Exploratory Research on Graphical Programming to Improve Pupils' Computational Thinking Ability----Taking a programming cat as an example

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Abstract: In recent years, computational thinking has become one of the core literacy of information technology in primary and secondary schools. Visual programming is also recognized by the public. Based on visual programming tools, this study explores the impact of visual programming on pupils' computational thinking through quasi-experimental research, in order to provide reference for visual programming education in primary and secondary schools. Through analysis, it is found that visual programming can promote the ability of primary school students to calculate thinking.

1. Introduction

Ren Youqun and others in East China Normal University believe that computational thinking is a process of solving practical problems by using computational concepts and tools, and also a scientific way of thinking that requires system training and exercise[1]. In 2017, the "New Generation Artificial Intelligence Development Plan" of the State Council of China clearly pointed out that artificial intelligence related courses should be set up in primary and secondary schools, and programmatic education should be encouraged to encourage social forces to participate in the development and promotion of programming software and games. Computational thinking was not mentioned in the primary school information technology curriculum in China. Most of the teaching objectives only consider knowledge and skills and think less about the cultivation of students' internal thinking. At present, the programming teaching for students in primary school is actively explored. If text-based programming teaching in the middle school and higher education stages is adopted, the cognitive load of primary school students will be greatly increased, which will hinder their learning. Based on this, this study explores the effect of graphical programming on the development of primary school students' computational thinking by using a quasi-experimental study of programming cats.

2. Method

2.1. Participants

The object of this study was 52 primary school students from two different classes of xi 'an university south road primary school, whose average age was 11 years old. According to the experiment, the students were divided into two groups according to the class. The experimental group was taught with graphical programming tools, while the control group was not taught with programming cats. In this study, two groups of students were taught by the same teacher with the same teaching design. After the experiment, a total of 104 valid data were recovered, including 52 from the experimental group and 52 from the control group. The remaining data were removed because the tester did not participate in the entire teaching session or did not complete the test.

2.2. Research tools

This research experiment uses the computational thinking skills test application evaluation method (Bebras test questions) and the thinking visualization iteration tool to program the cat.

The test tool is compiled by the researcher from the 2017 Bebras International Computing Thinking Challenge, the simulation package and the sub-package test. There are two sets of test papers, which are used as measurement tools for pre-test and post-test. The computational thinking test I volume is used for pre-experimental testing, and the computational thinking test II volume is used for post-experimental testing. The level of difficulty of the two sets of questions is basically the same, so the test questions have certain comparability.

To more effectively illustrate computational thinking, the researchers based on the International Society for Technology in Education (ISTE) proposed six measurement domains for computational thinking standards and Dr. Cynthia Selby and John Woollard of the University of Southampton in 2013. The Ph.D. proposes five elements of computational thinking[2]. The researchers further decompose computational thinking into six dimensions: abstract thinking, algorithmic thinking, induction, analogy, judgment, and evaluation. The two sets of test questions in this study each contain 9 questions, all of which are situational task questions, presented in an easy-to-understand way. Each question selected contains two to three dimensions in six dimensions.

2.3. Research design and procedure

The experimental process of this study is divided into four stages: student attitude questionnaire, pre-experimental test, teaching stage, and post-test. The purpose of the pre-test phase is to measure the degree of computational thinking level of the two groups of students in the initial stage.

The first step: select the experimental object. In order to ensure that the starting point levels of the experimental group and the control group were similar, a questionnaire survey of student attitudes was conducted. The results showed that the experimental group and the control group had the same starting point level. Therefore, the cat student was selected as the experimental group, and the non-programmed cat student was used as the control group.

The second step: the pre-test of the computational thinking of the two groups of students, the two sets of test questions are the same as the test I, the duration is 20 minutes.

The third step: the teaching practice stage, the teaching cycle is 10 hours. The experimental group used the programming cat to carry out teaching practice and the control group to carry out traditional teaching. During the period, the same teacher teaches and the teaching progress is the same.

Step 4: After 10 hours, post-test the two groups of students. The duration is 20 minutes.

3. Result

The subjects of this study were 52 primary school students from two different classes of xi 'an university south road primary school, whose average age was 11 years old. According to the survey, the students of the two classes are proficient in computer operation, and can use the Internet to find and collect the text, pictures and other materials they want, so the students have the basis of the existing operation and there is not much difference in the starting point of knowledge.Students are basically interested in learning programming and have good learning ability and positive learning intention.

3.1. The experimental group and the control group calculated thinking ability before and after the test results

In order to study the changes of the students' computational thinking ability before and after the experiment, the pre - and post-test of the students' computational thinking level were analyzed[3]. Experimental group and control group effective recovery of computational thinking test (I, II volume) are 25 copies, belong to the small sample study, so the effect of outliers is very significant.According to the analysis, the significance level of the normal test before and after the calculation of thinking difference between the experimental group and the control group was higher than 0.05, and the data followed the normal distribution. The paired sample T test could be used to analyze the difference of the test results between the experimental group and the control group. The data analysis results are shown in table 1. The data results showed that the experimental group (sig.

=0.000) had extremely significant results before and after the calculation of thinking, while the control group (sig. =0.029) had significant results before and after the calculation of thinking.

Table 1 T test results of paired samples before and after thinking calculation in the experimental group and the control group (N=25)

The test item	The mean	Standard error of the mean	T	Sig. (double side)
Comparison of the test results before and after thinking calculation in the experimental group	15.520	3.659	4.241	000.
Comparison of pre-test and post-test results of computational thinking in the control group	4.480	1.926	2.326	029.

3.2. Posttest results of computational thinking ability were compared between the experimental group and the control group

For respectively to compare the students' performance in the test before and after the existence of difference, this research use SPSS respectively on two groups of students computational thinking test (I, II roll) sorts through the data analysis. Since the sample size is less than 30, it is an independent small sample. Therefore, the Shapiro-Wilk Test was used for the normal Test, and the significance levels were all greater than 0.05, indicating that the two groups of data presented a normal distribution. Levene Test was used to Test the homogeneity of variance, and the significance levels were all greater than 0.05, indicating that there was no significant difference between the two groups. Therefore, independent sample T test can be used to analyze the data before and after the test. Table 2 shows the analysis of the pretest results of the two groups, and the sig. Value is greater than 0.05. Therefore, there is no significant difference between the two groups in students' scores, that is, the initial calculation thinking level of the two groups is similar.

Table 2 T test results of independent pre-test samples

The test item	category	The number of	The mean	The standard deviation	T	Sig. (double side)
Computational thinking test I volumes	The experimental group	25	42.16	15.789	- .184	.855
	The control group	25	42.96	14.979		

Table 3 T test results of independent samples in post test

The test item	category	The number of	The mean	The standard deviation	T	Sig. (double side)
Computational thinking test II volumes	The experimental group	25	57.68	16.224	2.156	.036
	The control group	25	47.44	17.335		

The sig. value of T test results of independent samples in the posttest (table 3) is less than 0.05, indicating that there is a significant difference in the posttest scores between the two groups. The posttest scores of the experimental group were significantly higher than those of the control group, and the students' computational thinking ability improved more than those of the control group.

4. Discussion

Through quasi-experimental research, it can be seen that graphical programming has a significant effect on the cultivation of primary school students' thinking ability[4]. Students who received traditional teaching were compared with students who received programming instruction based on traditional teaching. The research data showed that the latter's performance in the post-experimental test was significantly higher than that before the experiment, and its computational thinking ability was significantly improved. The results of this study show that increasing students' graphical programming education is more conducive to improving students' cognitive level than traditional teaching. Students can grasp the learning focus more vividly and directly, and focus on problem solving, thus making the visualization Programming is more conducive to improving the computational thinking ability of primary school students. At the same time, compared with the control group, students who learn graphical programming are better than those who accept traditional teaching in terms of problem solving and abstract thinking ability[5]. In the experiment, we also observed that the experimental group students are more inclined to have full thinking and teamwork in their studies. They prefer to jointly explore learning experiences and carry out learning innovation. It can be found that graphical programming not only improves students' computational thinking ability, but also stimulates students' further learning motivation and has a stronger desire for deeper learning. Therefore, it can be concluded that students who are learning graphical programming have made great progress in their ability to calculate thinking.

5. Conclusion

This study carried out an experimental study on the ability of visual programming to cultivate primary school students' computational thinking through preliminary investigation of the attitude of the research subjects. The research results show that visual programming can significantly promote the improvement of primary school students' thinking ability, and at the same time have a certain positive impact on the problem solving of their thinking. This research finding will provide some support for the popularization of visual programming teaching in primary and secondary schools.

However, due to the limited time and the limited sample, this experimental study still has certain limitations. In the future research, the combination of the dimensional analysis of the work and the dimensional analysis of the computational thinking is used to explore the aspects of the promotion of visual programming to the primary school students' computational thinking, so as to better carry out the teaching of information technology.

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