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Research on the teaching of universities' program design course by project decomposition and progressive method

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Abstract: *In order to improve the computer knowledge level of college students and strengthen their practical programming ability, a teaching model based on project decomposition and progression is constructed.In view of the problems existing in the teaching process of computer programming courses in colleges and universities, based on the analysis of the teaching content and modular construction of computer language courses, this paper puts forward a course teaching method aiming at cultivating the ability of computational thinking and programming.Adopting the progressive design idea of dividing the project into multiple tasks along with the progress of teaching content, introducing the teaching mode driven by task and project decomposition into the process of classroom teaching and practice teaching, designing a teaching mode of completing project modules progressively according to the teaching content and completing the project at the end of teaching.The practice proves that the teaching effect is better.*

Keywords: *program design; Project decomposition; Progressive design; Computational thinking*

1. Introduction

With the rapid development of computer science and technology, the popularization of application, people are required to master higher computer skills in work and study.According to the feedback of college students' employment market information, most employers need students to have higher computer innovation and practical ability, so most of the colleges and universities offer courses to strengthen students' computer ability when making professional talent training programs[1].The program design course is the foundation of computer education and the introductory course of computer science.In the learning process of this course, students are required not only to master programming language, but also to skillfully use programming to solve practical application problems.

2. There are the following problems in the teaching of programming language courses

Due to the rapid updating of computer science and technology and strong practical ability, most of the graduates trained according to the talent training program generally have the problems of backward programming tools and the content taught in class lags behind the market demand.This is because at the time of the revision of the training program, the current most mainstream programming language could not be included in the syllabus due to its immature data;On the other hand, the current mainstream programming languages are also likely to lose popularity and become marginal languages after students graduate.Therefore, the contradiction that the teaching standard of undergraduate talent training program lags behind the market demand exists for a long time.

In the teaching of computer language courses, it is common to use the teaching method of combining the teacher's theory teaching with the students' computer practice in different chapters.This teaching method has the following disadvantages.The theory teaching is teacher-centered, focusing on the explanation of knowledge points, not on the cultivation of students' computational thinking[2]. Most of the exercises on the computer are the intensive training of a single knowledge point.This teaching method focuses on theory rather than practice. Although students have mastered a lot of knowledge points, they cannot use them to solve problems in real work situations. As a result, the cultivated

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students lack the ability of system design and practical application.

Project teaching, based on traditional teaching, is student-centered, students design and realize a complete project, teachers give certain assistance.In this process, the emphasis on the cultivation of students' computing thinking first, causes the student to further realize the computer is not only a tool, but also is the scientific method can inspire thinking, way of thinking to transform the problem of computer processing used in different fields, guides the student to stand at the height of computational thinking to observe and deal with the problem, consciously cultivate computational thinking, It is beneficial to weaken the influence of language and improve the programming ability of students using different computer languages.Secondly, students have mastered the knowledge points required in the curriculum standards and strengthened their ability to apply knowledge points to solve practical problems[3]. Different knowledge points can complete different project modules, and the new knowledge points can improve the developed modules. At the end of the course, the designed modules can be used to achieve complete project development.After learning the course, students can understand the whole process of project construction and design, and enhance their language learning ability and ability to solve practical problems.

3. Project selection and composition

In the project teaching mode, the training of programming design skills is the core of the course.The teaching content selection of programming courses is mainly based on the process of program design, development, debugging, maintenance and so on, and problems are solved according to the actual working environment.The teaching of program design should be carried out under the simulated scene, and the teacher should teach the core knowledge points of the course.Students use the knowledge and scene combined with the design of program modules, let students experience a complete program design and development process in the simulation scene, to help students form the understanding of system development, build their own experience and knowledge system.

3.1. Project selection

Whether the project topic selection is appropriate or not determines the final teaching effect of the whole project.Teachers should carefully choose project topics, mainly from the following aspects.Task examples are selected according to the principle of "clear questions, moderate difficulty, centering on teaching materials, and stimulating interest".Among them, the clear and definite problem is that the selected instance can be realized by computer programming, such as the existence of multiple records, the information needs to be recycled, reflect the advantages of the system, the need for simple statistics and so on;Moderate difficulty refers to the cases that students can understand without too much research or searching for a lot of literature, such as Performance management, library management, class staff management, etc.Students are familiar with these contents, and can deal with multi-record, multi-field problems, and facilitate the expansion of the system;Centering on the textbook means that the completed functions can be realized by using the knowledge in this course;When students make practical small systems with discrete knowledge they have learned, they will have a sense of achievement and increase their interest in learning. With guidance, they can realize more functions of the system. Students will look forward to other related courses such as Database, Data Structure and Software Engineering[4].

3.2. Project composition

At present, the development of computer systems using modular design, although large and medium-sized system processing information is huge, the relationship between data is complex, but specific to each module, the completed function is specific, by a number of different functional modules composed of a variety of different systems.Module in addition to data "add, delete, change and check" and other basic functions, with the deepening of learning and the improvement of problem processing requirements, will involve database access, index establishment, concurrent problems, cluster problems, message queue and other related technologies.For the simple system designed by computer programming language, the main completion of "add, delete, change and check" basic functions and some simple data statistics can be.As shown in Figure 1, system information input includes tail add record and middle insert record.Information editing includes modifying and deleting records;The search of information includes search in sequence and search of any field;Finally, information statistics can take many forms, such as ordering records, summing up certain data,

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averaging, and so on.

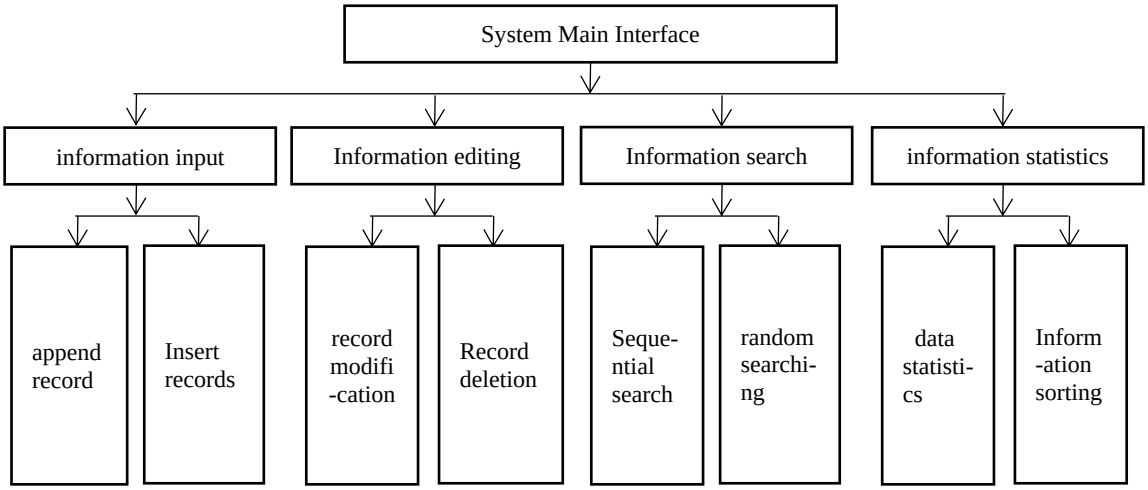

Figure 1: General program module diagram

4. The specific implementation of the teaching project

4.1. The cultivation of computational thinking

Mostly choose the course of college and university introductory programming language such as C language, JAVA language, V BISIC language and so on, introducing project teaching mode in the teaching process, and to calculate thinking training in the form of operational implementation to a specific course content and teaching process, can be thought of from programming experience through abstraction and sublimation of knowledge system.It does not appear clearly in the goal of teaching material knowledge, but is a method to solve a certain kind of problems, with higher knowledge depth and wider application basis.For example, programming patterns often help programmers break down complex problems, form modular solutions, and quickly code implementation.In programming learning, students who master the programming mode can easily complete the ability transition from simple grammar knowledge to comprehensive knowledge application.Therefore, the introduction of programming mode in the teaching process of cultivating computational thinking is conducive to the stepwise cultivation of the core abilities of computational thinking from basic algorithm thinking to abstraction and decomposition.At the same time, because the programming mode reflects the ability of higher-order computational thinking,investigate the mastery of the programming mode，it can be used as a powerful tool to evaluate the development of computational thinking.

4.2. Curriculum architecture

Table 1: JAVA knowledge units

First level knowledge unit	Secondary knowledge point
The data type	Constants, variables, data types;
expression	Arithmetic, relations, logic, assignment, type conversion;
Sequential structure	Input statement, output statement;
Choose structure	If statements, statement nesting, multi-branch statements;
Loop structure	While statement, do while statement, for statement, nesting, break, continue;
An array of	Declaration, initialization, referencing, sorting, strings, and common methods;
Methods	Definition, constructor, parameterless method, parameterless method;
file	Byte stream, character stream, read, write, close;
Classes and objects	Definition, encapsulation, inheritance, polymorphism, interface;

All programming languages have similar knowledge systems. Taking JAVA language programming as an example, its teaching content and knowledge system can be designed as multi-faceted knowledge units and knowledge bodies according to the project teaching requirements of problem abstraction and

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description, algorithm analysis and design, data expression and construction, and program programming and testing.The teaching idea revolves around program design and algorithm design.Its teaching content mainly includes data type, three kinds of program control structure, method, array, file, object-oriented programming and so on.Detailed knowledge points of each part are shown in Table 1.

4.3. Mapping relationship between knowledge unit and project module decomposition

Program design courses include a variety of knowledge points, if a variety of basic grammar and structure as the main line of teaching, will break the system of the program, destroy the thought of design, often appear "students seem to learn everything, but do not know how to start to write the program" phenomenon.Therefore, in the process of project teaching, teachers should analyze students' basic conditions, learning needs and learning ability, and determine the teaching objectives of knowledge units.Then, according to the system modules that can be designed by the core knowledge points of each knowledge unit, the project system is decomposed into modules to realize the mapping between knowledge points and project modules. The teaching teacher designs learning tasks, creates learning task lists and assigns tasks, as shown in Table 2. Most of the functional modules need students to learn a complete course to achieve, in order to achieve better teaching effects, the use of progressive module design method, that is, with the continuous expansion of the teaching content, to improve the designed module.For example: add record, in learning array is, can let students design array elements add.Design the addition of complex data types when learning about objects.Finally, after learning the knowledge unit of the file, the realization record is added to the file to complete the functional module that can be applied in practice.

Table 2: Corresponding relationship between knowledge units and modules

Knowledge unit	The project module
Sequential structure	Module interface display
Choose structure	Menu module function selection
Loop structure	Data statistics module
An array of	Array add, delete, edit, count, find, sort
object	Object add, delete, edit, count, find, sort, expand
methods	Module function item combination
file	Save function module data

At the same time, driven by learning tasks, students carry out autonomous learning design through cooperation and communication, problem discussion, difficulty analysis, task decomposition and other ways[5].Through the continuous teaching process, students can complete multiple modules with different functions, and use the new knowledge to improve the previously developed modules.In this way, after the completion of the whole teaching, the modules designed by students can form a system with practical functions.The implementation process is shown in Figure 2.

5. Analysis of project teaching effect

The application of project teaching in the course of JAVA programming has achieved good results.At the end of the course, through the final score and questionnaire to students (project teaching mode and traditional teaching mode), the implementation effect of learning goal achievement, learning engagement, teaching design, ability improvement and other aspects is investigated, and the results are as follows:

(1) Learning objectives: In terms of learning objectives, project teaching has achieved the most significant effect. More than 80% of students believe that they can complete the design of the system with clear tasks and sufficient time.Only 60 percent of students in the traditional model reached that goal.

(2) learning into: students outside the classroom into a week time on learning an average of about 4 class hours, and spend time (4 class hours) the ratio of the classroom is about 1:1, outside the class than the traditional teaching mode ratio of 0.5:1, it shows that the project teaching mode, the students have to spend more time for autonomous learning and cooperative inquiry learning.

(3) Interest in learning: The effect of class listening is improved compared with traditional class. 70% of students think that project teaching can make their thinking more active and discussion more in-depth in class.Sixty percent will refer to extra-curricular related content to supplement the personal

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design system.

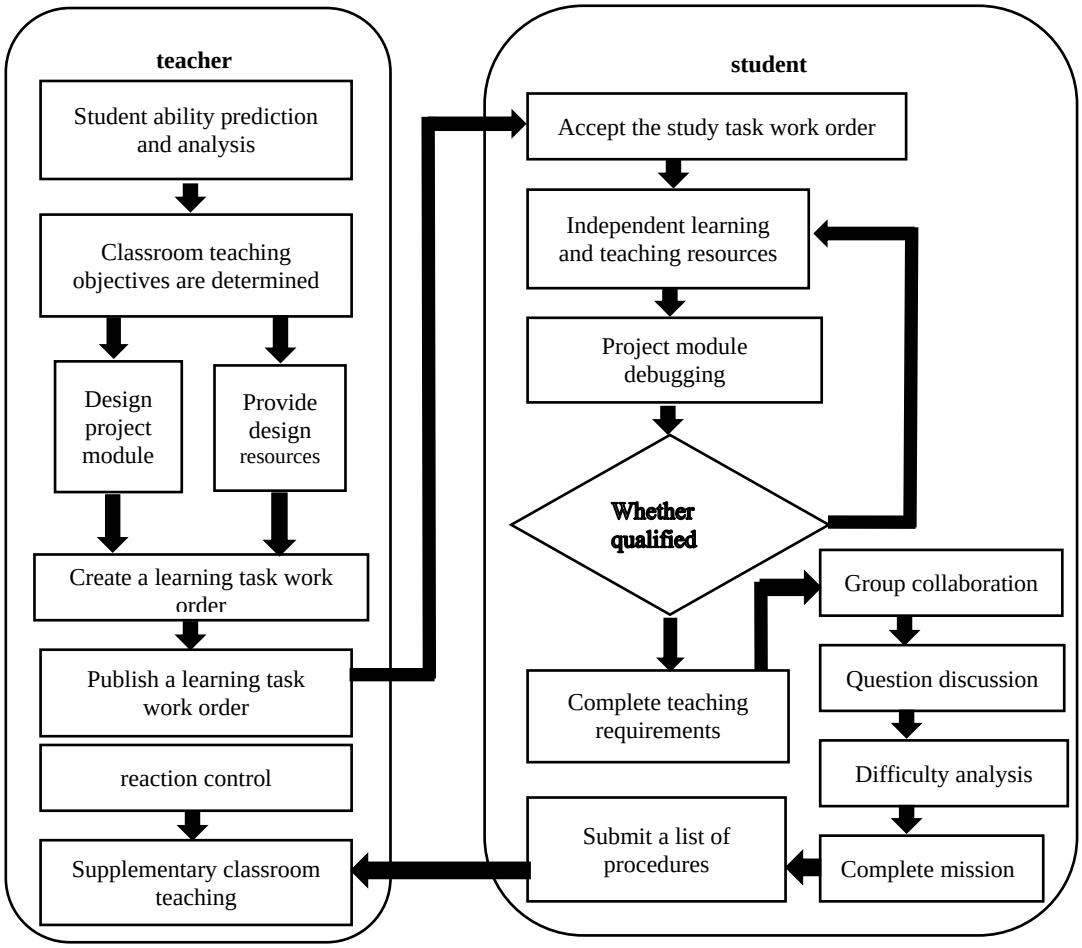

Figure 2: Task implementation process

(4) Ability improvement:In terms of ability improvement, more than 60% of the students believe that their independent learning ability, language expression ability and teamwork ability have been greatly improved, indicating that project-based teaching can help improve students' computational thinking ability and cultivate their individual problem-solving ability.

(5) Learning results: In order to further compare the difference in teaching effects between project-based teaching and traditional teaching, the author selected the same major and basic class as the control class to conduct a comparative analysis of the final paper scores: Compared with the traditional teaching mode, the excellent rate of project-based teaching mode increased by 6.0%, the failure rate decreased by 3%, the average score of the paper increased by 9.2, and the standard deviation decreased, indicating that the students' performance of project-based teaching mode has been significantly improved.An independent sample T-test was conducted on the final exam scores of project-based teaching and traditional teaching, and the results showed that there was a significant difference in the final exam scores of the two teaching modes at 0.01 level.It can be seen that the project model improves students' performance in concept, calculation and application to varying degrees.In terms of basic concepts, the average score rate increased by 4.4%, indicating that in this teaching mode, the teaching of basic concepts was more accurate and students' understanding of concepts was improved.In terms of the type of computing questions, there is no obvious difference between the two teaching modes. On the one hand, the traditional teaching mode attaches great importance to the cultivation of students' computing ability; on the other hand, the data analysis of subjective questions is relatively complex at present, leading to the ineffective intervention effect of teaching decision-making.In terms of knowledge application, the average score rate increased by 11%, indicating that under this teaching mode, students' ability to apply knowledge to solve problems has been improved, which is more conducive to the improvement of students' computational thinking ability such as "analysis" and "synthesis".

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6. Conclusion

In the process of introducing project-driven teaching, it is an effective teaching method to improve students' learning quality by adopting the teaching idea of "designing algorithm by problem and bringing out program by algorithm" and practicing the teaching mode of "imitating, modifying and writing", which has achieved good teaching effect.After reviewing the implementation process and effect of project-driven teaching mode, the following points of experience are gained:

First, teachers assume multiple roles in project-driven teaching and need to possess multiple teaching abilities.

In each link of project-driven teaching, teachers are not only the designers, organizers and evaluators of teaching activities, but also the listeners, guides and feedbacks.Especially in the project structure design, the use of a complete knowledge system to build a reasonable system architecture.Pay attention to the differences of students, increase the sense of achievement and progress of students, according to the different interests of students,select the questions of interest to the students for the system design.

Second, students need to further enhance the awareness of autonomous learning and master the composite learning method.

Autonomous learning ability can make students leap and develop in knowledge learning, subject learning, deep learning, inquiry learning and other aspects, laying a solid foundation for the development of life.According to the feedback of students, most of them believe that project-driven teaching can improve autonomous learning ability, hierarchical topic push can help deepen the understanding of knowledge points, and group discussion can stimulate learning interest and improve problem solving ability.

Third, the construction of professional teaching team, improve the practical ability of teachers.

The core of project-driven teaching is system design, which requires teachers not only to have profound theoretical knowledge, but also rich practical ability.Teachers should not only study project-driven teaching design, teaching methods, classroom organization forms and online question-answering interaction, but also build a teaching community with coordinated and complementary abilities to carry out student-centered intelligent teaching, so as to promote the effective implementation of project-driven teaching in college classrooms.

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