The effect of students' effectiveness and attitude in heterogeneous and free grouping cooperative learning applied in sixth-grade students' Scratch program teaching

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Abstract: Although the method of cooperative learning has been used popularly, but researchers paid less attention to different grouping way in the past, especially heterogeneous and free grouping. In this paper, researchers analyzed students' effectiveness and attitude in heterogeneous and free grouping cooperative learning in sixth-grade students' Scratch program teaching. 52 students participated in the study and the Scratch animation works assessment scale was prepared and revised by some experts, students and Scratch teaching teachers. Many interesting things have found in the study, such as heterogeneous grouping brings better students' works, and more efficiently arouses students' curiosity. In addition, free grouping stimulates more positive attitudes, while heterogeneous grouping leads to more learning pressure, and boys have less pressure in Scratch learning than girls. This can provide some constructive suggestions for cooperative learning.

Keywords: heterogeneous grouping, free grouping, Scratch, program teaching

1. Introduction

Nowadays, with the rapid development of modern information technology, technology plays a critical role in the education reform，and the ability of ICT has been regarded as essential skills for primary and middle school students. Since Ministry of Education published the curriculum guidelines of primary and middle school in 2003, education of information technology has been a major issue. And at once setting forth from the third level, students deliver a single lesson of information technology every week at least, thus as to improve the ability of ICT. Though students in primary can learn many things from lessons of information technology, programming lessons are abandoned or delayed until middle or senior high school.

Scratch is a new programming environment developed by MIT Media Lab. It is suitable for children aged over eight years old to make their own small programs creatively, such as interactive stories, animation, games and art (Chen, 2009). He (2013) also said that students could make a program easily by dragging blocks, which is suitable for young children. Some teachers have used the method of cooperative learning, but they don't give enough attention to it, and whether different grouping has some close relationship with students' effectiveness is still unknown.

2. Literature review

2.1 Study of Scratch programmed instruction methods

Xie (2013) puts forward a teaching method "creating situation—analyzing cases—interacting between teachers and students—design (personalized works) —sharing and communicating" by exploring the teaching model and the method of Scratch. Xu & Huang (2013) found that collaborative project-based on learning could enhance students' effectiveness and attitudes toward Scratch. With the didactic and inquiry teaching methods respectively, Yang (2010) tried teaching the Scratch program design, and the results showed that with these two kinds of teaching methods on the fifth grade primary school students, there were not significantly different, and the teaching method and the mathematics learning achievement didn't have close relationship. Ke (2013) explored the potentials of computer-aided and mathematics game making activity based on Scratch on promoting students' mathematics learning. Research showed, participants who involved in making computational game were more positive to mathematics learning. And the experience and design of game could connect to daily mathematical experience.

In summary, students usually make a Scratch work in a group, whose aim is to express their own feelings by engaging in developing comprehensive abilities, cultivating creative thinking, and learning how to cooperate with others (Brennan & Karen, et al, 2010). So the method of cooperative learning is suitable for Scratch learning. However, there are few studies about Scratch program cooperative learning of pupils. So researchers tend to focus on this area.

2.2 Studies of free grouping and heterogeneous grouping

Zhang (2006) made a study based on heterogeneous grouping, and after a semester's study the experimental group whose members were divided into groups by their basic ability got higher scores than the control group. The research showed that the heterogeneous grouping could improve different aspects of ability. A research (Deng & Huo, 2010) also found the basketball skills of heterogeneous grouping had been improved much more than that of free grouping. Teaching activities may be carried out in accordance with students' aptitude.

All in all, there are no definite conclusions about whether different grouping in programmed learning will bring disparate imparts on students' effectiveness and attitude. Similarly heterogeneous and free grouping are often used during daily teaching activities, but studies about students' effectiveness based on heterogeneous and free grouping are few.

3. Method

3.1 Participants

52 students in two classes in the 6th grade of Elementary School in Beijing are included in the research. The classes were assigned as the experimental group (22 students，Class 1) and a control group (30 students，Class 3). For 8 weeks, the same Scratch program teaching was conducted in both two groups. Only one researcher taught them Scratch.

3.2 Research design

Despite the lack of pre-test, two classes are normal classes, which aren't selected and changed. Given that students had no significant differences in effectiveness and attitude at first, One class (class 1) is free grouped, and the other one (class 3) is heterogeneous grouped. One group has two students. Then through evaluation of the works and an attitude questionnaire survey of cooperative learning groups, researchers compare the Scratch programming learning effectiveness and attitudes of students grouped by two different ways.

According to the objectives of the study and relevant literature information, the framework of this research was established as follows.

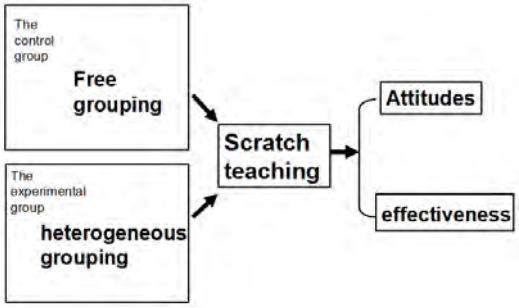

Figure 1. Framework of Research

3.3 Course design

According to the researchers' teaching practice and the general process of cooperative learning in the programming previously submitted by Ju（2007）, the teaching model during the research is shown in the following figure:

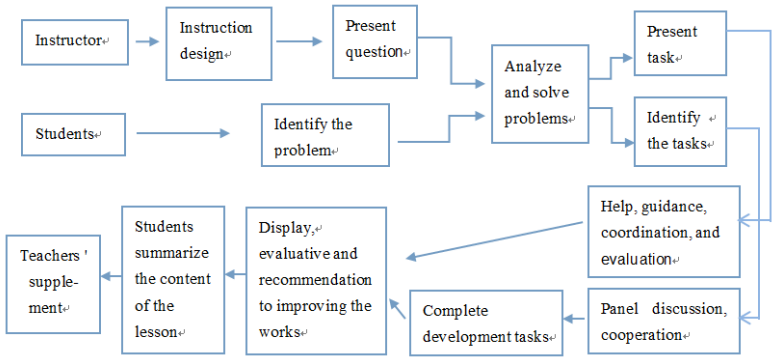

Figure 2. Programming cooperation model (Source: revised from chart of Ju, 2007)

During the eight-week research with one lesson a week each class, designed by the author, the teaching content was divided into four sections: broadcast, asking-answering, logical operators, and making Scratch works. Instructor, also a researcher, taught Scratch in two pilot classes in the same way.

As shown in the figure, cooperative learning in each class has the following main procedures: Based on the pupils ' previous knowledge, the teacher designs, reasonable and practicable teaching and learning activities, presents problems of cooperative learning and tasks after solving the knowledge problems. In task, with learned knowledge, students design Scratch programming theme, analyze problems and determine the division after group discussion, and solve problems by group

cooperation. Then the teacher and students, show group works, evaluate performance of another group and present improvements together. At last students' summary what they have learnt in this class.

3.4 Research tools

3.4.1 Scratch animation works assessment scale and learning attitudes questionnaire of Scratch

The assessment scale was developed by the researcher and revised by two experts, two masters and five Scratch teaching teachers across the country, consisting of four dimensions: design, aesthetic, technology and innovation. The scores of Cronbach's Alpha are both more than 0.8.

The questionnaire consists of five dimensions, respectively, motivation, self-efficacy, usability, usefulness, autonomous learning and learning pressure. It was developed by researchers referring to Professor Huang Guozhen's questionnaire of learning attitude and scientific accept mode (Hwang, Tsai & Tseng, 2010). Score of Cronbach's Alpha in one class is 0.895, and another is 0.933.

4. Results

4.1 Analysis of students' animation works

At the end of the term, works of each group were collected, but some group did not hand in their works finally. There were twenty-two animation works in total, nine from class 1 and thirteen from class 3. According to Scratch animation works assessment scale, three Scratch researchers (undergraduate students), gave a score for each animation seriously. The average score of three undergraduate students was the final score of animation works. Because each class had less than 30 students, and some students did not hand in their works, so samples might be not enough. When analyzing the samples, the method of nonparametric analysis was used to analyze works between class 1 and class 3 comparatively.

4.1.1. Heterogeneous grouping might bring better students' works

By nonparametric analysis of animation works between class1 and class 3, it indicated that these two kinds of grouping has no significant differences in scores of works. But According to descriptive analysis, it indicated that the average score of students' works in class 3 was about 79.0 points and the average score of students' works in class1 was about 83.7, four point seven points higher than works in class 3.

Table 1: Descriptive Data of students 'works in different dimensions

category	class	N	Mean	Std. Deviation	Std. Error Mean
total	1	9	83.72	6.45	2.15
	3	13	78.97	6.14	1.70
design	1	9	21.20	1.47	0.49
	3	13	19.66	2.11	0.59
aesthetics	1	9	20.39	2.00	0.67
	3	13	20.25	1.57	0.43

technology	1	9	21.48	2.03	0.68
	3	13	19.60	1.34	0.37
innovation	1	9	20.69	1.60	0.53
	3	13	19.44	1.69	0.47

Table 2: The results of Nonparametric analysis of students' works in different classes in different dimensions

Null Hypothesis	Sig.
The distribution of total is the same across categories of class	.03*
The distribution of design is the same across categories of class	.014
The distribution of aesthetics is the same across categories of class	.65
The distribution of technology is the same across categories of class	.03*
The distribution of innovation is the same across categories of class	.13

Then researchers analyzed the scores in four dimensions of Scratch animation works assessment scale, found that only the dimension of technology had significant differences between the two classes. And the average score of technology in class 1 was about 21.5 points, 1.9 points higher than that in class 3.

By nonparametric analysis on items of the dimension of technology, it indicated that score of the item "Scratch can arouse my curiosity" had significant differences between the two classes. And The score in class 1 was 0.5 points higher than that in class 3.

4.2 Analysis of students' attitudes towards Scratch

4.2.1 Free grouping brought out more positive attitudes.

All participants completed the attitude questionnaire towards Scratch at the end of term, and forty effective questionnaires were collected finally, 27 from class 3 and 13 from class 1. By nonparametric analysis of attitudes between class1 and class 3, it indicated that these two kinds of grouping had significant differences about attitudes towards Scratch. Descriptive statistics showed that the score of attitudes in control class(class 3) was 16.5 points higher than that in experimental class（class1）, and the score in each dimension of attitudes in class 3 was higher than class 1. So students in free grouping had more positive attitudes towards learning Scratch than students in heterogeneous grouping.

Table 3: Descriptive Data of students' attitudes in different class in different dimensions

category	class	N	Mean	Std. Deviation	Std. Error Mean
total	1	13	40.77	19.76	5.48
	3	27	57.26	20.73	3.99
motivation	1	13	6.77	3.52	0.98
	3	27	9.30	5.10	0.98

self-efficiency	1	13	8.23	5.20	1.44
	3	27	10.26	4.79	0.92
usability	1	13	8.00	4.53	1.26
	3	27	10.78	4.94	0.95
usefulness	1	13	6.62	2.96	0.82
	3	27	9.11	4.30	0.83
autonomous learning	1	13	5.31	3.52	0.98
	3	27	6.70	2.88	0.55
pressure	1	13	5.85	3.02	0.84
	3	27	11.11	5.32	1.02

4.2.2 Heterogeneous grouping might lead to more learning pressure.

The scores in the six dimensions of learning attitude questionnaire of Scratch were analyzed, and the result shows that the dimensions of usability, usefulness and pressure had significant differences between the two classes, especially learning pressure between two classes had abnormally significant differences (sig=. 00**).

Table 4: The results of Nonparametric analysis of students 'works in different classes in different dimensions

Null Hypothesis	Sig.
The distribution of total is the same across categories of class	.01*
The distribution of motivation is the same across categories of class	.011
The distribution of self-efficiency is the same across categories of class	.014
The distribution of usability is the same across categories of class	.04*
The distribution of usefulness is the same across categories of class	.03*
The distribution of autonomous is the same across categories of class	.11
The distribution of pressure is the same across categories of class	.00**

Then researchers analyzed the five items of learning pressure detailedly and found that three of them had significant differences between the two classes. These items included" Usually I can't concentrate on learning Scratch.", "I'm stressed when using Scratch.", and "It takes me much time to master the use of Scratch."

A descriptive analysis was carried out, and reverse scoring was used in the dimension of learning pressure when analyzing data in SPSS, so it means the more score of learning pressure is, the less pressure students have. From Table 3, it indicated that the score in each item of pressure in class 3 was higher than that in class 1, so students in class 3 have less learning pressure than that in class 1. In other words, students in heterogeneous grouping feel more stressed than students in free grouping. Table 3 shows the score in each item of learning pressure in class 3 was respectively higher than that in class 1. So heterogeneous grouping makes students feel more stressed. They couldn't concentrate on learning Scratch, felt stressed when using Scratch and needed to spend more time to master it.

4.3 Analysis of gender impact on student attitudes

The scores in six dimensions of learning attitude questionnaire of Scratch were analyzed and it shows there were no significant differences totally between boys and girls in two classes. However, boys and girls had abnormally significant differences in pressure, and boys had less pressure than girls in Scratch learning. The results of nonparametric analysis of students' attitudes between boys and girls in different dimensions are shown in table 5.

Table 5: The results of nonparametric analysis of students' attitudes between boys and girls in different dimensions

Null Hypothesis	Sig.
The distribution of total is the same across categories of class	.09
The distribution of motivation is the same across categories of gender	.78
The distribution of self-efficiency is the same across categories of gender	.91
The distribution of usability is the same across categories of gender	.20
The distribution of usefulness is the same across categories of gender	.19
The distribution of autonomous is the same across categories of gender	.17
The distribution of pressure is the same across categories of gender	.00**

5. Conclusions and discussion

5.1 Analysis of students' works

Students in heterogeneous grouping got more scores than students in free grouping，which means heterogeneous grouping may lead to more positive effect in effectiveness than free grouping. Also, students in class 1 had significant differences in technology, especially in the item of "Scratch can arouse my curiosity". So Scratch teaching in heterogeneous grouping could more efficiently arouse students' curiosity and stimulate a strong desire to learn.

5.2 Analysis of students' attitudes

According to the nonparametric analysis of attitudes between class1 and class 3, it indicated that different grouping made significant differences about attitudes towards Scratch. Descriptive statistics show that the score of attitudes in free grouping was 16.5 points higher than that in heterogeneous grouping, and the score in each dimension of attitudes in free grouping was higher than heterogeneous grouping. Free grouping brings out more positive attitudes.

Dimensions of usability, usefulness and pressure had significant differences between the two classes, especially learning pressure (sig=.00). From Table 3, it indicated that students in heterogeneous grouping feel more pressure than students in free grouping. In other words, Heterogeneous grouping may lead to more learning pressure, particularly in these aspects: concentrating on learning Scratch, using Scratch and costing more time to master it.

Boys and girls have abnormally significant differences in the dimension of pressure both in two classes, and boys have less pressure than girls in Scratch learning. Maybe girls have difficulty in programming, and some studies have confirmed this inference.

5.3 Research Limitations

This study analyzed students' effectiveness and attitude in heterogeneous and free grouping cooperative learning in sixth-grade students' Scratch program teaching, and some distinguished results have been shown above. However, without pre-test, it may have some influence on the later analysis of the results. The research design will be improved and more differences in heterogeneous and free grouping are going to be found in the future.

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