

# Analysis of the Support of Mathematical Calculation Literacy in Examples and Exercises of High School Mathematics

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## Abstract

According to the division of three levels and four aspects of mathematical calculation literacy in the General Senior High School Mathematics Curriculum Standard, we used questionnaires and statistical analysis to analyze the support of examples and exercises for mathematical calculation literacy in the first volume of compulsory textbooks of general high school mathematics. The result shows that the example part of the textbook supports the implementations of nine aspects of mathematical calculation literacy. In all these nine aspects, the support of level 2 of knowledge and skill is the best. However, level 1 of situation and problem, level 3 of knowledge and skill, and level 3 of communication and reflection are not supported. As for the exercise part of the textbook, this part supports the implementations of 11 aspects of mathematical calculation literacy. Among them, level 2 of communication and reflection is supported mostly, while level 1 of the situation and problem is totally not. Therefore, in order to use the examples and exercises more effectively, we suggest that the examples and exercises in the textbook should be selected and elaborated. Only in that way, they can play a role in the maximum extent and help more to cultivate students' mathematical calculation literacy.

## Keywords

Core Literacy, Mathematical Calculation Literacy, High School Mathematics Textbooks, Examples, Exercises, Mathematics Teaching

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## 1. Introduction

Chinese Students Development Core Literacy proposes to achieve the educational goal of cultivating students' core literacy. In order to achieve this goal, the General Senior High School Mathematics Curriculum Standard (2017 Edition) (hereinafter referred to as the "Standard") focuses on the implementation of core literacy [1, 2]. Mathematical operation is a basic means to solve related mathematical problems. It can further develop students' mathematical operation ability, use arithmetic methods to solve practical problems, and to promote the development of students' mathematical thinking so that students can form the quality of standardized thinking problems [3]. It clearly points out

that mathematical calculation literacy can run through from beginning to end of the mathematical learning [4]. At present, teachers are using the first volume of high school mathematics compulsory textbooks to cultivate students' mathematical calculation literacy. The implementation of mathematical calculation literacy mainly depends on operations, while the examples and exercises of the textbooks are the main support of mathematical calculation literacy. So, the examples and exercises are the most important to implement the literacy of mathematical calculation. Some teachers just rely on their own teaching experience to determine whether the examples and exercises in the textbooks have cultivated students' mathematical calculation literacy because it still hasn't reliable data to support them yet.

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Therefore, this research has important guiding significance for teachers' teaching.

## 2. Literature Review

In order to better implement students' mathematical calculation literacy, many people have made a lot of research from the perspective of teaching and teaching materials. From the perspective of teaching, Jin Jiexia believes that it is necessary to combine the reading comprehension questions appearing in some high-level examination questions to highlight the characteristics of basicity, selectivity, development, and relevance, reminding front-line teachers that mathematics teaching is not the teaching of mathematical knowledge, but pay attention to the understanding and application of mathematical knowledge. Li Xiaojuan and others believe that core literacy can be implemented with the help of mathematical tools. For example, by learning to use the abacus, students can develop mathematical calculation literacy. Dong Wenli, Cheng Chong and others believe that it is necessary to change traditional teaching methods, carry out in-depth teaching, enrich teaching forms, enable students to participate in the process of knowledge generation actively, and improve the discipline evaluation mechanism [3-7]. From the perspective of teaching materials, Zhou Yuanfang and others propose that the core literacy of mathematics should be implemented through scientifically designed after-class exercises and reasonable formulation of evaluation rules. Li Hongyan and Wang Lina believe that in the design of high school mathematics textbooks, it is necessary to take core literacy training as the ultimate goal and build a teaching bridge between teachers and students through textbooks [8-12]. Textbook is the main basis of teaching, the concrete embodiment of the syllabus, and the crystallization of teachers' teaching experience. It has a partial and overall relationship with teaching [15]. In the teaching process, teaching materials are regarded as the carrier of knowledge, and vitality is gained through the interactive process of teaching and learning between teachers and students [16].

It can be seen that there have been lots of researches on how to implement mathematical calculation literacy. The research results are mainly focused on teaching and textbooks, and the conclusions are very general. It is undeniable that the above researches provide lots of good ideas, but obviously incomplete. At present, the research on the implementation of mathematical calculation literacy from the perspective of examples and exercises in high school mathematics textbooks is still blank.

## 3. Method

### 3.1. Sample and Research Instruments

A total of 21 senior high school teachers from Shandong Normal University Affiliated Middle School, Ningyang No. 2 Middle School of Shandong Province, and Jinan Middle School of Shandong Province with more than 5 years of teaching experience and a good understanding of high school textbooks and students' learning were selected. The questionnaire was prepared based on the division of the three levels (level 1, level 2, and level 3) and four aspects (situation and problem, knowledge and skill, thinking and expression, communication and reflection) of mathematical calculation literacy in the Standards.

### 3.2. Information Collection

A questionnaire survey was conducted among 21 teachers. After explaining the division of three levels and four aspects of mathematical calculation literacy in the Standard, the teacher checked the examples and exercises of the five chapters in the corresponding positions in the table.

### 3.3. Data Analysis

We sort out the feedback from the questionnaires collected. First, we count the number of people at each level and convert them into percentages. Then, we took the level of the largest number of supporters in the same aspect as the main analysis element and the number of choices for each dimension in the 12 dimensions was obtained. Finally, we draw a table and analyzed the data using statistical analysis with the help of a table tool.

## 4. Results

### 4.1. Form Description

The statistical analysis method was used to summarize the mathematical calculation literacy of the five chapters in the examples and exercises. We use A, B, C, and D to represent the four aspects of mathematical calculation literacy: situation and problem, knowledge and skill, thinking and expression, communication and reflection; use 1, 2, and 3 to represent the three levels of mathematical calculation literacy: level 1, level 2 and level 3. The contents in the table indicate the number of support points.

### 4.2. The Support Situation of Examples for Mathematical Calculation Literacy

The first volume of the compulsory textbook of general high school mathematics has 95 support points for the implementation of mathematical calculation literacy.

Vertically, there are 18 support points for level 2 for situation and problem, and 6 support points for level 3; 1 support point for level 1 for knowledge and skill, and 23 support points for level 2. There are 4 support points for level 1 in thinking and expression, 16 support points for level 2 and 3 support points for level 3; 4 support points for level 1 for communication

and reflection, and 20 support points for level 2. Horizontally, there are 19 points for the implementation of mathematical calculation literacy in the example part of the chapter 1, 12 points of the chapter 2, 16 points of the chapter 3, 20 points of the chapter 4, and 28 points of the chapter 5. The details are shown in the table below.

**Table 1.** The support situation of examples for mathematical calculation literacy.

	A1	A2	A3	B1	B2	B3	C1	C2	C3	D1	D2	D3	Total
Chapter 1		5		1	4		2	2		3	2		19
Chapter 2		1	2		3			3			3		12
Chapter 3		2	2		4		1	3		1	3		16
Chapter 4		4	1		5			3	2		5		20
Chapter 5		6	1		7		1	5	1		7		28
Total		18	6	1	23		4	16	3	4	20		95

### 4.3. The Support Situation of Exercises for Mathematical Calculation Literacy

The first volume of the compulsory textbook of general high school mathematics has 97 support points for the implementation of mathematical calculation literacy. Vertically, there are 12 support points for level 2 for situation and problem, and 12 support points for level 3; 1 support point for level 1 for knowledge and skill, 20 support points for level 2 and 3 support points for level 3. There are 2

support points for level 1 in thinking and expression, 21 support points for level 2 and 1 support point for level 3; 1 support point for level 1 for communication and reflection, 22 support points for level 2 and 1 support point for level 3. Horizontally, there are 20 points for the implementation of mathematical calculation literacy in the exercise part of the chapter 1, 12 points of the chapter 2, 16 points of the chapter 3, 20 points of the chapter 4, and 28 points of the chapter 5. The details are shown in the table below.

**Table 2.** The support situation of exercises for mathematical calculation literacy.

	A1	A2	A3	B1	B2	B3	C1	C2	C3	D1	D2	D3	Total
Chapter 1		1	4	1	4		2	3		1	4		20
Chapter 2		2	1		3			3			3		12
Chapter 3		2	2		4			4			4		16
Chapter 4		2	3		3	2		5			4	1	20
Chapter 5		5	2		6	1		6	1		7		28
Total		12	12	1	20	3	2	21	1	1	22	1	97

## 5. Conclusion

From the analysis of the above results, we can see that the example part of the textbook supports the nine aspects of implementing mathematical calculation literacy, and there is no support for level 1 in situation and problem, level 3 in knowledge and skill, and level 3 in communication and reflection. Among them, the degree of support for level 2 of knowledge and skill is the best, the degree of support for level 2 of communication and reflection is better, and the degree of support for level 1 of knowledge and skill is weak. The exercise part of the textbook supports 11 aspects of the implementation of mathematical literacy. It does not support level 1 in situation and problem. Among them, it supports level 2 in communication and reflection. Level 2 of the two aspects has better support, and level 1 of knowledge and skill, level 3 of thinking and expression, and level 1 and level 3 of communication and reflection are weak. In summary, the examples and exercises of that textbook have good support

for mathematical calculation literacy. Therefore, teachers should fully dig up the textbook in teaching and use the mathematics question reasonably because they play the greatest role in cultivating students' mathematical calculation literacy.

## 6. Suggestions

In order to make better use of the examples and exercises in the textbook and cultivate students' mathematical calculation literacy, according to the results of this study, it is recommended that the part which has good support in the teaching, such as level 2 of the knowledge and skill for the example, and level 2 of the communication and reflection for the exercise, teachers should make full use of the teaching materials, and try to raise the students' mastery of mathematical calculation literacy to a higher level by digging into the textbook. For those parts which with low or no support, we must carefully select the examples and exercises in teaching, and carry out the secondary development of the

teaching materials to optimize the choice of examples and exercises.

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