



Estimation Teaching Thinking of Transforming Knowledge into Literacy

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Abstract

Teaching should focus on the core qualities of the subject. How to implement the two core qualities of data analysis and logical reasoning in estimation teaching is a problem that teachers need to pay attention to. Based on teacher Wu Zhengxian's lesson, the estimation teaching path of transforming knowledge into literacy should be implemented in paying attention to estimation consciousness, choosing estimation methods and evaluating estimation results.

Subject Areas

Mathematics Education

Keywords

Core Literacy, Estimation, Data Analysis, Logical Reasoning

1. Introduction

It is not hard to find that the student-centered teaching concept requires us to pay more attention to students' learning, what students have learned? How do teachers help students learn? In daily teaching practice, teachers will pay special attention to teachers' teaching behavior. However, teaching and learning are inseparable. Although teachers' teaching is equally important, it is ultimately reflected in how students learn. To measure the value of primary school mathematics by life scale, the knowledge and skills acquired by students are superficial forms, and the core quality of mathematics that students can acquire is pointed behind.

In particular, the status of estimates is unusual. Estimation is a rough calculation of the quantity of things. It is to roughly calculate or reasonably infer the quantitative relationship to obtain an approximate value in case of some situations where accurate measurement and calculation are impossible or unneces-

sary. As one of the most practical mathematical methods in life, it points to the core qualities of comprehensive analysis and logical reasoning of mathematics. The so-called accomplishment needs to be permeated and internalized in teaching for a long time. At the same time, the adjustment of Mathematics Curriculum Standard for Compulsory Education (2011 Edition) elevates the status of estimation teaching, cancelling the class hour of estimation, requiring the knowledge to be infiltrated into daily teaching and focusing on cultivating students' estimation ability [1]. However, most textbooks do not estimate a lesson, how to infiltrate estimation into teaching and how to create independent curriculum content out of nothing have become a headache for primary school teachers. Therefore, how Teacher Wu Zhengxian transformed knowledge into mathematical analysis and logical reasoning literacy in estimation teaching needs to be analyzed and explored.

2. Estimation Awareness: Penetration of Data Analytics

2.1. What Is Estimation Consciousness: The Support of Data Analysis Thought

In the usual long-term mathematics learning, primary school students receive more training in accurate calculation, so they form the thinking pattern of accurate calculation, that a question must have a certain answer. When students see mathematical information, they will think of certain calculation process and calculation result, and their estimation consciousness is very weak, which leads to the lack of fuzzy analysis ability of data in daily life. Research shows that there are only 69 estimation questions in the primary school mathematics textbooks of grade one to grade three in Jiangsu Education Edition [2].

2.2. The Value of Data Analysis Literacy

The so-called data analysis literacy is the ability to discover rules from data by using some data analysis methods or thinking, so as to reveal the truth behind the data. Its value lies in that it can provide basis for us to make decisions. In specific teaching situations, some teachers may directly show the calculation formula for students to estimate when the teaching estimate is $43 + 28$. However, due to the small data, it is easy to calculate directly, and the value and superiority of estimation cannot be reflected in this problem. Under the requirement of the teacher, students appeared the phenomenon of "calculate first and estimate later". They first calculated the sum of $43 + 28$, and then changed the numbers around the determined result to get the estimated result. This sort of back-and-forth creates a false class of estimation.

Therefore, in the estimation teaching, although the estimation knowledge itself is not difficult, the difficulty of transforming this knowledge into students' data analysis thinking is greatly deepened due to the long-term thinking pattern of students and the teachers' lack of attention to designing the problem situation of estimation teaching. How to cultivate students' estimation consciousness and

help them build up their ability of data analysis with their existing number sense.

2.3. The Implementation of Data Analysis Literacy

Take Teacher Wu Zhengxian's estimation teaching as an example, teacher Wu takes students' mathematical literacy of data analysis as the primary teaching objective. First, a realistic problem situation is created, is it enough to bring 200 yuan to the supermarket? Because of the large number of data, students found it difficult to calculate accurately, and without being asked to figure out how much they would ultimately pay, they found the estimate a simpler and more convenient algorithm. So most students are willing to try and estimate. This very common situational problem in life directly leads students' thinking to data analysis, getting rid of the thinking of accurate calculation when they see a mathematical problem in the past.

Then Teacher Wu Zhengxian showed some practical examples, which are helpful to the cultivation of data analysis ability in the following two aspects:

1) Students take the initiative to recognize the estimated value.

Before we go shopping, there are five kinds of goods on the shopping list, the prices are 48 yuan, 16 yuan, 23 yuan, 69 yuan, 31 yuan respectively. We want to confirm in advance whether 200 yuan is enough. In this situation, students consciously realize that in the process of calculation, in addition to accurate calculation and estimation, when the calculation requirements are not high, they can flexibly use estimation to solve some simple problems in daily life, and gradually realize the practicality and universality of estimation.

2) Students distinguish between the advantages and applications of estimation and actuarial calculations.

In the example, Teacher Wu zhengxian also guided students to compare specific problem situations. With "if you buy things spent 168 yuan, the cashier estimated estimated, tell you about 200 yuan, do you pay?" Such questions help students choose between estimates or precise calculations. Students constantly recall life experience, in this process, they also accumulate experience in estimating the use of the situation, and gradually acquire the ability of data analysis and the awareness of choosing algorithms, forming the awareness of estimation. The core literacy of data analysis is permeated silently in this way.

3. Estimation Method: The Guidance of Logical Reasoning

Estimation teaching should not only permeate the idea of analyzing data, but also help students master the basic method of estimation, which contains the mathematical literacy of students' logical reasoning ability. In the estimation teaching of Teacher Wu Zhengxian, the following two teaching methods are used to cultivate students' logical reasoning ability.

3.1. Guide Students to Communicate Actively and Encourage the Diversity of Estimation Methods

In the process of exchanging estimation methods, Mr. Wu encouraged everyone

to discuss with each other. It was in the process of mutual discussion that students divergent thinking and mobilized logical reasoning ability to put forward various estimation methods. Taking Cao Chong as an example, Wu encouraged students to communicate actively and come up with their own estimation methods. The rationality of “size estimation”, “rounding method” and “accurate calculation method” proposed by students is recognized, and students are encouraged to name the estimation method independently, so as to enhance students’ memory and understanding of the method, which is the process of helping students to externalize and clarify their thinking. At the same time, Teacher Wu’s encouragement also encouraged students to dare to express, so as to better understand the diversity of estimation methods.

3.2. Guide Students to Reflect Independently and Analyze the Rationality of the Estimation Method

Let’s start with two teaching cases:

Case 1:

Teacher: 350 students are going out for a spring outing. There are 7 cars with 56 seats in each car. Is it enough?

That’s enough. That’s enough.

Teacher: What do you mean too much?

S: I’m taking 56 seats as 50. $50 \times 7 = 350$. Look! Fifty seats is enough, actually each car has 56 seats, so it’s quite enough.”

Case 2:

T: the weight limit of the bridge is 3 tons. One car has 6 boxes of goods, 285 kg each. Can the car cross the bridge safely?

S: I use $300 \times 6 = 1800$.

T: That is to say, you consider each case of 285 kilograms as --

S: If you take 300 kg per case, it means that the cargo of this car is about 1800 kg first, and then 1800 plus 986.

T: How about 986?

S: If you take the 986 kg weight as 1000 kg, the total is about 2800 kg.

T: Then why don’t you regard 285 as 200?

S: That’s not a safe estimate. Think of 285 kg as 200 kg, but not in case of emergency.

In the two examples of spring outing and crossing a bridge, Teacher Wu Zhengxian used “What do you want to say by comparing the results of your estimation with the results of accurate calculation, and comparing the estimation methods of students with their own methods? Ask the students to reflect on their estimation process, put forward two main methods of “big estimation” and “small estimation”, judge the rationality of their estimation method, and practically develop logical judgment and reasonable reasoning ability.

The students fully understood the significance of the estimation of xiaoli through the practical example of spring outing, and the problem of crossing the bridge made the students understand the importance of the estimation of daoli.

A large and a small itself may cause confusion in students' thinking estimation method, through the situation creation of Teacher Wu Zhengxian, students easily understand the significance of big and small estimation, students' logical thinking in a specific situation has been a training. In the end, Teacher Wu guided everyone to summarize the estimation methods and processes and form estimation strategies to help students turn the logical thinking process in their minds into practical strategies that can be used reasonably.

It is not difficult for students to learn basic estimation methods, but it is not easy for students to master strategies for using estimation to solve problems. It requires students to flexibly choose whether to estimate the number according to the actual situation, and at the same time, it also needs to make appropriate adjustments to the estimation results, so as to form a reasonable estimation strategy, so that students can learn practical mathematics and develop the quality of logical reasoning.

4. Result Evaluation: Judgment of the Rationality of Data

Estimation, as the most common mathematical tool in life, contains a lot of mathematical core literacy. This teaching content is very difficult for teachers, in the actual teaching, many teachers will be hesitant because of the result of an estimation question. What is the right estimate? How to evaluate estimates? There is no reference answer for estimation, but is there a standard for evaluation? Evaluating teaching is even harder.

4.1. The Significance of Developing Logical Reasoning Literacy in Evaluation

The method of Teacher Wu Zhengxian can help teachers get a new understanding of estimation evaluation. Behind this evaluation is still the logical reasoning ability, that is, the judgment of the rationality of the estimation method. In the process of estimation, the results of estimation are often inconsistent due to different life experiences and different methods and strategies adopted by each person. But the main purpose of estimation teaching is to develop students' approximation consciousness. Since it is an approximate number, there is no need to have a unified standard. A reasonable estimation strategy can be selected according to the actual problems, and the reasonable result is correct.

For example, when it comes to renting a car for spring outing, ask, "Can four cars fit?" Students just need to say "can sit down" according to the actual number of people. If the calculation is pure: $328 + 346 + 307 + 377 + 398 + 352$. According to the students' psychological development level, cognitive rules and existing mathematical logic reasoning ability, the estimation result is reasonable or not. For students in lower grades (grades 1 - 2), as long as the answer is between 1800 and 2400 is reasonable; However, if students are in grade five or six, such answers are not accurate enough, and it is necessary to further narrow the range of estimated results under the guidance of teachers. After students give the esti-

mated answer, just like Teacher Wu Zhengxian, students can compare the result with the accurate answer, judge how to estimate more reasonable in the actual situation, develop students' logical reasoning literacy, and improve students' estimation ability.

4.2. The Path to Develop Logical Reasoning Literacy in the Evaluation Results

Therefore, how to develop students' logical reasoning literacy in the evaluation results, combined with the example of Teacher Wu Zhengxian, put forward the following suggestions:

1) Pay attention to students' judgment on the rationality of data.

To judge the rationality of data is to judge the logic of the problem itself. In a problem with context, any data is meaningful, and for meaningful data, the estimation is also meaningful. When the estimated value is too large, there should be some influence on the real situation. A small estimate can also have an impact on real-world problems [3]. At this time, teachers need to emphasize the judgment of the rationality of data, which is the use of logical reasoning ability. The deviation of these estimated results is analyzed in practice to judge whether the estimated results are reasonable or not.

The significance of focusing on the rationality of data is:

a) Students can first judge the meaning of data by using logical ability, so as to check the results of their own estimation, and then make self-evaluation. In the process of self-evaluation, students understand the meaning of the problem situation and the mathematical logic of the estimated value, so as to further understand the role and value of the estimated value.

b) Paying attention to the rationality of data can help students establish the "uncertain" thinking of mathematical reasoning. This "uncertainty" is reflected in the selection of estimation data according to the problem, the selection of estimation method according to the actual situation, and the judgment of whether the estimation results meet the requirements of the situation. This "uncertainty" is more relevant to the reality of life, because in life, many mathematical problems are not directly the only correct answer. By judging the rationality of data, students deeply realize that the results of "uncertainty" are traceable in mathematics, and develop logical reasoning ability in the process of in-depth understanding of "uncertainty" thinking.

Therefore, after students complete the estimation questions independently, teachers should evaluate the estimation results of students through whether the significance of the estimation results in the context is reasonable. It is important to note that the question of whether "reasonable" also depends on the subject of object data judgment, so in addition to pay attention to the problem of logic, also need to pay attention to different students' ability of mathematics at the same time to master degree and the students' cognitive development levels to determine the students to judge whether the results belong to the reasonable scope.

2) Using the externalization of students' thinking: language.

Using students' language is to understand students' thinking through their mathematical expression and data interpretation. By encouraging students to speak in class, teachers give students the opportunity to put their thought process into words.

Logical reasoning belongs to the more abstract level of mathematical thinking quality, it is difficult to show directly in an explicit way. From the perspective of developmental psychology, thinking is the internalization of language, and language is the externalization of thinking, which is more obvious in children than in adults. Children like to describe one thing first and then act to complete the target activity, which is the process of internalizing external language into thinking. Asking students to describe how and why they estimate is an externalization of the internal language. In this process, students not only need to use simple discourse description, but also need to use standard mathematical language to express mathematical content clearly, and use logical and organized language to accurately convey their mathematical thinking process to others. Therefore, teachers can use students' language, let students say, to judge students' thinking state, so as to guide students to form logical reasoning ability.

5. Research Summary and Reflection

5.1. Research Summary

Thus, in estimation teaching, estimation knowledge and methods are implemented into the core literacy of mathematics: data analysis and logical reasoning through the thinking of the above three aspects. Students naturally but not deliberately approach the core literacy of mathematics in the process of having estimation consciousness, reasonably choosing estimation methods and evaluating estimation results.

5.2. Research Limitations and Reflection

To sum up, this study still has limitations in the following aspects:

- 1) The thinking of estimation teaching is based on the teaching case analysis of a famous teacher's lesson, which lacks the support of theoretical system.
- 2) Teaching thinking has not been turned into practical teaching practice, and further action research is still needed to verify the scientific and operational thinking.

Conflicts of Interest

The authors declare no conflicts of interest.

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