Research and Practice of "423 Mode" Teaching Based on Scratch Assisted Instruction ——Taking the Java Programming Course as an Example

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Abstract. In the case of a general decline in the quality of students in vocational colleges, how to improve the teaching effectiveness of programming basic courses? This article introduces the use of graphical and Scratch software as teaching aids in the basic courses of higher vocational programming. At this stage, following two lines including Scratch and Java in the course design, and also following "423 model" consists of "pre-class"—"in class"—"after class" in the implementation of the classes to cultivate students' innovative thinking ability, stimulate students’ learning interest, reduce the course difficulty and improving course teaching effectiveness. This teaching mode has achieved ideal teaching effect in Java teaching of Rizhao Vocational Technical College.

Keywords: STEAM; Scratch; Programming; Teaching mode.

1. Barriers of Vocational Programming
The "Java Programming" course is the first professional core course of software technology, and is the cornerstone of the whole profession. It can be said that whether to learn this course is related to the quality of the whole professional course. As a vocational college, in recent years, with the independent enrollment and counterpart enrollment, almost all higher vocational colleges have faced the problem of a general decline in the quality of students. In the teaching of software technology, the impact of this decline in student quality is particularly evident. Less and less students can insist on learning programming, and fewer students can really learn focus on the program.

In order to seek reasons, the author has conducted a survey of 768 students in the 2017 and 2018 software technology majors and related majors in our college. 577 students think that learning is not good because programming is too difficult. 132 students think programming is too boring, 59 students do not want to work in software programming and they give up studying.

After further interviews, it was found that students felt that programming was difficult, mainly because of poor English foundation, poor logical thinking ability, improper learning methods, and poor hands-on ability. Just as Taiwan’s well-known technical expert Mr. Cai Xuejun wrote a book on “Programming ING” analysis, whether the “positive” interest cycle successfully established is the key to success. Strong interest and a constant sense of accomplishment are the “engines” of the entire learning process, providing a constant source of power for students to complete their entire learning tasks [1]. The reason why many vocational students feel that programming is difficult is that the existing computer teaching methods have given these students a "painful" programming experience from the beginning, and they have been continuously strengthened in the boring professional courses, which ultimately made many college students fear programming.
2. Based on the Cultivation of Innovation Ability, with the Help of Scratch, Build the "432" Teaching Mode

"4" is the four stages: in the overall design of teaching, the whole teaching process is divided into four stages: “fun project - algorithm project - actual combat project - innovative project”.

"2" means two lines: In the unit teaching design, the logic and code are separated, and the teaching unit is designed according to the two lines "Scratch line" and "Java line".

"3" is the three links: in the implementation of teaching, the implementation of mixed teaching in accordance with the "preview - take class - review".

1. Based on the cultivation of innovative ability, with Scratch as the assistant, the teaching process is divided into four stages: “fun project - algorithm project - actual combat project - innovative project”, and the overall design of the curriculum is implemented.

1) Based on the cultivation of innovation ability, the teaching process is divided into four stages: “First-time programming-thinking training-project actual combat-innovative design” to reconstruct the teaching content.

**Figure 1.** The teaching is divided into four learning stages

The first stage, fun project: through the attractive Scratch project, playing games, learning programming, helping students understand instructions, variables, program structure, events, etc., have a preliminary understanding of programming, reduce gap and rejection of programming, encourage students to use Scratch to innovate games. In the first stage of programming, **Scratch can help students quickly establish programming thinking**. Scratch building blocks are used to guide students to realize what programming is, programming can do those things, stimulate students' interest in learning and gain a sense of accomplishment, ignite the learning engine, avoid "painful" programming experience at the beginning.

The second stage, algorithm project: focus on learning the front part of Java object-oriented, including variables, methods, branch structure, loop structure, etc. When using the Scratch comb algorithm principle, let students master the basic grammar of Java and improve the problem solving ability. In the stage of thinking training, **Scratch assists students to easily rationalize programming thinking, and uses Scratch to explain the logical structure and basic concepts**, so that students can understand the ideas of the program first, and separate the programming ideas from the writing and debugging procedures to avoid the most common inanimation of beginners. The problem of the difference between language and computer language, only copying the code but not understanding the logic of the codes is meaningless.
The third stage, actual combat project: the teaching content is object-oriented, including classes and objects, inheritance, polymorphic, interfaces, arrays, GUI, Java2D, and so on. When you present, you can use Scratch to implement project functions, clear the principle, help students to establish object-oriented programming ideas, and let students master java as a tool to realize their own ideas. In the actual phase of the project, Scratch assists students in correctly analyzing the project principles, using *Scratch to simulate light software or game implementation*, separating the rules and principles of the game from the computer programming language, so that students can learn it step by step. The problems are incapable of reading, too complicated to understand, cannot be understand by principles, and cannot be imagined by principles;

The fourth stage, innovative project: After the course is completed, students are required to complete a project independently. They are required to use Scratch to apply their ideas, training students' innovative thinking, and cultivate students' innovative ability. In the stage of innovative design, Scratch assists students to create creative works and use Scratch to create game projects or application software. Because Scratch is not limited by the code, almost all the games can be realized, so that students can boldly create and solve the students' imagination at this stage. What to do out, can't imagine the principle of the game, plagiarize the online code but don't know what to do.

(2) Based on the innovation ability training, according to the needs of the four teaching stages, combined with Scratch, the design of "fun project - algorithm project - actual combat project - innovative project" as the teaching carrier.

Figure 2. The teaching is divided into four learning stages

In the first stage, the design fun project allows students to implement some traditional fun games and educational light games with Scratch, so that students can gain a sense of accomplishment in game creation and build interest in programming.

In the second stage, the design of ancient quiz, logical reasoning, competition topics, digital black holes and other algorithm topics, first use Scratch to explain the algorithm principle, and then use Java programming to achieve, the algorithm and grammar are separated, easier for students to understand.

The third stage, design performance management, running competition, meteorite war and other educational light games, first use Scratch simulation function, straighten out the ideas, and then use java object-oriented technology to achieve the principle analysis and object-oriented separation, easy for students to understand the project, rationalize ideas.

In the fourth stage, students are encouraged to create, recommend students to refer to excellent scratch works, and encourage creation. After analyzing and understanding, and then using Java technology to achieve the creation of the work, the programming thinking and Java technology are combined.

(3) Based on the cultivation of innovation ability, clarify the results forms and assessment criteria of each stage of the four learning stages, and encourage “original” and “innovation”.
After the first and second stage, each student is required to create a game or application using Scratch to check the report in small groups. In the third stage of the learning process, each class has several synchronization items, requiring each person. At this stage, the students complete at least two simultaneous projects, and report the projects in small groups. After the fourth stage, each student completes an innovative project. The innovative project consists of two parts, the Scratch project and the Java project. Check the report for the unit.

![Diagram](image)

**Figure 3.** Clarifies the form of results and assessment methods in each learning phase

2. Based on the cultivation of innovation ability, with the help of Scratch, the logic and code are separated, and the teaching unit is designed according to the two lines of “Scratch line” and “Java line”.

**One line is the "Scratch Line"**, to discuss the logic and functionality of the project. The graphical and modular Scratch allows students to be creatively independent of the programming language, and to stimulate students' creative desires through preliminary creation, brainstorming, and spiraling of project functions.

**One line is the “Java line”**, which breaks down the skill points or knowledge points used in the project, and guides and trains the students in the three steps of preparation before the class, classroom implementation, and after-school promotion, and applies them to the project.

3. Implementing the design of the hybrid teaching unit in the three steps of “before the class – after class – after class”.

   Use the "Scratch Line" and "Java Line" to separate the logic and code implementation of the project. Split project knowledge points and skill points, and implement teaching in accordance with the three environments of “pre-class preparation – classroom implementation – after-school promotion”.

   (1) Preparation of teaching links before class

   **Scratch Line:** To propose project requirements, students can design and implement their own scratch works based on the Scratch official website or the Ne tease card programming community.

   **Java line:** Organize learning resources to be published on the online teaching platform. Students then prepare students for knowledge through micro-courses, study materials, and exercises.

   (2) Classroom implementation teaching design

   **Scratch line:** show the Scratch game in groups, let the students see the shortcomings and gaps in the comparison, stimulating the innovation of the undergraduate engine, encourage students to explain their implementation principles, teacher comments, summary, propose a solution path and the principle of analysis to form a functional model.

   **Java line:** First, through the pre-class test, check the students' understanding of the pre-class knowledge, and then analyze the principle of the project according to brainstorming, analyze the principle, and focus on the knowledge points prepared before class.
(3) Improve the design of teaching links after class

**Scratch Line:** Encourage students to further improve project functionality through Scratch in the second class. **Java line:** Do a good job in the second class, encourage students to use Java to complete the new functions of Scratch, and force students to learn the knowledge points and skill points encountered in project development. Teachers can learn knowledge in the course learning platform.

### 3. The Conclusion and Outlook

The graphical and integrated programming software Scratch assists in the teaching of high-level programming basic courses. It is quick to start, easy to understand and easy to debug features reduce the “threshold” and difficulty of programming, stimulating learning interest, creating innovative students, and providing technical protection. The first advantage is easy to understand and reduces the threshold for getting started with programming. Scratch implements the commands and parameters of the program through the modular shape module. It does not need to learn the grammar. It does not need to learn complicated operations, so that beginners can “drag” the desired result in a short period of time. Getting started quickly reduces the "frustration" of beginners. Second advantage is that it is easy to master and reduce the difficulty of learning for beginners. When beginners are learning programming, they will be at a loss for ubiquitous grammatical errors and logical errors. The unpleasant experience of beginners makes it difficult for high-level students with poor frustration to abandon programming. Because Scratch uses the method of dragging the building block module, the learner does not need to write the code. It only needs to pay attention to whether the logic is correct and does not need to pay attention to whether the grammar is correct, and the entry is quick and easy to get started. The third is to train programming thinking, stimulate interest in learning, and encourage creativity. Programming is not a language, but the training of programming thinking and the establishment of programming ideas. Scratch weakens the grammar, and beginners can quickly develop simple games; after a period of learning, they can simulate existing games; after in-depth learning and innovation, they can create games. Through the introduction of games and the display of results, students' interest is stimulated and confidence in learning programming is established.

In addition, promote scratch in universities, let more college students today, let more today's college students, next generation of young parents, understand Scratch programming, accept Scratch programming, and promote the "Notice of the State Council on Printing and Distributing a New Generation of Artificial Intelligence Development Plan". In the primary and secondary schools, artificial intelligence-related courses will be set up, and programming education will be gradually promoted, and social forces will be encouraged to participate in the development and promotion of programming and teaching software and games. [2]

In order to promote the teaching reform achievements, the author has built a Scratch promotion course “Playing Games to Learn Programming” and a series of java assisted teaching with Scratch on self-media platforms such as Netease Cloud Classroom, Bilibili, and Watermelon Video. The results of the reform are integrated into these online courses, and I hope that more teachers can use these resources as references.

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