

# Exploration of Programming Thinking Teaching Based on Game Development

—Taking “Scratch” as an Example

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**Abstract**—In the current environment, in order to improve students' information discipline literacy, this paper starts with the programming thinking of cultivating information discipline, and explores the main methods and strategies of programming based on game development from theoretical research and practical application. Practice results show that students can improve their self-learning ability through self-learning; the improvement of programming thinking can be used to solve other problems; students' ability in all aspects has been improved. The following strategies are proposed for the existing problems of programming courses: simplifying the course content, lowering the learning threshold; graphical programming, implementing mouse programming; community resource sharing, reducing the difficulty of access. The innovative content of this paper is to design and discuss the course of students' programming thinking based on game development in theory, and to provide reference for other educators. At the practical level, the game-based teaching method is different from the traditional information technology teaching method, which can better stimulate students' interest in the further learning programming language in the future, and provide teaching reference for higher-level learning programming teaching.

**Keywords**— *Game; Student; Programming Thinking; Scratch*

## I. INTRODUCTION

### A. Research background and significance

Nowadays, in the wave of social informatization, computational thinking has become a universal skill, and everyone, not only computer scientists, should be enthusiastic about its learning and application.[1] In the field of education, information technology has become a leader in today's wave of educational informatization because of its close relationship with the information society. Programming teaching, as a reliable means of improving computational thinking, has many functions. The emergence of Scratch graphical programming

software makes programming interesting and makes the learning process no longer boring. Through the interaction and cooperation of educational games, students' learning motivation can be stimulated, so that students can better learn and accept knowledge. At the same time, it also meets the information literacy requirements for primary education in today's information society and cultivates programming thinking so as to play a role in future learning.[2]

### B. Introduction of related concepts

#### 1) Programming thinking

Programming thinking is an efficient way of logical thinking when solving problems. The training of programming thinking is not to train future programmers, but to train logical thinking ability and make learners more organized and comprehensive when thinking about problems.[3]

#### 2) Educational games

Educational games are a kind of serious game. Serious games are games that teach knowledge, provide professional training and simulation. With the development of the Internet, more and more educational games are used in classroom teaching, and the teaching value attached to the game is also recognized by more and more people.[4]

## II. TEACHING RESEARCH AND PRACTICE OF PROGRAMMING THINKING BASED ON GAME DEVELOPMENT

### A. Teaching research

#### 1) Teaching status

##### a) The learner's learning foundation is poor.

According to the survey, most of the fifth-grade students know little about Scratch and programming. Even some students are not very familiar with typing and some basic computer operations. Knowledge of information technology needs to be strengthened urgently.

*b) Programming courses are more complicated.*

There are many types of programming languages, including C, C++, java. The teaching of these languages needs to be reached in the advanced teaching stage. Although there is a newly added Scratch graphical programming language, in essence, programming is still an activity that needs to be driven by logical thinking. [5]

*c) Shortage of teaching resources*

In recent years, there has been a sudden upsurge of learning Scratch, which has caused insufficient attention when it was introduced. Scratch teaching resources that have not formed a complete teaching system seem to be stretched to the limit. Therefore, it is urgent to develop existing Scratch teaching resources.[6]

**2) Teaching design**

*a) Analysis of Learning Objects*

The fifth-grade students have just acquired the initial logical thinking ability, can solve some simple sorting, screening, logical operations and other operations, have the initial conditions to use Scratch and can use Scratch software to

*c) Teaching design*

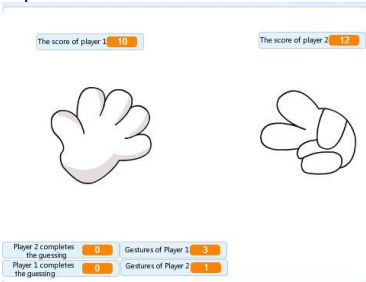
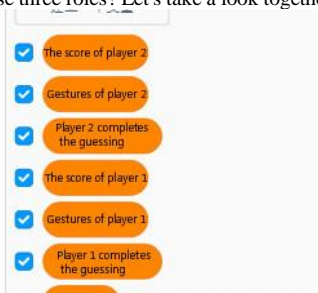
complete the framework of some scenarios in combination with life.




*b) Analysis of Teaching Objectives*

**Knowledge and Skills:** The teaching of students' programming thinking based on game development, taking Scratch as an example, hopes that students can master some concepts on the basis of programming, and start to enter the algorithm by starting to learn specific algorithms by simply learning the basic concepts, combined with textbooks to consolidate. This course only requires students to understand the basic branch structure, can enumerate the possibility of guessing the game, and express it in code.

**Process and Method:** To solve the problem through programming thinking, then there will be a practical level, and knowledge will be mastered through the production of some projects.

**Emotional attitude:** in the information age, we need to master information technology to carry out practical operations, express our creative ideas with computers, and form good habits of communication among groups.

Fun Programming Guessing Boxing	
1. Ask questions to create a life story and guide you into the topic.	<p>Teacher: Boys and girls, have you ever played the guessing game? Who can tell us the rules of the guessing game?</p> <p>Student 1: Teacher, the rules of the guessing game are stone wins scissors, scissors win cloth, cloth wins stone. (Students think about life situations and become interested in the classroom)</p> <p>Teacher: Boys and girls, have you ever tried to play guessing games on the computer? How should computers judge winning or losing? With this question in the mind, let's start today's study. (Set questions at the beginning so that students can think about problems in their study)</p>
2. Scenario import, case analysis	<p>Teacher: Let's think about the roles we need to set up when designing the guessing game.</p> <p>Student 2: Scissors, stones and cloth.</p> <p>Teacher: Good. Let's think about it again. We just said the requirements for winning the game. What else do we need when we play guessing games?</p> <p>Student 3: You need both sides to shoot at the same time, you can't cheat.</p> <p>Student 4: When the hands from both sides are the same, the draw will be counted again.</p> <p>Teacher: What the students said is very good. These are all the elements of the game process and the issues of neediness. Next, I'll show you the guessing game and its production process. You should think with the first questions.</p> <div style="text-align: center;">  </div> <p>Student 5: I know that I need to add a number to record the number of wins on both sides.</p> <p>Student 6: Only the numbers that complete the shots will become one after, and the results of the guessing on both sides will come out.</p> <p>Student 7: Different gestures, the number of player gestures will change.</p> <p>Teacher: The students have found the key to many problems. What will these conclusions look like if they are embodied in our programming code? What will we design for these three roles? Let's take a look together.</p> <div style="text-align: center;">  </div>

<p>3.Task 1: Complete the role design</p>	<p>Role Name: Player 1 Character function analysis (pressing different buttons will result in different hands, both sides will change shape when pressed at the same time, and give the completion signal, etc.) role instruction</p>  <p>(Taking the role of scissors as an example)</p>
<p>3.Task 2: Complete the design of rules</p>	<p>Rule 1: Both sides must take the shot at the same time and change their shapes until they both shoot. Rule 2: Stone wins scissors, scissors wins cloth, cloth wins stones. Rule 3: The winner will add one point, the loser will add 0 points, and the tie will be zero. Role instruction: To solve problem one:</p>  <p>Make a logical judgment that waits for both sides to finish shooting, and judges the outcome when the variable of shooting becomes 1. To solve problem two: Scissors, stones and cloth are defined as three different numbers, and the outcome judgment is transferred to the comparison of numbers. Use nested if loop conditions to complete the design.</p>  <p>The solution to Problem 3: Add new points such as directly adding points after the comparison of figures is completed. In order to be able to start the next round, the previous guessing game data will be cleared after each round.</p>
<p>4.Self-exploration and completion of works</p>	<p>According to the teacher's explanation, the scattered roles and stage rules are completely supplemented, and finally, scripts are written and tested. Put forward the difficulties encountered in solving the problem and exchange among groups. Prepare for the production of open works. In this process, the teacher acts as a guide, does not need to directly instill knowledge, encourages students to think more, and gives advice on difficult points instead of directly stating the operation method.</p>
<p>5.Exchange and sharing</p>	<p>Share among the students, exchange their ideas and understanding with the students, and finally select one person from the group to make a concluding speech and tell the summary of this class.</p>
<p>6.Classroom evaluation</p>	<p>Near the end of class, the teacher summarized the class, and finally issued a class evaluation form, allowing students to make an evaluation of the teacher. Each group handed in their own works, and the teacher collected works to evaluate the students in class.</p>

**B. Teaching practice**

**1) Survey method**

Questionnaire survey.

**2) Survey object**

40 students from Class 1, Grade 5, Dong yang Foreign Languages. After class, they will issue questionnaires and return them after answering. The questionnaire recovery rate is 100%.

**3) Questionnaire survey results and research**

This questionnaire has 10 questions. The main survey is the students' views on the course of programming thinking. The survey data are shown in the following figure.

TABLE I. STUDENTS' ACCEPTANCE OF CLASS CONTENTS

	Difficult to understand	As usual	Easier to understand
Number of people	3	7	30
Percentage	7.5%	17.5%	75%

It can be seen from the chart that 7.5% of the people find the contents of the Scratch programming course difficult to understand, 17.5% say it is almost the same as usual, while 75% think it is easier to master and understand. To sum up, Scratch-based programming teaching can help students to better understand programming content and cultivate programming thinking to a certain extent.

TABLE II. STUDENTS' INTEREST IN CONTINUING TO STUDY PROGRAMMING COURSES IN THE FUTURE

	Not interested	Generally	Very interested
Number of people	1	5	34
Percentage	2.5%	12.5%	85%

From the chart, it can be seen that 2.5% of the people have no interest in learning the contents of Scratch programming in the future, 12.5% of the people show general interest, and 85% of the people want to continue learning in the future. From this, it can be found that Scratch programming, as a programming initiation course, can well stimulate students' learning interest and motivation.

TABLE III. COMPLETION OF CLASSROOM TASKS

	Not finish the task	Completed the task	Going to design after completing the task
Number of people	10	27	3
Percentage	25%	62.5	7.5%

According to the chart, 25% of the students did not complete the classroom tasks, but most of the students still completed the basic tasks, while a few students did some improvisation after completing the tasks and finished their own creative ideas.

TABLE IV. UNDERSTANDING OF SCRIPT LANGUAGE MEANING

	Did not understand at all	Understand the part	Fully understand
Number of people	1	10	29
Percentage	2.5%	20%	72.5%

According to the chart, about 2.5% of the people did not understand the code, 20% of the people understood part of it, but still some did not understand it, and 72.5% fully understood it. The Scratch programming script language, which illustrates the graphical structure, can still be understood by most beginners.

TABLE V. DEVELOP IDEAS FOR SOLVING PROBLEMS

	No	Yes
Number of people	17	23
Percentage	42.5%	57.5%

According to the chart, 42.5% of the students in the course did not expand their thinking on the problems, but 57.5% of the students still expanded their thinking on their own problems, which shows that Scratch is an open programming software and teachers should think in an open way in class.

**4) Summary of Practice**

Through the teaching discovery of students' programming thinking courses based on game development: students can improve their self-study ability through self-study. The improvement of programming thinking can make students think more methodically, comprehensively, think more broadly and improve their logical thinking ability. Game-based learning methods improve students' programming thinking, logical thinking, etc. At the same time, it is conducive to the all-round development of students.

**5) Strategies for Solving Problems in Programming Courses**

Through the above game-based teaching practice of students' programming thinking course, we propose the following strategies to solve the existing problems in the programming course.

*a) Simplify the content of the course and lower the learning threshold.*

The primary school students' programming thinking course based on game development simplifies the learning difficulty of programming. Using Scratch to disassemble the course into basic modes can realize functions through simple dragging.

*b) Graphical programming is implemented by mouse programming.*

Scratch is to turn instructions into simple jigsaw puzzles. Students can directly determine the position of sentences through different jigsaw shapes and gaps. At the same time, the graphical operation of the program can also help students find out where the problem is.

*c) Sharing community resources to reduce access difficulties.*

Scratch can also upload works designed by itself to the community to share and communicate with friends all over the world to improve the learning level. At the same time, a large number of teaching resources can be easily obtained in the Scratch community.

**III. SUMMARY**

This paper combines the learning psychological characteristics of fifth-grade students, chooses the appropriate

content of the programming thinking course, gives the teaching design of students' programming thinking teaching practice based on game development, and evaluates the classroom effect through questionnaires. At the same time, it is found that programming thinking can also be extended to other subjects, and cultivates some learning habits and learning methods. However, due to limited capacity, this paper has not conducted in-depth research on other aspects of the expansion content, research is limited to a grade, there are shortcomings and defects, need to be further improved.

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