Empirical Research on Pupils' Creative Thinking from the Perspective of Mathematical Problems Posing

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Abstract: This paper explores the creative thinking of primary school students from the perspective of posing mathematical problems. Compile the test volume of "posing mathematical problems of primary school students", takes the grade 5 students of J primary school in Zhenjiang City as the research object, and measures the development level of students' creative thinking. The results show that the overall level of pupils' creative thinking is low, the performance gap in fluency is the largest, and the gap in originality is the smallest; There is a significant correlation between the three dimensions of creative thinking; In terms of gender variables, there is no difference between boys and girls in creative thinking. According to the results, this paper puts forward effective suggestions for teachers' teaching and promotes the development of pupils' creative thinking.

1. Introduction

In the context of quality education, the main educational goal of the school is to cultivate creative talents. Primary school is the initial stage of students' ability development, so it is very important to strengthen the cultivation of students' thinking consciousness and thinking ability. First of all, innovation begins with problems, so students' asking questions is a prerequisite [1]; Moreover, the ability to ask questions is the core part of creativity, which is very important to cultivate students' creative thinking. Mathematics is a subject with strong logic. Students can expand their thinking ability and effectively improve their creativity through learning. However, the situation of cultivating creative talents in school education in China is worrying. Specifically, students lack thinking and can't ask questions in Mathematics Learning [2]. Previous studies have pointed out that there is a certain connection between problem solving and thinking, but there are few studies on problem posing and creative thinking [3]. Therefore, based on the perspective of mathematical problems, this paper understands the current situation of pupils' creative thinking and further analyzes the existing problems, which can not only promote the development of pupils' thinking, but also provide effective practical guidance for teachers.

2. Definition of Related Concepts

"creative thinking" refers to the process in which students break through their own thinking mode and achieve valuable thinking results [4], that is use a new thinking mode to raise problems, solve problems and reveal new laws. Problem posing refers to the generation of new problems in a certain situation or problem solving. Therefore, the definition of "mathematical problem posing" in this study is that students put forward well structured, meaningful and solvable mathematical problems in mathematical language in a given situation.

3. The Relationship between Creative Thinking and Mathematical Problems

Problems are the beginning of thinking. Without problems, there will be no creation; In the process of thinking, we will put forward various mathematical problems, which will guide our further thinking.

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Therefore, the whole creative thinking is carried out under the guidance of various problems. Putting forward different mathematical problems may change the direction of thinking and lead to completely different thinking results. Being diligent in discovering and raising problems is the premise of scientific creation. Therefore, the quality of problems has an important impact on creative thinking. Scholars abroad believe that the ability to ask questions is related to the ability of creative thinking [5]. Some scholars pointed out that the ability to ask questions is an important measure of thinking ability. Song zhen-shao, a domestic researcher, has established a model of the function and mechanism of questioning. The model shows that there is a positive correlation between question raising and thinking ability [6]. It can be seen that research at home and abroad shows that there is a certain correlation between problem-raising ability and creative thinking. Creativity is the basis of problem-raising, and problem-raising can promote the development of creative thinking. Therefore, this study intends to analyze the current situation of students' creative thinking through students' mathematical problem-solving ability, and put forward some visual practical guidance for teachers.

4. Research Design

4.1. Experimental Sample Selection

Four classes were selected from grade 5 of J primary school in Zhenjiang City, with 40 people in each class and 160 people in total. There is no obvious difference in the scores of students in the four classes, so the sample is representative and effective.

4.2. Preparation of Test Questions

This test question mainly contains three questions, which are adapted from the textbooks of the first volume of grade 4 and the first volume of grade 5 of primary school mathematics of the people's education press. Each problem requires students to ask mathematical questions from different angles as much as possible without solving the questions. The test questions are systematically prepared to test the students' thinking ability. The test questions cover a wide range, including knowledge of mathematics and algebra, as well as graphics and geometry; The examination questions are in the form of novel questions, but the examination content does not exceed the scope of students' knowledge [7]. For example, after counting the average life span of several animals, students can ask different types of questions according to the data in the table or find out the relationship between the data. The second question is to show a ladder diagram. Students can use the information in the situation diagram to change or add condition information and ask questions in combination with practice. The third question is to contact the students' life and show the information of car rental for spring outing and the total number of students. Students use this information to ask logical questions.

4.3. Formulation of Scoring Standards

This study synthesizes previous studies, encodes and analyzes the questions raised by students, selects three dimensions of fluency, flexibility and originality, and scores according to specific evaluation indicators. Fluency. It is determined according to the effective number, heterogeneous number and fluent number of correct answers given by students. The problems that are unclear, incomprehensible and irrelevant to mathematical knowledge are invalid quantities; The structural difference of the questions raised by students is the heterogeneous quantity; The questions that can be answered according to the information given are fluent. Flexibility. It is determined according to the types of questions raised by students. For mathematical problems that meet the requirements of fluency, analyze the types of problems. Including sum, difference, product, quotient, multiple, score, average, comparison size, etc. Originality. It is determined according to the uniqueness of the questions raised by students. For mathematical problems that meet the requirements of fluency, investigate the number and proportion of students who raise the problem. If the proportion of students who ask this question is less than 10%, it indicates that it is novel, which is 3 points; If the proportion is between 10% and 30%, 2 points will be given; If the proportion of students who ask this question is higher than 30%, 1 point will be given.

5. Research Results and Analysis

5.1. Score Statistics and Correlation Analysis of Three Dimensions of Students' Creative Thinking

5.1.1. Descriptive Statistical Analysis of Creative Thinking Score

Describe and count the scores of students according to the three dimensions of creative thinking, as shown in Table 1.

Table 1 The score of three dimensions of creativity.

	Number of cases	Minimum value	Maximum	Average value	Standard deviation
Fluency	160	2.00	17.00	4.9000	2.45259
Flexibility	160	1.00	7.00	2.7750	1.12481
Originality	160	1.00	3.00	1.5375	.63533

As can be seen from the table, in terms of fluency, the average number of effective, heterogeneous and fluent mathematical problems that each student can ask is about 5. One student can ask up to 17 mathematical problems, but at least 2. In terms of flexibility, the average types of mathematical problems raised by each student are about 3. One student can put forward up to 7 different types and at least 1 type. In terms of originality, the average score of each student is about 1.5, the highest score is 3, and the lowest score is 1. In addition, it can be seen that students have the largest difference in fluency, followed by flexibility, and the smallest difference in originality.

Based on the understanding of the described statistics, the specific statistics of the three dimensions are analyzed in detail. In terms of fluency, more than half of the students put forward 3-4 mathematical problems, accounting for 56.3%, 3.9% of the students can put forward more than 10 mathematical problems, and 3.8% of the students correctly put forward 2 mathematical problems. It can be seen that there are great differences in the performance of students' fluency in these three test questions. In terms of flexibility, most students can put forward 2-3 different types of mathematical problems, but only 16.3% of students put forward 4-7 different types of mathematical problems. Therefore, it can be seen that there are some differences in the performance of students' flexibility in these three test questions. In terms of originality, half of the students get a score of 1, which shows that most students do not show some originality in the test questions; About 38.8% of the students scored 2 points for originality, and only 7.5% scored 3 points for originality. This part of the students raised more unique mathematical problems and had better originality. On the whole, the performance of students in originality is relatively balanced, and there is no significant difference.

5.1.2. Correlation Analysis of Three Dimensions of Creative Thinking

According to the correlation analysis of the three dimensions of creative thinking, fluency, flexibility and originality are related, as shown in Table 2.

Table 2 Correlation Analysis of three dimensions.

		Fluency	Flexibility	Originality
Fluency	Pearson correlation	1	.781**	.669**
	Significance		.000	.000
Flexibility	Pearson correlation	.781**	1	.650**
	Significance	.000		.000
Originality	Pearson correlation	.669**	.650**	1
	Significance	.000	.000	

It can be seen from table 2 that there is a significant correlation among the three dimensions of creative thinking, in which the correlation between fluency and flexibility is relatively higher, and the correlation coefficient is 0.781, which shows that if students can ask more and different numbers of mathematical problems, there may be more types of mathematical problems.

5.2. Analysis of Gender Differences in Creative Thinking

The difference between boys and girls in mathematics learning has always been the focus of mathematics education research. Therefore, this paper also discusses whether there are obvious differences between boys and girls in the three dimensions of creative thinking. Firstly, it is analyzed that there is no significant difference between boys and girls in each of the three dimensions, and specifically analyzes whether there is a significant difference between boys and girls in the performance of the three dimensions of creative thinking. An independent sample t-test is carried out, as shown in Table 3.

Table 3 Independent sample t-test.

	F	Significance	T	Freedom	Significance (two tailed)
Fluency	.016	.901	.091	78	.928
Flexibility	.092	.763	.198	78	.844
Originality	.887	.349	-.175	78	.862

The test results show that the T value of fluency is 0.091, the p value is 0.928, the T value of flexibility is 0.198, the p value is 0.844, the T value of originality is -0.175, the p value is 0.862, and the P values of the three dimensions are greater than 0.05. Therefore, there is no significant difference in the performance of boys and girls in the three dimensions of creative thinking in the test of mathematical problem posing.

6. Research Conclusions and Teaching Suggestions

6.1. Research Conclusion

Based on the survey results and analysis of creative thinking put forward by mathematical problems, the following research conclusions are formed.

In terms of fluency of thinking, students' score dispersion is high, and there are differences among students. In terms of flexibility, the overall scores of students are not high, and the gap between the maximum value and the minimum value is small, which shows that most of the mathematical problems put forward by students are of the same type, do not flexibly convert between different thinking angles, and there is still a lack of flexibility in thinking. In terms of originality, most students' originality score is 1. Few students can think from an unusual angle and put forward some very novel mathematical problems, showing the phenomenon that most students' originality score is low and a few students' originality score is high. There is a significant correlation between the fluency, flexibility and originality of students' thinking in the three topics, which is consistent with Kim's research results [8]. This shows that students who can fully expand their thinking and come up with multiple problems are also more likely to think about problems from different angles and put forward different types of problems. They are also more likely to come up with some unusual mathematical problems. Such students' thinking will be more active and divergent, and their creativity will be stronger. There is no significant difference between boys and girls in the performance of creative thinking.

6.2. Teaching Suggestions

Improve teachers' own quality and strengthen the cultivation of students' awareness of creative thinking. Students generally lack the spirit of exploration and do not fully show their creative thinking. Some incorrect ideas that may exist in ordinary mathematics learning are related to students' lack of problem consciousness, poor questioning teachers' ideas and thinking problems with inertial thinking, which leads to the limitation of students' creative thinking [9]. Therefore, teachers need to enhance the awareness of cultivating students' creative thinking in raising questions, give full play to the maximum value of raising questions, and provide students with sufficient thinking space. At the same time, teachers are an important leader in the creative thinking training of primary school students, and their own innovation ability also affects students' innovation ability, so teachers should also improve

their own quality.

Open flexible classes and improve students' creative thinking ability. Teachers should create a flexible and open class, create a pleasant and harmonious class atmosphere in the teaching process, set more questions, encourage primary school students to ask questions in the process of mathematics learning, and create scenes to cultivate students' courage to ask questions. In addition, teachers should also pay attention to integrating theory with practice, carry out teaching activities, guide students' autonomous learning and cooperative learning, and promote the development of students' mathematical creative thinking ability.

Pay attention to the cultivation of students' original and open thinking. Open questions are the key to the cultivation of students' mathematical innovation ability. Compared with traditional problems, it is more conducive to cultivate students' innovative thinking, including imaginative thinking, reverse thinking, divergent thinking, analogy thinking and so on. Students can think and ask questions in the way they like according to their own thinking habits; You can also constantly break through your habitual thinking, try some unusual and novel angles, and ask different kinds of questions. Therefore, teachers should be able to carry out more mathematics open-ended problem teaching, change the situation of only listening without asking, let students ask more questions and ask questions from different angles, and finally promote the development of students' thinking originality.

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