting of the experiments, special attention is paid not to introduce too much or too difficult knowledge of AI beyond the scope of C++. Generally, the prototype code and background description of the applications should be provided to the students. Otherwise, it may be easy to hit the students' enthusiasm for learning.

This stage is the upgrading of students' practical ability, in which them exists certain difficulty and suggested to be completed by team cooperation. An oral presentation should be given by the way of PPT in each group. The practical process should also be summarized to form an analysis report to be evaluated by teacher.

(3) Evaluation effect and feedback

In view of the theoretical teaching and practical teaching of the course, the process and multi-dimensional assessment method should be adopted, and the assessment results can provide quick and effective feedback to the effects of teachers' teaching and students' learning.

For teachers, the evaluation results can guide the adjustment of the teaching implementation process, so as to find out the problems existing in the students' learning process as soon as possible, and play a supervisory role in the students' learning. For example, at the comprehensive application stage, for the groups with poor evaluation of oral presentation, we should timely communicate with the team members and give technical guidance, know the shortcomings in their practical process, and guide students to improve the analysis reports submitted later.

For students, the evaluation results are effective feedback to students' learning effect. Through the discovery of the shortcomings and deficiencies in the learning process, the gaps in knowledge can be filled timely. In addition, through the practical learning at the comprehensive application stage, students have a deeper understanding of the connection between C++ programming and their major of artificial intelligence, which helps improve students' ability to solve practical application problems in their professional field. From the later questionnaire, we also learned that students are generally satisfied with the above teaching implementation, and they believe that their programming ability has been effectively improved under the reformed teaching mode.

5. Conclusion

Taking C++ programming course in artificial intelligence major as an example, this paper discusses the teaching reform ideas and implementation of object-oriented programming course under the guidance of contextual teaching method. The effect of teaching shows that through the integration of contextual teaching method into various stages of teaching, and the organic fusion of C++ programming language and artificial intelligence professional background at the stage of comprehensive application, not only better stimulated the enthusiasm of students' learning, but also improve the ability of solving problems of practical application and enhance the students' inquiry consciousness and team consciousness.

The teaching reform ideas proposed in this paper can not only be applied in C++ programming course, but also be further promoted in other object-oriented programming courses such as Java language and Python language.

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