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Research on teacher questioning in primary school mathematics classroom based on LICC paradigm

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Abstract

LICC is a professional model of listening to and evaluating lessons. It observes the classroom from four dimensions: student learning, teacher teaching, curriculum nature and classroom culture. Among them, teacher questioning is an observation point worth studying. Taking "area and area unit" open class as an example, based on the LICC paradigm of classroom observation and the observation scale of "teacher questioning", this paper makes a comprehensive and in-depth observation and analysis of teacher questioning in primary school mathematics classroom. Through observation records and data analysis, the author puts forward some suggestions on primary school mathematics teachers' questioning in order to improve the effectiveness of teachers' questioning.

Keywords: LICC paradigm; Teachers ask questions; Observation scale; Elementary mathematics

1. Question proposed

The Ministry of Education issued the compulsory education mathematics curriculum standard (2022 edition), points out that teachers should attach importance to the design problem, questions should cause students cognitive conflict, stimulate students learning enthusiasm, promote the effect of students consciously explore, let the student experience mathematical observation, mathematical thinking and mathematical expression learning process.[1] Teachers should avoid random questions and pay attention to the design of questions. Professor Shi Ningzhong said: " The core quality of mathematics is not directly taught by teachers, but is improved by solving problems in a specific problem environment."[2] Therefore, teachers should pay attention to the design of problem situations and problems, and develop students' core qualities with the help of problem solving. The process of mathematics teaching cannot be separated from "problems", and the process of solving problems is also the process of cultivating students' quality.

It is very important for teachers to ask questions, but from the actual situation of most primary school mathematics classroom questions, there are still some problems in teachers asking questions. For example, some studies point out that ordinary teachers ask too many questions in class, and give students less time to think after asking questions, resulting in teachers passively "listening" to students' answers in a question and answer.[3] Special-grade teachers are the outstanding teachers in China. They have rich experience in asking questions. How to ask questions effectively is worth research and reference.

This paper with Cui YunRong LICC classroom observation paradigm as the theoretical basis, according to the teacher teaching this dimension dialogue perspective to make teachers question observation scale, in elementary school mathematics "area and area unit" as the carrier, the mathematics teacher question behavior observation record, comprehensive analysis, in order to provide reference for primary school mathematics teacher classroom questions.

2. Research design

2.1 Subject investigated

In order to make the research more practical value, and have certain inspiration and reference significance in asking the questions of primary school mathematics teachers, the observation object selected in this study is Wu Zhengxian, the national model teacher and special grade teacher, and the teaching content is "area and area unit".

2.2 Study tools and processes

According to the LICC classroom observation paradigm proposed by Cui Yun, the observers selected the teachers 'teaching dimension, took the teacher's questions as the observation point, and combined with the previous research, formulated the teacher's questioning and observation scale. After pre-observation, appropriate analysis and modification, the observation tool was formed for observation and recording of teachers' questions. This observation will analyze the teacher's question behavior from the four main aspects of mathematics class question —— waiting time, question type, question object and students' answer method. Problem type includes four observation dimensions, according to the cognitive level will be divided into memory (A), understanding (B), creative (C), critical problems (D), memory (A) and understanding (B) belong to low cognitive level, creative problems (C) and critical problem (D) is A high cognitive level. There are four categories: one student to answer (a), two or more students to answer (b), a group to answer (c), and a collective answer (d), as shown in Table 1. In the process of research, first of all, the observer watches the teaching record, truthfully records the questions raised by the teacher in the teacher's question and observation scale, and "(" in the corresponding position according to the actual situation. Secondly, the observer coded and analyzed the questions raised by Mr.Wu in the teaching process. Finally, the observer will collect the observation data for detailed statistical analysis, and draw the corresponding conclusions and enlightenment through the qualitative study of the teaching behavior of teachers "asking questions".

Table 1: Teacher's questioning and observation scale

The teacher asked	**Waiting time**			**problem types**				**Answer the way**				**Ask the object**	
	<1s	1-3s	>3s	A	B	C	D	a	b	c	d	Individual students	The whole class

3. Study results and analysis

The observer adopted teacher Wu Zhengxian's teaching video "area and area unit", which lasted about 55 minutes. Through observation and analysis, the whole class was about 50 questions and about 50 questions. These questions ran throughout the whole class and continued to promote the dynamic development of teaching.

(1) Problem type

In this class, the types of problems shown in Figure 1 are mainly understanding problems and creative problems, while other types of problems are less. Because this class mainly enables students to understand the concept and significance of area and area unit, and can apply them to daily life to analyze and solve practical problems. Creative problems and critical problems also involve a lot. These problems require students 'high cognitive level, corresponding to students' higher level thinking, which reflects Mr.Wu's importance to cultivating students' thinking and thinking ability. Therefore, the more questions are not the more the better, the key is whether these questions are helpful to train students' thinking, teachers should reduce the number of memory questions.

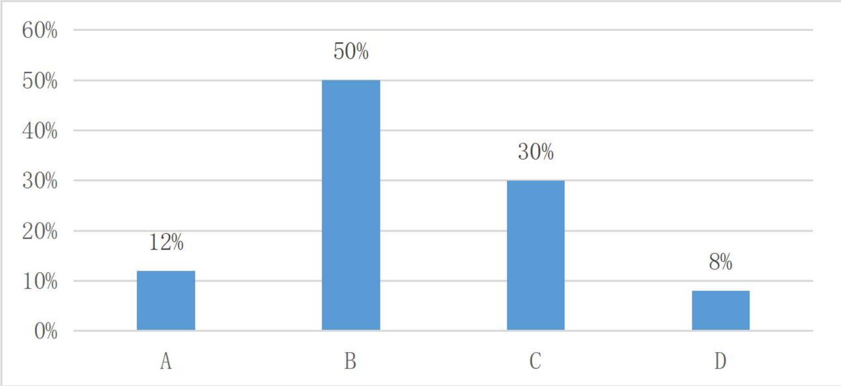

Figure 1. Proportion of problem types

(2) Waiting time

In this class, it took about 40 minutes and 10 seconds for Teacher Wu to ask questions and students to answer. Memory questions (A), 15% of the average waiting time, This kind of problem is relatively simple, Students don't need to invest too much time in thinking, Waiting time is very reasonable; Understanding questions (B) average 34%, This type of activity needs to give students some time to react, Students need to understand what they have learned to answer, Waiting time between 1-3 seconds is more appropriate; The average waiting time of high cognitive level questions is 51%, Creative and critical questions (C, D), Because students need in-depth analysis, thinking, judgment, To get to a conclusion, Waiting time to answer in more than 3 seconds is appropriate, In this way, students can deeply analyze and think, Then responding to the teacher, Thus maintaining the coherence of the teaching process, If such problems are not given some time to think, It may affect the later learning. It can be seen that teachers can give students appropriate time to answer according to different types of questions and difficulty.

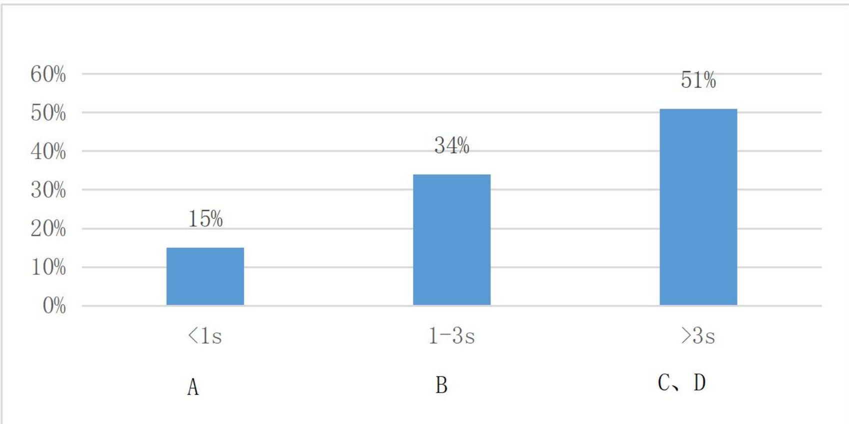

Figure 2 Average proportion of waiting to answer Time

(3) The object of the question

According to Figure 4, it can be directly seen that in this class, the proportion of the whole class, and the questions involved a wide range of objects, so it has a certain test. In addition, the teacher proposed question is very targeted and open, most of the problem for the class, when wu let the students understand the concept of the area, not directly into the area unit, but through the creation, let the students by comparing different quantity grid, but the size of the paper is the same, and let the students realize the importance of unified area unit, and then guide the students to realize the meaning of the area unit. The questions raised in this link are logical and thoughtful, such as: " Can you judge the size of the grid?"," What do you find through this comparison? Do you have any new thinking?"," What are our requirements for the grid?"," What is this big grid?"," What is the area unit, do you know those? ” . These questions spiral up, one by one, making the questions very efficient. A small part is closed, simple memory, and understanding

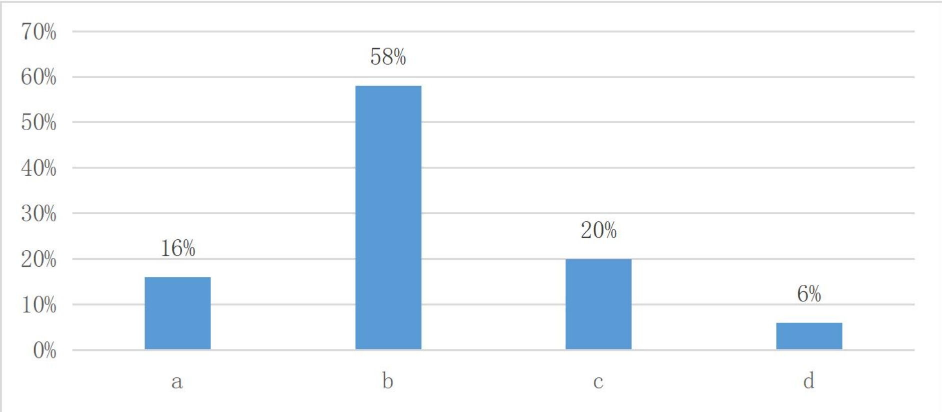

Figure 3. Proportion of response styles

（4) Ask the object

According to Figure 4, it can be directly seen that in this class, the proportion of the whole class, questions involving a wide range of objects, so it has a certain test. In addition, the teacher proposed question is very targeted and open, most of the problem for the class, when the teacher wu let the students understand the concept of the area, not directly into the area unit, but through creating situation, let the students by comparing different quantity grid, but the size of the paper is the same, and let the students realize the importance of unified area unit, and then guide students to realize the meaning of the area unit. The questions raised in this section are logical and thoughtful, such as: " Can you judge the size of the grid?"," What do you find through this comparison? Do you have any new thinking?"," What are our requirements for the grid?"," What is this big grid?"," What is the area unit, do you know those? ” 。These questions spiral up, one by one, making the questions very efficient. A small number of closed, simple memory and understanding questions will only ask individual students to answer, or ask the wrong individual students to answer again, such as: " What is the area of this small square?"," What is one square meter?"," How to express a square meter?” 。This can save limited class time, eliminate doubts in the hearts of individual students, at the same time can better interact with individual students, give students encouragement and praise, indirectly improve the quality of teaching.

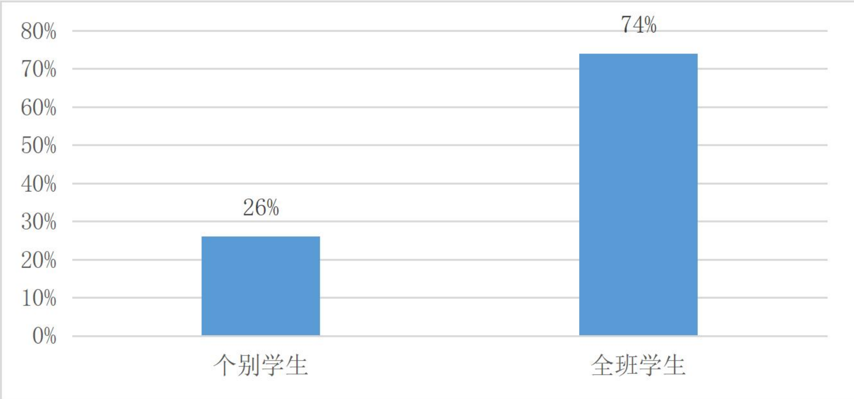

Figure 4 Rportion of questioning subjects

4 The enlightenment of primary school mathematics classroom teachers' effective questioning

Based on LICC paradigm of classroom observation and teacher Wu Zhengxian's classroom teaching, this paper makes a comprehensive observation and in-depth analysis of the observation point of teachers' questioning, so as to improve the effectiveness of teachers' questioning in primary school mathematics classroom, truly achieve teacher-led and active participation of students.

(1) Increase the high cognitive level of the problem, layer by layer, spiral upward

First of all, the depth of the teaching content is gradually deepened, and the teacher's questions should also be from shallow to deep, layer by layer. The former questions are the basis for students to understand or solve the later questions. For example, in the teaching process, Mr. Wu first let students think about what is 1 square decimeter, and then create a scene to understand 1 square decimeter, and then apply 1 square decimeter, and finally lead to 1 square meter, at this time students are mastering 1 square meter on the basis of further understanding and learning 1 square meter, reducing the difficulty of learning area units, which reflects the logic of classroom questions, layer by layer. Spiral up. Secondly, as can be seen from Figure 1, understanding questions account for 50%, which can eliminate students' negative "silent knowledge" about this knowledge point to a certain extent, and also reflects that "understanding" is the basic orientation of mathematics questions, implementing the requirements of the 2022 curriculum standard: "Understanding the meaning of area and forming a sense of quantity". [1] In addition, Vygotsky's theory of education in the zone of proximal Development proposed that "teaching should be ahead of development", which suggested that teachers should not only design memory and understanding questions that can test students' current development level, but also propose creative and critical questions with high cognitive level in the teaching process, so as to stimulate the desire for knowledge and promote the development of students' upper limit. Only in this way can students exercise their mathematical thinking ability. Middle grade students' abstract logical thinking has begun to develop, and critical and creative questions help to promote the transformation of students' logical thinking. In the face of problems with high cognitive level, students will think and reflect, find their weaknesses, and give full play to their subjective initiative to analyze and solve problems, so as to continuously improve their cognitive level. For example, before entering the area unit students, Teacher Wu created a scene to let students think, "by counting the number of squares, can you judge the size of the area?" Why?" "Do you have any way of comparing the size of the area of these two pieces of paper?" Is there another way?" From the thinking state and answers of students, it can be seen that questions with high cognitive level are often more likely to trigger cognitive conflicts of students, thus promoting the reorganization of knowledge structure and concept change, and developing their creative thinking and divergent thinking. Constructivism knowledge view holds that knowledge learning is actively constructive, and students need to carry out high-level thinking activities in the process of dealing with problems with high cognitive level, deeply processing old and new knowledge, generating new reasoning and hypotheses, and reflecting on and testing their own ideas. In other words, the development of students' mathematical thinking and mathematical core literacy is often carried out in the "problems" that require deep exploration and thinking. Therefore, teachers should ask progressive questions, increase the high cognitive level of questions, and play the value of mathematics to make students "smart".

(2) Appropriate waiting time for all

American psychologist Rowe put forward the "waiting time" theory, he believes that teachers should give students a certain amount of time to think after asking questions. Reasonable grasp of students' waiting time is conducive to improving the efficiency of questioning. [5] In addition, the instructional design of constructivism learning environment proposes that learning environment is a place where learners can freely explore and learn independently. [6] The environment here is not only a space environment such as classrooms, but also a sufficient time environment, which can better realize teaching activities. According to Figure 2, for memory and comprehension questions with low cognitive level, the waiting time can be about 1 to 3 seconds; However, for creative and critical questions with high cognitive level, the waiting time should be extended to more than 3 seconds. If there are very difficult questions, teachers can set aside 1 minute or even more time for students to conduct in-depth exploration, so that students can think in a real sense and get a complete and valuable answer. In this case, Ms. Wu created reasonable time conditions for the students, and the students' thinking level was higher, so that the responses were more logical and thoughtful. Therefore, the teachers could leave appropriate time for the students according to different types of questions, so that most students could have sufficient time for deep thinking. In addition, students' cognitive structure is different, [7] affecting their transfer and application of knowledge. Students with good academic performance have a complete and solid knowledge base and a relatively perfect knowledge structure, so that the cognitive structure has high utilizability, high discriminability, strong stability and high tolerance level. Students with poor academic performance have weak basic knowledge, no systematic and close connection between knowledge and knowledge, and incomplete knowledge structure, so the cognitive structure is unstable. Therefore, for students with complete cognitive structure, they have a good foundation and strong divergent thinking, and the teacher can respond quickly after asking questions, and the waiting time can be shorter; However, for students with incomplete cognitive structure, they do not have a solid grasp of basic knowledge, their thinking is relatively slow, and they need to solve problems for a relatively long time, so the waiting time needs to be appropriately extended. Second, questions should be directed at the whole class to share the results of collective thinking. In teaching, about 74% of Ms. Wu's questions are directed to the whole class instead of individual students, which enables students to achieve the effect of interactive communication, conducive to the spark of different ideas, enrich students' own cognitive system in the process of spark collision, and prevent marginal students from becoming "spectators" in the mathematics class and losing their interest and confidence in learning mathematics.

(3) Increase the number of multi-student answers and group discussions to improve student participation

Constructivism learning theory emphasizes the social interaction of learning and proposes cooperative learning and interactive teaching, which means that learning needs to be completed through cooperation and interaction, and cooperation and interaction are both ways for students to construct knowledge in a meaningful way. The cooperation in classroom teaching activities is mainly reflected in deskmate communication, group cooperation and so on. First of all, for difficult, controversial and large tasks, teachers can adopt the way of group or desk cooperation. In the process of cooperation with others, students will take the initiative to express their views and share ideas to their peers, prompting them to have a collision of ideas. In this process, creative results may be obtained, thus feeling the charm of cooperation. In addition, constructivism holds that the interaction between learners and their environment has a decisive influence on their deep understanding of what they are learning. Under the organization and guidance of the teachers, the students participated in discussions and exchanges, successfully established a learning group, and became a part of this group. In this particular group, students and teachers work together to think critically and explore students' different assumptions, perspectives and ideas; In the process of negotiation, the first is personal thinking and analysis, followed by internal negotiation, then mutual negotiation, and finally the teacher's summary guidance. This process plays an interactive role and plays a key role in the students' understanding of the learning content. In this kind of cooperative or interactive learning environment, the thoughts and insights of the teacher and each student can be shared by the whole learning group, that is, the whole learning group has completed the meaning construction of the knowledge, rather than just a few students. [6] Secondly, answering more questions for students can not only promote the atmosphere, but also play a role of repetition and reinforcement. More than two students are invited to answer, which can greatly improve students' class participation and enthusiasm, create a good classroom atmosphere, and make students integrate into the class and enter the experiential learning. In addition, when the teacher asked another student to answer a question, the question or the student's answer was repeated virtually, which played a strengthening role and provided more opportunities for those students who did not understand the question or wanted to express themselves. Therefore, in order to improve the classroom teaching effect, teachers should ask questions for more than one student, organize group discussions at appropriate times, and minimize the need for one student to answer.

(4) Design questions effectively

Questioning is the most important thinking tool, [8] Designing "good" questions is the key to improving the quality of teaching, so how should teachers improve the effectiveness of questioning? First of all, according to the teaching content, take into account the problem of different cognitive levels. If a class is filled with problems at a low cognitive level, it will certainly hinder the development of students' high-level thinking. Teachers must ensure that there are high cognitive level problems in classroom teaching in order to develop students' ability to reason, think, analyze, create, evaluate, etc. But the emphasis on high-cognitive questions does not eliminate low-cognitive questions. Questions at different levels have different functions. For example, questions at lower levels can diagnose students' understanding of basic knowledge, and teachers can judge whether students have the basis to solve high-level problems. Secondly, teachers' questions should be matched with teaching objectives. According to the requirements of the 2022 version of the new curriculum standards, teachers can design teaching objectives from the perspective of "four foundations" and "four abilities". When designing questions, they should closely follow the teaching objectives and focus on the questions that help to complete the teaching objectives, which can not only avoid asking too many questions, but also balance questions at different levels. For example, in terms of "competence" goals, teachers can develop students' high-level thinking by designing questions such as evaluative expressions based on the teaching content, such as, "How do you think you can better... (Students are asked to come up with unique ideas or opinions). [8] Therefore, when designing problems, teachers should combine teaching content and think from the perspective of teaching objectives.

In short, timely questioning is a high level of teaching art, just like a pool of stone, "stone" in the morning and evening directly affect the quality of teaching effect. [9] Based on the observation of Ms. Wu's teaching record, it is suggested that primary school mathematics teachers should increase the proportion of questions with high cognitive level in classroom questioning. Teachers' questioning directly affects students' thinking level, asks questions in a collective way, improves students' participation, and gives students enough thinking time to give full play to the teaching value of questioning. Improve teaching quality and implement core literacy.

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