Analysis of Support of the Knowledge of High School Mathematics to Mathematical Calculation Literacy

American Journal of Creative Education
Vol. 3, No. 2, 70-75, 2020
e-ISSN: 2706-6088

(Corresponding Author)

Qi Han[1]
Zezhong Yang[2]

[1,2]*School of Mathematics and Statistics, Shandong Normal University, Jinan, China.*
[1]*Email: 17862963995@163.com Tel: 17862963995*
[2]*Email: zhongzee@163.com Tel: 15098771849*

ABSTRACT

According to the division of three levels and four aspects of mathematical calculation literacy in Chinese General Senior High School Mathematics Curriculum Standard (2017 Edition), by using the way of questionnaire and statistical analysis, we analyze the degree of support of the knowledge (including knowledge presentation and proposition derivation) in the first volume of compulsory textbook of general high school mathematics to mathematical calculation literacy. The results show that the knowledge presentation part of the textbook supports the implementations of ten aspects of mathematical calculation literacy. In all these ten aspects, the support to level 1 of knowledge and skill is the best. However, level 3 of knowledge and skill, and level 3 of thinking and expression are not supported. As for the proposition derivation part of the textbook, it supports the implementations of 11 aspects of mathematical calculation literacy. Among them, level 1 of situation and problem is supported mostly, while level 3 of thinking and expression is not. Therefore, in order to use knowledge more effectively, we suggest that the knowledge in the textbook should be selected and elaborated. Only in this way, can we use them to the maximum extent and help more to cultivate students' mathematical calculation literacy.

Keywords: *Core literacy, Mathematical calculation, High school, Textbooks, Mathematics teaching, Support.*

DOI: 10.20448/815.32.70.75
Citation | Qi Han, Zezhong Yang (2020). Analysis of Support of the Knowledge of High School Mathematics to Mathematical Calculation Literacy. American Journal of Creative Education, 3(2): 70-75.

Funding: This study received no specific financial support.
Competing Interests: The authors declare that they have no competing interests.
History: Received: 18 March 2020/ Revised: 22 April 2020/ Accepted: 29 May 2020/ Published: 24 June 2020
Publisher: Online Science Publishing

Highlights of this paper

- The results show that the knowledge presentation part of the textbook supports the implementations of ten aspects of mathematical calculation literacy.
- To use knowledge more effectively, we suggest that the knowledge in the textbook should be selected and elaborated.

1. INTRODUCTION

Chinese Student Development Core Literacy suggests achieving 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. It clearly points out that mathematical calculation literacy can run through from beginning to the end of the mathematical learning. 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 knowledge includes the knowledge presentation part such as theorem or concept giving, and the proposition derivation part such as the inference process of the theorem or formula, which is the most important theoretical knowledge of each textbook and the knowledge reserve for subsequent learning. Therefore, making full use of the knowledge part of textbooks is the basis for implementing mathematical literacy. Some teachers just rely on their own teaching experience to determine whether the knowledge in the textbooks has cultivated students' mathematical calculation literacy because it still hasn't reliable data to support them. 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 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 (Jin, 2018). Li 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 (Li & Kuang, 2018). Dong, Cheng, 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 actively, and improve the discipline evaluation mechanism (Cheng, 2018; Dong, 2019; Huang, 2017). From the perspective of teaching materials, Zhou and others propose that the core literacy of mathematics should be implemented through scientifically designed after-class exercises and reasonable formulation of evaluation rules (Zhou & Feng, 2018). Li and Wang 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 bridge between teachers and students through textbooks (Li, 2018; Wang, 2018). It can be seen that there has been a lot 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 knowledge in high school mathematics textbook is still blank. This article attempts to study the knowledge part of the textbooks and investigate the support of mathematical operation literacy in the high school mathematics textbooks, so that teachers can use the knowledge part in the

textbook to carry out teaching more accurately and efficiently.

3. THEORETICAL BASIS

Regarding the definition of core literacy in mathematics, Chen proposes that core literacy in mathematics refers to the key abilities that learners must have to adapt to lifelong development and social development. It is a comprehensive ability that students should achieve in learning mathematics (Chen, 2016). Yao believes that core literacy refers to the essential qualities and key abilities that students should have to adapt to social development and lifelong development. Core literacy in mathematics is based on content literacy in practical teaching, including content literacy, character literacy, and practical literacy (Yao, 2019). The above definitions of core literacy in mathematics disciplines are all extensions and an in-depth understanding of the definitions in the Standard. The Standard proposes that core literacy is a concentrated reflection of the value of educating people and is the quality gradually formed by students through subject learning. The core literacy of mathematics is a concentrated reflection of the goals of the mathematics curriculum. It is a comprehensive reflection of the qualities of thinking, key abilities, and emotions, attitudes, and values that have the basic characteristics of mathematics.

Regarding the division of core literacy in mathematics, there is currently the only and authoritative division, which is proposed in the Standard. The core literacy in mathematics includes mathematical abstraction, logical reasoning, mathematical modeling, intuitive imagination, mathematical calculation, and data analysis. The core literacies of these mathematical disciplines are opposite to each other and blends with each other. It is an organic whole. Regarding the definition of mathematical calculation literacy, there are many opinions in the current research. Lu and Dong believe that mathematical calculation literacy refers to the ability of students to understand arithmetic, to seek reasonable and concise arithmetic methods to solve problems, and to effectively cultivate students' logical reasoning ability and innovative thinking (Lv & Dong, 2019). Xu proposes that mathematical calculation literacy is a higher requirement based on computing ability, which should include computing ability, computing consciousness, computing quality, and computing attitude (Xu, 2019). Lai proposes that mathematical calculation is not a simple operation, but a process based on effective methods to solve problems (Lai, 2019). The most authoritative is the "standard", it raises that the mathematical calculation literacy is based on the clarification of the object of operation, according to the algorithm to solve mathematical problems. It mainly includes understanding the operational object, mastering the algorithm, exploring the operational idea, selecting the operational method, designing the operational program, and obtaining the operational result.

This study adopts the definition of mathematical calculation literacy in the Standard, which is the most objective and rigorous. Through the study of high school mathematics courses, students can further develop their mathematical operation abilities. Mathematics textbooks play an important role because they are the main carrier of mathematics curriculum learning. Therefore, the main investigation of this research is the support of mathematical calculation literacy in the knowledge part of high school mathematics textbooks.

4. METHOD

4.1. Sample

We selected the first volume of high school mathematics compulsory textbooks as the research sample. The reason is it was written and published by Chinese famous press named People's Education Press in 2019 in order to implement the requirement of the Standard (2017) and cultivate the core literacy of students in mathematics. It is a very popular textbook in high schools in China at present and is a typical representative of the current high school mathematics textbook.

4.2. Instrument

The questionnaire used in this study was made by researchers 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.

4.3. Data Collection

We recruited firstly 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. They all have more than 5 years of teaching experience and have a good understanding of high school textbooks and students' learning. Then we explained the division of three levels and four aspects of mathematical calculation literacy in the Standard to these teachers and let them check the examples and exercises of the five chapters in the corresponding positions in the table. At last, we ask them to finish the questionnaire according to their own understanding of the textbook.

4.4. 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. 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.

5. RESULTS

5.1. The Support Situation of Knowledge Presentations for Mathematical Calculation Literacy

The first volume of the compulsory textbook of general high school mathematics has 43 support points for the implementation of mathematical calculation literacy. Vertically, there are 4 support points for level 1 for situation and problem, 18 support points for level 2, and 6 support points for level 3; 10 support points for level 1 for knowledge and skill, and 2 support points for level 2.

Table-1. The support situation of knowledge presentations.

Chapters	A1	A2	A3	B1	B2	B3	C1	C2	C3	D1	D2	D3	Total
Chapter 1	1		1	1			1				1		5
Chapter 2	2	1		2	1		2	1		3			12
Chapter 3		2		2				2				1	7
Chapter 4	1	1		3			2			1			8
Chapter 5		3		2	1		3			1	1		11
Total	4	7	1	10	2		8	3		5	2	1	43

Source: Field survey, 2019.

There are 8 support points for level 1 in thinking and expression, 3 support points for level 2; 5 support points for level 1 for communication and reflection, 2 support points for level 2 and 1 support point for level 3. Horizontally, there are 5 points for the implementation of mathematical calculation literacy in the example part of the chapter 1, 12 points of the chapter 2, 7 points of the chapter 3, 8 points of the chapter 4, and 11 points of the

chapter 5. The details are shown in the Table 1.

5.2. The Support Situation of Proposition Derivations for Mathematical Calculation Literacy

The first volume of the compulsory textbook of general high school mathematics has 82 support points for the implementation of mathematical calculation literacy. Vertically, there are 14 support points for level 1 for situation and problem, 7 support points for level 2 and 1 support point for level 3; 9 support points for level 1 for knowledge and skill, 11 support points for level 2 and 1 support point for level 3. There are 12 support points for level 1 in thinking and expression, 9 support points for level 2 and 4 support points for level 3; 4 support points for level 1 for communication and reflection, 12 support points for level 2 and 2 support point3 for level 3. Horizontally, there are 12 points for the implementation of mathematical calculation literacy in the exercise part of the chapter 1, 12 points of the chapter 2, 12 points of the chapter 3, 19 points of the chapter 4, and 27 points of the chapter 5. The details are shown in the Table 2.

Table-2. The support situation of proposition derivations.

Chapters	A1	A2	A3	B1	B2	B3	C1	C2	C3	D1	D2	D3	Total
Chapter 1	2	2		2	1		1	2		1	1		12
Chapter 2	1	2		1	2		2	1		1	2		12
Chapter 3	2	1		1	2		2	1		1	2		12
Chapter 4	4	1		3	1	1	3	2			3	1	19
Chapter 5	5	1	1	2	5		4	3		1	4	1	27
Total	14	7	1	9	11	1	12	9		4	12	2	82

Source: Field survey, 2019.

6. DISCUSSION

From the analysis of the above results, we can see that the knowledge presentation part of the textbook supports the ten aspects of the implementation of mathematical calculation literacy, and there is no support for level 3 in knowledge and skill, and level 3 in thinking and expression. Among them, the degree of support for level 1 of knowledge and skill is the best, the degree of support for level 1 of thinking and expression is better, and the degree of support for level 3 of situation and problem and level 3 of communication and reflection are weak.

The proposition derivation part of the textbook supports 11 aspects of the implementation of mathematical calculation literacy. It does not support level 3 in thinking and expression. Among them, it supports level 1 in situation and problem. Level 2 of the two aspects have better support, and level 3 of situation and problem and level 3 of Knowledge and skill are weak.

7. CONCLUSION

In summary, the knowledge of the textbook has comprehensive support for mathematical calculation literacy, but the number of support points is small. The support is generally concentrated on level one, followed by level two, and fewer on level three. Therefore, the support for mathematical literacy in the knowledge of the textbook needs to be improved. In my opinion, teachers should fully dig up the textbooks in teaching and make reasonable use of the knowledge of the textbooks.

REFERENCES

Chen, Y. J. (2016). Examples on the cultivation of core literacy of senior high school mathematics-from the dimension of Mathematical operations in classroom teaching. *Mathematics Bulletin*, *55*(8), 34-36.

Cheng, C. (2018). The Implementation of core literacy in senior middle school mathematics teaching with deep teaching. *Curriculum Education Research, 9*(39), 137-138.

Dong, W. L. (2019). On the implementation of core literacy in middle school mathematics teaching. *Ningxia Education, 39*(02), 38-39.

Huang, C. Y. (2017). Exploring how to implement core literacy cultivation in mathematics classroom teaching. *Contemporary Course of Teaching and Research, 5*(12), 59-62.

Jin, J. X. (2018). Attach importance to teaching with questions and implement core literacy——thinking caused by the "reading comprehension" question type of junior middle school mathematics. *Communication in Mathematics Teaching, 40*(32), 29-30.

Lai, L. Y. (2019). Thoughts on the core literacy of Mathematical operations. *Middle School Mathematics, 39*(21), 6- 7.

Li, X. J., & Kuang, Y. (2018). Make abacus a tool to implement the core literacy of mathematics——taking "knowledge of numbers within ten thousand" as an example. *Primary School Mathematics Teacher, 41*(09), 24-27.

Li, H. Y. (2018). Thinking about the implementation of core literacy in high school mathematics textbooks. *Mathematics Learning and Research, 36*(14), 104.

Lv, Y. A., & Dong, T. (2019). Problem-solving analysis and teaching suggestions based on mathematical literacy. *Fujian Basic Education Research, 11*(11), 61-63.

Wang, L. N. (2018). Some thoughts on the implementation of core literacy in junior middle school Mathematics teaching materials. *Mathematics Learning and Research, 36*(16), 106.

Xu, J. X. (2019). Teaching strategies to improve Mathematics competence of high school students. *Middle School Mathematics, 21*(39), 76-77.

Yao, D. (2019). High school mathematics core literacy: From understanding to landing. *Communication in Mathematics Teaching, 41*(33), 50-51.

Zhou, Y. F., & Feng, D. Y. (2018). Optimizing the textbook training system and implementing the core literacy of mathematics——taking revised "number series" unit of the mathematics textbook for senior middle school as an example. *Mathematics Education in China, 16*(22), 3-10.