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Research on the Efficiency of Cooperative Inquiry in Junior High School Mathematics Classroom in China

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Abstract

It is proved in many regions and countries that cooperative inquiry is an effective way to improve the effect of students learning and the quality of teaching. However, its application in china is unsatisfactory currently, especially in the mathematics classroom in junior high school. The outstanding problem is its efficiency is low. To find out the reasons, this research selected 320 junior high school students as participants and investigated the influencing factors of it. The results show that: (1) the students' enthusiasm for cooperative inquiry is low; (2) the problems that teachers selected for students to solve by inquiry is unreasonable; (3) the physical environment in the classroom is not good; (4) the preparation for cooperative inquiry is not enough, and the time for reviewing is inadequate; (5) the teacher's inspiration, guidance, and evaluation of the students are unreasonable; (6) the cooperative inquiry procedure is unreasonable; (7) some students and teachers do not understand the meaning of cooperative inquiry completely. In view of this, we suggest that the teachers should study the related knowledge of cooperative inquiry carefully at first, master the operative method, meticulously design the environment, task and steps of activities of cooperative inquiry in the classroom, stimulate the enthusiasm of students' cooperative inquiry, and give students more time and conditions to prepare for it.

Keywords

Junior Middle School, Mathematics Classroom, Cooperative Inquiry, Learning Style, Empirical Research

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1. Introduction

It is proved in many regions and countries that cooperative inquiry is an effective way to improve the effect of students learning and the quality of teaching [1]. To improve the effect of students learning and the quality of teaching, the Chinese government attaches great importance to the cooperative inquiry activities recently and mentions it many times in the decision of the (China) State Council on the reform and development of basic education. It said that "cooperative inquiry is encouraged, mutual exchange and common development between students are promoted, and teachers and students learn from each other [2]." Therefore, the way of cooperative inquiry is widely used in junior high school mathematics teaching [3]. The use of cooperative inquiry in mathematics classroom teaching does bring some changes and improvements to some extent [4]. However, overall, its application is unsatisfactory [5]. An outstanding problem is the teachers usually have to prepare it for a long time before class and have to find much time to organize and instruct students to do it in the classroom. Even though, the effect is not satisfactory yet. That is, low efficiency is a common situation in the current mathematics classroom teaching when the cooperative inquiry was adopted [6]. What is the reason for this? It is undoubtedly of great significance to figure it out. Therefore, this study intends to investigate some students in China to find out the factors that affect the efficiency of cooperative inquiry activities.

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2. Literature Review

In the early 21st century, cooperative inquiry learning has entered the field of vision of Chinese academic researchers. Although it started late, there are many research results about cooperative inquiry learning. As for the problems existing in cooperative learning, Yang thinks that there are some problems in a group learning discussion, such as students have nothing to say, they are confused, and only individual members discuss and speak [7]. Ran thinks that the main problems of adopting cooperative inquiry teaching methods in secondary vocational mathematics teaching are teachers' insufficient attention, unreasonable grouping method and one-sided evaluation [8]. Wang took junior middle school students as the research object and thinks that there are two problems in the process of cooperative inquiry learning, namely, mechanical imitation and lack of regulation mechanism [9]. Chen found that in the cooperative inquiry class, there is a general phenomenon of chaotic classroom order, lack of communication and cooperation skills among group students, and the excellent students often become important activists in group learning, while the poor students often belong to the subordinate position [10]. Wang and others think that students can't produce an overall plan in the process of cooperative inquiry learning, but spend a lot of time to assign specific tasks among team members; only focus on finding the correct answers, but ignore the supervision and evaluation of each other's solutions; stay in the discussion of basic knowledge, but can't think more deeply about the learning materials [11]. Zhou analyzed the cooperative inquiry learning in primary school teaching, and thought that there was a lack of substantive cooperation and clear teaching objectives in the learning process, and ignored the ability of students to think independently [12]. Peng thinks that junior middle school mathematics teachers pay too much attention to this teaching form of cooperative inquiry learning and ignore the effective guidance, and the effective communication with students is not enough, and students lack cooperation skills [13]. According to Wu, teachers do not divide students into groups reasonably when they carry out cooperative learning to save time. They only form cooperative groups according to the seating relationship of students, often with four members in front and back. When they arrange learning content at will, the teacher's guidance is not in place; the teaching method is single, the learning atmosphere is not strong; the evaluation system is not perfect, and the students' motivation is not strong enough [14].

As for the strategy of adopting cooperative inquiry learning, Wang and others pointed out many problems in the process of implementing cooperative teaching in primary and secondary schools and then conducted an experimental study on the two classes in grade three of junior high school by using the method of pretest and posttest. They found that the "guiding" problem is helpful for students to generate the overall plan of problem-solving and enhance their monitoring and understanding ability, to improve their ability of problem-solving cooperative learning efficiency, but there are some limitations [11]. Zhao studies the efficiency of group cooperative inquiry learning according to the development of new curriculum reform in his school and his own teaching experience. In her paper, it points out that teachers should adjust by the way of link life, and ask teachers to let the classroom go to students, but this is not the same as letting go unchecked, sometimes it is also necessary to participate in the discussion of individual groups [15]. Wei stressed the scientific nature and rationality of the evaluation mechanism, the diversity, and comprehensiveness of the evaluation content, the diversity, and openness of the evaluation methods, and must include "group cooperation performance" as one of the main indicators of the evaluation [16]. Wang put forward the reform suggestions of cooperative inquiry teaching for teachers. He believed that teachers should change their ideas, scientifically group students, timely instruct and guide students, and reasonably evaluate and motivate students [9]. Ran also put forward suggestions from three aspects: Students' grouping, learning atmosphere, and scientific evaluation [8]. Li made suggestions for the implementation of cooperative inquiry learning from the entire lesson preparation and teaching activities of mathematics teaching, including student grouping, activity goals, and teaching preparation [17]. Peng mainly discusses the countermeasures to improve the low efficiency of mathematics cooperative inquiry learning, including building a learning atmosphere, creating exploration space, and playing the leading role of teachers [18]. Zhang took primary school students as the research object to explore the countermeasures to improve the situation of cooperative inquiry learning. He pointed out that teachers should attach importance to students' physical and mental experience, determine the key points of inquiry, and carry out cooperative inquiry activities effectively [19]. After pointing out the problems in cooperative inquiry learning, Zhou put forward the strategies of cooperative inquiry activities from three aspects: learning content, learning methods, and division of labor [12]. Peng believes that in cooperative inquiry teaching, we should pay attention to stimulating students' interest in learning, establishing an incentive evaluation mechanism and, making students discover, raise, and solve problems [13]. Song thinks that group cooperative inquiry learning can make the teaching

effect of mathematics classroom more significant, so he thinks that the selection of cooperative inquiry learning content, the organization and division of labor of cooperative inquiry group and the scientific feedback evaluation system directly affect the cooperative learning of students, and we should improve the cooperative learning of students from these aspects [20]. Wen studies the application of autonomous, cooperative, and inquiry learning methods in primary school mathematics classrooms, which is also a breakthrough in current teaching methods. She believes that teachers and students should pay more attention to the situation creation, preparation, and learning objectives of cooperative learning [21]. Based on the background of the network environment, Sun put forward suggestions to improve cooperative inquiry learning. She thinks that in terms of the theme objectives of cooperative exploration activities, we can absorb the actual materials in life, create vivid and real situations according to the objectives of activities, and arouse students' interest in learning; also, in terms of cooperation methods and evaluation feedback, we should make use of the developed network information exchange platform to innovate the methods and feedback mechanisms of cooperative exploration activities [22].

It can be seen from the above that at present, scholars' research on cooperative inquiry learning mainly focuses on the problems existing in the implementation of cooperative inquiry learning and the strategies and suggestions to improve the current situation of cooperative inquiry learning, which undoubtedly lays a foundation for the further reform of cooperative inquiry learning. However, reviewing the previous studies, we can find that there is almost no research on the efficiency of cooperative inquiry activities and the influencing factors of the inefficiency of cooperative inquiry activities. It is very important to study this problem because this research can help scholars and educational practitioners to understand the reasons that affect the low efficiency of cooperative inquiry activities directly. After they understand these reasons, they can carry out the reform of cooperative inquiry classroom, to improve the efficiency of cooperative inquiry learning, improve students' ability of cooperation and communication, innovation and expression, etc. Therefore, this study intends to explore the causes of low efficiency of cooperative inquiry learning based on previous studies and put forward targeted reform suggestions according to the causes.

3. Theoretical Foundation

3.1. Cooperative Inquiry Learning

Ge and others mentioned in the research summary of cooperative learning that cooperative learning is a kind of teaching activity of interaction and cooperation between teachers and students, students and so on, which takes group as the basic form, common goal as the guidance and team achievement as the reward basis. And the article also mentioned four types of cooperative learning, which are process cooperative learning, guiding cooperative learning, exploratory cooperative learning, and structural cooperative learning [23]. According to Zhang fake and Zhao Ting, the basic connotation of learning theory is: (1) to create a learning mode that combines closely with integrated learning; (2) to form and change learners' learning attitude and improve their cooperative learning skills; (3) to develop the ability of critical thinking, reasoning and problem-solving [24]. Other scholars believe that cooperative inquiry teaching refers to: in the context of problems created by teachers for teaching purposes, taking learning groups as the basic organizational form; taking students' independent thinking and cooperative communication as the premise; taking textbooks or reference materials as the basic inquiry content; taking students' existing knowledge and experience as the cognitive basis; taking inquiry, query, and discussion as the means; a form promoting teaching organization for students to form a new cognitive structure [25]. At present, Wang Tan is more famous in the research of cooperative learning in China. He defined cooperative learning as "a teaching strategy system which aims to promote students to cooperate in heterogeneous groups, achieve common learning goals, and based on the overall performance of the group as the reward" [26].

From the above, we can see that some scholars in the current academic circle are discussing cooperative learning and inquiry teaching separately, but even so, they are not completely independent individuals but are integrated, interacted and promoted each other. Moreover, from the previous studies, we can see that the commonly accepted point of view in the current academic circle is to regard cooperative inquiry as a teaching method or learning activity. Therefore, based on the previous definitions and the subject scope of this study, this study defines cooperative inquiry learning of mathematics as a kind of teaching method, which is based on the situation of mathematics problems given by teachers and the existing knowledge and experience of students, and group learning as the basic learning form, through students' independent inquiry, cooperative communication and joint exploration of mathematics problems to obtain mathematics knowledge, improve mathematics ability and cooperative communication ability.

3.2. The Efficiency of Cooperative Inquiry in Mathematics Class

The general explanation of "efficiency" is the amount of work completed in unit time. In physics, efficiency refers to the ratio of useful power to driving power, which also extends a variety of meanings in different disciplines. The general explanation of "teaching efficiency" is that teachers should not only complete the contents and requirements stipulated in the syllabus in time and effectively, but also enable students to understand and apply the systematic scientific knowledge as well as skills that they have learned, and actively study and practice. At the same time, they should also be cultivated in many aspects of morality and conduct. In an article by Wang, it is pointed out that teaching efficiency is a relative concept. For the same learning result, if students spend less time, the teaching efficiency is high; if students spend the same learning time, the learning effect is good and diverse, and the teaching efficiency is high [27]. In a survey of teaching efficiency research by Shi and Yao, several representative viewpoints are summed up on the meaning of teaching efficiency: (1) the ratio of effective teaching time to total teaching time; (2) the ratio of effective teaching time to actual teaching time; (3) the ratio of teaching results to teaching input; (4) the ratio of teaching efficiency to teaching results, and the ratio of teaching time Inversely proportional. The article also pointed out that the research on teaching efficiency discussed by the academic community mainly focuses on factors such as teachers' personality characteristics, teachers' behavior, learning activities, teacher-student interaction, cooperation activities, and teaching strategies and so on [28].

Combined with the previous research results on teaching efficiency, this paper studies the efficiency of cooperative inquiry in mathematics classrooms from two aspects: the time invested by students and the effect of cooperative inquiry. At the same time, the better the effect of cooperative exploration is, the higher the efficiency is, and vice versa.

4. Methods

4.1. Participants

In this study, 320 students from three junior high schools in Jinan and Weifang of Shandong Province were selected as the subjects. Among them, there are 172 students in grade one, 148 students in grade two, 157 boys and 163 girls. The average age of students in grade one and grade two is 12.8 and 13.9 years old respectively.

4.2. Instrument

This study uses a self-designed questionnaire based on relevant information. There are 44 questions in the questionnaire, including 42 multiple-choice questions and 2 subjective questions. The objective questions mainly involve seven aspects: emotional attitude, grouping, division of labor, objective environment, preparation, and cooperative exploration process, and teacher guidance. Subjective questions mainly investigate students' understanding of cooperative exploration activities, including students' understanding of high-efficiency cooperative exploration activities, good exploration activities, and cooperative exploration learning steps.

4.3. Data Collection

The questionnaire of this study was sent to students by their mathematics teachers. In the process of distribution, for the convenience of teachers, they distributed questionnaires to three classes in grade one and six classes in grade two. There are 176 students in three classes of grade one and 162 students in three classes of grade two. A total of 338 questionnaires were distributed to students. After 45 minutes, 338 questionnaires were collected. After preliminary sorting out, after removing some documents that were not fully answered, 320 questionnaires were finally obtained that could be used for data statistics.

4.4. Data Processing

At the end of the questionnaire collection, the researcher made statistics and analysis according to the types of questions. For objective questions, the researcher makes percentage statistics and analysis for each option of each question. For subjective questions, the researcher sorts out all the answers, classifies and summarizes all the answers, which is, classifies the answers with similar content into one category, and then calculates the percentage of each category.

5. Results

5.1. Statistical Results of Objective Questions

5.1.1. Emotional Attitude

On the emotional attitude of junior high school students about cooperative inquiry in the mathematics classroom, the questionnaire investigated whether it was valuable, whether it hoped teachers would carry out it, whether they could actively participate in it and whether they could treat it correctly. After statistical analysis, it is found that, first of all, the vast majority of students think that cooperative inquiry activities are valuable, and nearly half of them think it is very valuable; Secondly, most of the students prefer to carry out cooperative exploration, and more than half of the students choose the degree option; Besides, in terms of the

participation enthusiasm, most students can actively participate, but nearly one-third of the students can not actively participate; Finally, most of the students can take the cooperative exploration activities seriously in class, but a small number of people cannot take it seriously. Details are shown in Table 1.

Table 1. Junior high school students' emotional attitude.

Options / Percentage (%) / QN	A	B	C	D	E
1	1.58	7.26	9.46	36.59	45.11
2	0.63	1.57	12.54	58.62	26.65
3	0.94	13.76	31.00	25.77	28.53
4	0.32	1.27	8.54	36.71	53.16

Source: Field Survey, 2019. Notes: QN stands for "Question Number".

5.1.2. Grouping Aspect

On the group of junior high school students' mathematics classroom cooperation, three aspects of group size, grouping standards, and whether there is a person in charge were investigated. Through the statistical analysis, it is found that the vast majority of group members are between 4 and 6; In terms of grouping standard, most teachers group by the seat for convenience; in terms of group leaders, teachers fail to select group leaders or responsible students for each group in time when they cooperate and explore in groups in class. Details are shown in Table 2.

Generally speaking, in terms of grouping, the number of group members is basically between 4 and 6, all of which are grouped according to the seating, and the grouping method is not very scientific.

Table 2. The situation of junior high school students in grouping.

Options / Percentage (%) / QN	A	B	C	D	E	F
5	10.73	76.03	8.83	1.58	2.84	
6	10.73	57.73	1.26	13.88	7.57	8.83
7	13.02	19.68	14.29	14.60	38.41	

Source: Field Survey, 2019.

5.1.3. Division of Labor

In the field of junior high school students' mathematics classroom cooperation and exploration, three aspects were investigated: whether there is a division of labor, whether the division is clear, and the division standard. Through the statistical analysis, it is found that most of the students have their tasks; there are many cooperative explorations in the classroom, most of which are not clear about their division of labor; nearly half of the students in the classroom carry out cooperative explorations according to their wishes. Details are shown in Table 3.

Generally speaking, when there is a division of labor in cooperative inquiry activities in the classroom, many are unclear, and most divisions have no standard, and students carry out according to their wishes.

Table 3. The situation of junior high school students in the division of labor.

Options / Percentage (%) / QN	A	B	C	D	E
8	8.15	19.75	15.05	26.65	30.41
9	8.20	33.23	29.24	18.67	10.67
10	39.94	21.32	7.23	24.91	6.60

Source: Field Survey, 2019.

5.1.4. Objective Conditions

In terms of cooperative exploration of objective conditions, it mainly investigated the time constraints, surrounding environment, and the impact of other students. Through the statistical analysis, it is found that most of the cooperative explorations in the classroom are limited in time, most of them are between 5 and 10 minutes; when conducting cooperative explorations, many students in the group discuss unrelated topics; more than half of the students in the group do not take reasonable measures when they find that students in the group discuss unrelated topics, and even a small part of the students will participate in it; most of the time, when

students procrastinate or are lazy for no reason, they are urged; most of the students' ideas will not be affected by other students' discussions and ideas. Many students will ask the teacher or other students when they are different from others' views, but some students will stick to their views, and a few students will follow others' views; in the process of cooperative exploration, students are not good at planning and time allocation; in most cases, students actively abide by the time limit. Details are shown in Table 4.

Table 4. The objective condition of junior high school students' cooperation in mathematics class.

Options / Percentage (%) / QN	A	B	C	D	E
11	4.53	9.71	11.65	31.39	42.72
12	20.25	54.75	18.99	4.43	1.58
13	10.00	37.69	21.4	16.63	13.25
14	8.54	16.46	32.47	19.94	22.59
15	5.26	19.08	12.50	24.67	38.49
16	9.78	5.68	10.09	53.94	20.50
17	16.88	2.87	4.14	42.04	34.08
18	15.67	34.14	15.67	19.14	15.38
19	2.52	3.15	12.62	29.97	51.74

Source: Field Survey, 2019.

5.1.5. Preparation Before Classroom Cooperation and Exploration

In the preparatory work, it mainly investigated whether teachers would inform before the cooperative inquiry and how much time they spent on review. After statistical analysis, more than half of the students think that the teacher should inform them before cooperative exploration; in cooperative exploration, most students need to spend more time reviewing the knowledge they have learned. Details are shown in Table 5.

Table 5. The preparatory work of junior high school students before the cooperative exploration in mathematics class.

Options / Percentage (%) / QN	A	B	C	D	E
20	12.70	13.02	9.52	28.57	36.19
21	5.83	44.92	24.66	18.12	6.47

Source: Field Survey, 2019.

5.1.6. Cooperative Inquiry Process

In the process of cooperative inquiry, it mainly investigated the problem situation and specific links of cooperative inquiry. Through statistical analysis, it is found that more than half of the content of situation creation comes from teaching materials, followed by real life; in the degree of interest in the situation, the vast majority of students are not interested; in the degree of difficulty, the vast majority of students think that the teacher's problem is more difficult; in addition, nearly 1/3 of the students think that teachers pay general attention to the process of cooperative inquiry, while most of the students think that teachers do not pay high attention; in terms of inquiry goals, most of the students can have inquiry goals, and some of the students cannot have inquiry goals; when dealing with the difficulties in the process of inquiry, most of the students would like to have a clear goal of inquiry and then carry out cooperative inquiry, of which half would choose to continue to examine the questions; when encountering the more difficult problem situation, most of the students choose to discuss collectively without division of labor; in terms of the way of cooperative inquiry, most of the students can explore first and then discuss; in terms of participation, most of the students show that they can actively participate; in terms of their own opinion expression, most of the students can not obey the arrangement of the teacher or the group leader; when others express their opinions, most of the students are able to take seriously, think actively, and behave rationally when others express their personal opinions. Also, most of the students can take seriously the difficult problems raised by other students; In terms of problem-solving, most of the groups can actively deal with difficult problems, but most of them continue to explore and discuss; in case of divergence of views, more than half of the group students can not actively think and discuss. Details are shown in Table 6.

Table 6. The Status of the Cooperative Inquiry Process in Junior High School Mathematics Class.

Options / Percentage (%) / QN	A	B	C	D	E	F
22	53.40	21.04	22.01	2.27	1.29	
23	4.81	24.05	27.44	22.55	21.15	
24	1.61	6.77	43.23	2.90	45.48	
25	6.13	2.90	26.45	36.45	28.06	
26	4.82	10.93	16.08	36.33	31.83	
27	5.74	5.74	45.61	41.89	1.01	
28	6.56	11.56	6.56	7.19	43.44	24.69
29	7.99	4.47	19.81	7.67	60.06	
30	2.20	10.06	7.55	16.67	63.52	
31	7.32	8.28	37.90	21.66	24.84	
32	0.64	20.51	31.09	47.44	0.32	
33	3.30	9.24	7.59	77.89	1.98	
34	4.55	27.27	26.95	8.12	31.82	1.30
35	9.00	8.36	28.62	11.90	40.51	1.61

Source: Field Survey, 2019.

5.1.7. Teachers' Guidance

In the aspect of teacher guidance, it mainly investigated whether teachers can give prompt in time, answer in time, supervise frequently, maintain order in time, and allow free play. After statistical analysis, it was found that in the prompting, most students said that the teacher could promptly prompt them when they encountered difficulties in cooperative inquiry in the class. Most students thought that the teacher could answer the questions in a timely manner in most cases. However, there are still some questions that cannot be answered by the teacher; in teacher supervision, more than half of the students think that the teacher's supervision work is in place; in order maintenance, more than half of the students think the teacher is doing a good job in maintaining the order; the vast majority of students said that teachers would allow students to play freely in most cases; in addition, more than half of the students said that the teacher would not give an answer; on the aspect of teacher guidance, more than one-third of the students said that teachers often guide the groups with the most heated discussion, and nearly one-third of the students said that teachers can communicate with students equally. Details are shown in Table 7.

Table 7. The situation of teacher guidance.

Options / Percentage (%) / QN	A	B	C	D	E
36	3.26	29.22	24.10	25.83	17.59
37	0.96	36.54	23.46	21.41	16.63
38	6.45	15.81	16.77	34.84	26.13
39	6.37	15.92	11.15	28.66	37.90
40	5.14	9.00	15.11	32.80	37.94
41	15.26	13.31	11.04	35.71	24.68
42	20.63	5.63	38.44	30.31	5.00

Source: Field Survey, 2019.

5.2. Statistical Results of Subjective Questions

5.2.1. Students' Understanding of Cooperative Inquiry Steps

The answer to "what steps should students follow in cooperative exploration" is as follows: 32.78% of the students answered "first give their opinions, then discuss whose answer is right"; 26.23% of the students answered "explore independently first and discuss in-group"; 15.85% of the students answered "direct discussion"; 7.65% of the students answered "at-will"; 6.01% of the students answered " division of cooperation"; 5.46% of the students answered "speaking from good grades to bad grades"; 3.28% of the students answered "group leader's speech"; 1.09% of the students answered "listen to the teacher's arrangement"; 1.09% of the students answered "speak first if you have any questions"; 0.55% of the students answered, "first discuss in group, then discuss between groups".

A small number of students answered how to allocate time, which is summarized as follows:

Among the students who answered "first explore independently, then discuss in groups", two said that explore independently for 5 minutes and discuss in groups for 10 minutes; one said it took two minutes for independent

exploration and group discussion; one said that examine questions for 2 minutes, explore independently for 3 minutes and discuss for 5 minutes; Three students said less time for independent exploration and more time for group discussion; one student said 5 minutes for independent thinking and group discussion; two students said 1/3 of the total time for independent exploration and 2/3 of the total time for discussion; two students said 10 minutes for each of the above two steps; two students said more time for independent thinking and less time for group discussion; Among the students who answered "direct discussion": one student said it took 5 minutes for examination and 1 minute for discussion; another said it took 2 minutes for examination and 4-6 minutes for discussion; one said it took 3-5 minutes for examination and 7 minutes for discussion. Among the students who answered "speak first, then discuss", two students said they would take 3 minutes to speak and discuss each other; one student said they would take 10 minutes each; one student said they would take 5 minutes each; two students said they would allocate time equally. Among the students who answered "division of work and cooperation": one student said that it took 1 minute for examination, 2 minutes for the division of work, and 2 minutes for discussion.

5.2.2. Students' Understanding of High-Efficiency Cooperative Inquiry Activities

Students' answers to "what is efficient cooperative exploration" are as follows: 35.86% of the students answered "positive"; 11.11% of the students answered "cooperative"; 11.11% of the students answered "get the right answer in a short time"; 8.08% of the students answered "everyone involved"; 5.05% of the students answered "free play"; 4.55% of the students answered "all students master knowledge after the activity"; 4.04% of the students answered "clear division of labor"; 3.54% of the students answered "clear goal"; 4.04% of the students answered "standard and orderly"; 3.03% of the students answered "independent exploration first, then group discussion"; 2.53% of the students answered "concluded"; 2.53% of the students answered "don't know"; 3.04% answered "equal communication"; 1.52% answered "no irrelevant topic".

5.2.3. Students' Understanding of Good Cooperative Inquiry Activities

For "what is a good cooperative exploration?" The answers are as follows: 35.35% of the students answered "positive"; 11.11% of the students answered "cooperative"; 8.08% of the students answered "normative and orderly"; 6.57% of the students answered "able to solve problems"; 5.56% of the students answered "all participate"; 6.57% of the students answered "all understand"; 5.56% of the students answered "no irrelevant topic"; 5.56% of the students answered "free speech"; 3.03% responded "clear division of labor"; 3.03% responded "targeted"; 4.05% responded "equal communication"; 5.56% responded "time is abundant".

6. Discussion

It can be seen from the previous survey results that, although most of the current students have realized the importance of cooperative exploration, there are still quite some people who do not actively participate. This is likely to be the direct cause of the unsatisfactory cooperative exploration activities.

For the arrangement of cooperative exploration, it can be seen from the above survey results that in most cases, cooperative exploration is made up of 4-6 people in a group and the students nearby their seats. Generally, the leaders and organizers of cooperative exploration will not be selected. It can be seen that the current classroom cooperative exploration is not very careful in grouping and more casual member arrangement.

In terms of division of cooperation and preparation work, it can be seen from the above survey results that although most students have their tasks when conducting cooperative exploration activities in the classroom, the standard of division of work based on tasks is uncertain, and the degree of division of work is far from in-depth, resulting in most of the students carrying out activities at will; also, the survey results show that students' preview of cooperative inquiry is not deep enough, and most students need to spend a long time to review their knowledge. It can be seen that the unclear division of labor and the long review process before the beginning of cooperative inquiry cause problems in the process and learning efficiency of cooperative inquiry.

As for the objective environment and conditions of cooperative inquiry learning, it can be seen from the above survey results that, first of all, most of the time of cooperative inquiry is generally 5-10 minutes, relatively short, which inevitably affects students' enthusiasm to carry out cooperative exploration activities. Secondly, many students in the group discuss unrelated topics, some of them don't listen to persuasion, some of them participate in the discussion, and the teacher doesn't maintain the order in time, which results in less time for real cooperation to explore problems. Thirdly, more than half of the students did not take reasonable measures when they found that the students in the group discussed unrelated topics. Also, when there are different views, many students ask the teacher or other students, and there are not many groups that can seriously think and actively discuss. It can be seen that problems such

as students' insufficient thinking, many irrelevant topics, and low efficiency of discipline management may lead to poor results of the cooperative inquiry, which may lead to the low efficiency of cooperative inquiry learning.

As for the entire process of cooperative inquiry, from the above survey results, first of all, from the perspective of the problem situation, more than half of the situations are from textbooks, which is very difficult. Many students also expressed no interest in these situations. In the process of cooperative inquiry learning, when encountering difficult problem situations, most groups are group discussions, without division of labor and organization. Also, most of the students can't obey the arrangement of the teacher or the group leader in terms of their opinion expression, which leads to confusion in the exchange of views; in case of divergence of views, many students can't think and discuss actively when their classmates disagree. It can be seen that in the whole process of cooperative inquiry, students' interest in inquiry is not high, and the order of inquiry and discussion is relatively chaotic, and there are also inappropriate ways of communication and handling in terms of opinion expression and divergence.

As for teachers' guidance and question answering, we can see from the survey results that some questions in cooperative inquiry cannot be answered by teachers in time; on the issue of teacher guidance, a small number of students said that teachers often guide the groups with the most heated discussions and that the proportion of students who can communicate with students equally is less than half. It can be seen that when students encounter difficulties and problems, many students do not get prompt or answer from teachers in time. Therefore, the problems existing in the problem-solving and guidance work of teachers in the process of cooperative inquiry may be one of the reasons for the low efficiency of students' cooperative inquiry learning.

As for the theoretical understanding of cooperative inquiry, from the statistical results of the three aspects summarized by the subjective questions, we can see that students do not have a deep understanding of the specific procedures and theoretical understanding of cooperative inquiry, and most of the steps, operations and time allocation in the process of activities are carried out according to their views. For what is efficient cooperative inquiry and good cooperative inquiry, the level of students' understanding is far from in-depth. It can be seen that students' theoretical understanding of the significance, steps, and operation of cooperative inquiry is insufficient, which may weaken students' attention to cooperative inquiry learning, and then affect their enthusiasm and efficiency of learning activities.

7. Conclusions

It is of great significance to apply the way of cooperative inquiry in the mathematics classroom. There are lots of try in different schools in China currently, however, the implementation effect is unsatisfactory, especially in junior high school mathematics teaching. Many teachers think it does not bring the expected effect even though they spend much time on it. After the investigation, it could be found that the factors affecting the application of cooperation inquiry in junior high school mathematics classroom teaching mainly include: (1) Students' enthusiasm for cooperative inquiry in the mathematics classroom is not high; (2) the problems that teachers selected for students to solve by the way of cooperation inquiry is unreasonable; (3) the physical environment in the classroom is not good; (4) the preparation for cooperative inquiry is not enough, and the time for reviewing is inadequate; (5) the teacher's inspiration, guidance, and evaluation of the students are unreasonable; (6) the cooperative inquiry procedure is unreasonable; (7) some students and teachers do not understand the meaning of cooperative inquiry completely.

According to these, it seems that many junior high school mathematics teachers in China do not understand the essence of the way of cooperation inquiry yet. Or they do not know the way of cooperation inquiry very well, they just do it as related steps mechanically or imitate others' operation. Or they do not prepare for it carefully and completely before class. Or they do not realize the value and importance of the way of cooperation inquiry yet so as to they do not apply it carefully. These should be the most important and fundamental affecting factors to the low efficiency of cooperation inquiry in mathematics classrooms currently.

8. Suggestions

In view of the results above, we suggest that the teachers should attach great importance to the way of cooperative inquiry to correspond the government's call and comply with the law of education, study the related knowledge of cooperative inquiry completely and profound to master the operative method, meticulously design the environment, task and steps of activities of cooperative inquiry in the classroom before class, stimulate the enthusiasm of students' cooperative inquiry, and give students more time and conditions to prepare for it.

This study investigated only 320 students from three junior high schools in two regions in China. This may affect the representativeness of the results. Consequently, in future research, it is strongly recommended to expand the sample size and use samples from different regions to make this study

go in deep.

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