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The studies on middle school mathematical evaluation based on core literacy in China

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Abstract
Core literacy has gradually become a key research topic in the field of education since its introduction in 2012. From the end of 2017, core literacy evaluation has been the focus of research in core literacy. Along with the development of this topic, a series of related studies have emerged. These studies not only promote the development of mathematical assessment based on core literacy, but also provide many practical and valuable reform measures for mathematical assessment. Thus, this paper sorts out the existing researches and summarizes the viewpoints, so as to point out the direction for further research in the future.

Keywords: mathematical core literacy, mathematical evaluation, evaluation index, evaluation method

1. Introduction
In 2016, the research results of "The development of Chinese students' core literacy" were officially released, and core literacy was defined as "Essential character and key competencies for lifelong development and social development". Core literacy has become a hot research topic, and most researchers focus on the cultivation of students' core literacy in teaching practice. The 2017 High school Mathematics Curriculum Standards propose three ways to develop students' core literacy—the curriculum reform, teaching practice, and educational evaluation framework. Mathematics evaluation based on core literacy after the introduction of the Standard has received wide attention. It is generally believed that the evaluation of students' core literacy not only can promote the development of students' core literacy, but also can feedback the effectiveness of mathematical core literacy training. Therefore, a number of related academic studies have emerged. These academic studies have undoubtedly greatly promoted the development of assessment and further promoted the cultivation of students' core literacy. In order to absorb useful experience and clear research vacancies from these studies, let us further advance the research. This paper intends to sort out the existing research and summarize the viewpoints.

2. Insufficient assessment
2.1 Test Index
Chen Kun believes that according to the propositional rules of the middle school examination questions in Beijing and Shanghai for the past five years, based on the core literacy content, China attaches great importance to the investigation of basic knowledge and basic abilities. There are few investigations on problem solving and disciplinary thinking. Although it has shown an upward trend, it has not investigated the innovative thinking and practical ability. These are all reflected that China's mathematics evaluation has not yet made a timely turn, the evaluation system needs corresponding supporting reform in the core literacy training (Chen, K., 2007) [1].
Kong Fanzhe believes that core literacy is a must-have character for students' lifelong development and social development needs. It should be evaluated in the evaluation. Based on this, it is pointed out that due to the wide application of mathematics, we pay too much attention to the cognitive field in the evaluation. However, the cognition of the field of affection and personality is relatively unfamiliar. Although it also pays attention to the application of knowledge and skills, it pays little attention to the application between the subject with less application and the application of knowledge and skills in reality (Kong, F. Z., 2017) [2].

2.2 Test Content
According to the framework of mathematical literacy analysis model of core literacy construction, Chen Kun analyzes the test questions of The Academic Test for the Junior High School Students in China. He believes that China's four content areas in the middle school test questions are distributed unevenly. Test questions tend to examine changes and relationships and spaces and shapes. But statistics and analysis are not taken seriously. They rarely involve the application of content awareness and innovation awareness (Chen, K., 2007) [1].
Yu Chunmei believes that from the literacy of middle school students, Mathematics test in China pays more attention to the cultivation and evaluation of students' ability to solve problems, and neglects the cultivation of the ability to ask questions. Yu Chunmei emphasized that the evaluation of mathematics' ability to ask questions can reflect students' understanding and mastery of mathematics knowledge (Yu, C. M., 2017) [3].

2.3 Test Method
According to the framework of mathematical core literacy analysis model, Chen Kun pointed out that the evaluation

method of China's test questions is a “one size fits all” score quantification. This test method ignores many difficult evaluation aspects. In the context of the test questions, China's test questions present a large number of academic situations and mathematical symbolic operations without contextual questions. The situation in which the problem depends is abstracted and distant from the actual life of the students. It is presented to students in a single form, single-minded, unique answer, and structurally complete form. It examines students' memory ability, formula application, and computing ability. It is difficult to combine students' knowledge with real-life situations (Chen, K., 2007) [1].

According to the evaluation of the core literacy of mathematics in China, Kong Fanzhe believes that it is difficult to measure the difference in the use of knowledge-based results evaluation (such as the usual written test).In short, core literacy is a comprehensive ability to discover problems, ask questions, and solve them with mathematical consciousness (Kong, F.Z., 2017) [2].

3. Evaluation improvement suggestions and measures

3.1 Test Index

Hu Fengjuan, Bao Jiguang, Ren Zichao and Chen Ang believe that the evaluation of mathematical core literacy should be based on the content of mathematical core literacy. So the evaluative indicators should include mathematical abstraction, logical reasoning, mathematical modeling, visual imagination, mathematical operations and mathematical analysis. It is also an evaluation indicator established by most researchers (Hu, F. J. & Bao, J. G. & Ren, Z. C. & Chen, A., 2017) [4].

Chen Liuyi and Liu Xiaoping believe that according to part of the PISA mathematical literacy test and China's national conditions, in order to better examine the core literacy of students in propositional orientation, it is necessary to emphasize the examination of advanced cognitive abilities such as critical thinking, inquiry, problem solving, and practice innovation, as well as emotional attitudes, value orientation, self-management, and responsibility of non-cognitive factors. Therefore, the primary indicators of primary school mathematics core literacy should be: mathematics humanities, mathematics consciousness and mathematics thinking (Chen, L. Y. & Liu, X. P., 2017) [5].

Zhu Yamei, Liu Wei and Chen Linshan analyze the six core literacy of mathematics and the role of mathematical core literacy in mathematics. They think the core literacy indicators of mathematics can be divided into mathematical research objects, methods of operation in mathematics, and the use of mathematical tools. This division has established a unified structure covering the above six core elements, so that their respective meanings and roles are emphasized (Zhu, Y. M. & Liu, W. & Chen, L. S. 2018) [6].

Weng Yanping specializes in the evaluation of mathematical literacy intuitive imagination core literacy. She thought the three-dimensional visual imagination literacy level evaluation framework can be defined as: building visual imagination literacy framework from the content, structure, process three dimensions. Each of these dimensions has its own secondary indicators. The secondary indicators of the content dimension are: vector and its application, stereo geometry preliminary and plane analytic geometry. The components of intuitive imagination are the structural dimensions. Its secondary indicators are: understanding schema, application schema, expression communication. The process dimension is the horizontal division of visual imagination (Weng, Y. P., 2017) [7].

3.2 Test Content

Hu Fengjuan, Bao Jiguang, Ren Zichao and Chen Ang believe that the content of the investigation should focus on the knowledge system, the students' understanding and application of important mathematical concepts, theorems, ideas and methods, the nature of mathematics and generality, and diluting problem-solving skills (Hu, F. J. & Bao, J. G. & Ren, Z. C. & Chen, A., 2017) [4].

Hu Dianshun, Lei Peiyao and Liu Ting believe that the content of mathematics questions based on core literacy is not only the content of a certain part of Mathematics subject, but the synthesis of multiple contents, such as geometry, algebra, statistics, etc. Students need to translate real-world information into mathematical problems, establish mathematical representations, use mathematical concepts, steps, and mathematical inference to obtain mathematical conclusions and explain mathematical conclusions. Mathematical core literacy assessment questions should describe a real problem situation in words, data or diagrams (Hu, D. S. & Lei, P. Y. & Liu, T., 2017) [8].

3.3 Evaluation Presentation

Chen Kun believes that the presentation of the test questions should be constitutional. The test questions should be taken to examine students' ability to quickly extract and transform their internal qualities into corresponding abilities. To help students achieve the integration of learning, life and practice in three major situations, so that students can live a more rational life after leaving the campus (Chen, K., 2007) [1].

Hu Fengjuan, Bao Jiguang, Ren Zichao and Chen Ang believe that the situation presented by the topic should be reasonable, in line with the actual situation of real life, mathematics and scientific situations, and cannot be fabricated (Hu, F. J. & Bao, J. G. & Ren, Z.C. & Chen, A., 2017) [4].

3.4 Evaluation Method

Chen Kun believes that at present, China's mathematics academic level examination mainly adopts the paper-and-pencil test method, which takes the quantification of scores as the standard, but the test questions have great limitations on students' ability to innovate, practice, and examine the values of emotional attitudes. Therefore, it is necessary to enrich the methods of mathematical evaluation. The evaluation changes from simplification to mufti-dimensional and hierarchical, combines quantitative evaluation with qualitative evaluation, integrates the advantages of various evaluation methods, incorporates the ability of students to use tools interactively, and adopts performance evaluation (Chen, K., 2007) [1].

Zheng Qiongliang believes that although everyone advocates a variety of evaluation methods, paper and pencil testing is still the mainstream. Then we need to optimize the pen and paper test.: First, the test questions have a real situation, which reflects the problem solving. Only true situations, especially the real situation close to the actual life of students, students

have the interest and enthusiasm to think, analyze and solve problems. It is also possible for us to find clues in the student's problem solution that reflect the core literacy of the students. Second, the diversification of solutions can reflect the level of cognition, level of thinking and level of literacy. Therefore, more attention is paid to the value issues behind the questions, as well as the diversity and guidance of the test questions. The test questions allow different levels of students to have different performances, fully reflecting the students' level of thinking and literacy level (Zheng, Q. L., 2018) [9].

Hu Fengjuan, Bao Jiguang, Ren Zichao and Chen Ang believe that the evaluation form of the core literacy thinking process of mathematics can be diversified. In addition to the traditional paper and pencil test, it can also be used in the form of classroom observation, oral test, and performance in open activities. In the test process of the paper-and-pencil test form, especially when testing the students' thinking quality, they can give students enough time to think, reduce the number of test questions or extend the test time. In addition, students should be allowed to use a calculator in order to examine students' innovative awareness and thinking processes (Hu, F. J. & Bao, J. G. & Ren, Z. C. & Chen, A., 2017) [4].

Zhang Junzhen proposed to actively explore the evaluation methods of mathematical literacy, and explore the detection methods from the aspects of student learning process, homework design, paper-and-pencil test, and practical investigation (Zhang, J. Z., 2016) [10].

3.5 Processing of Scores

Hu Fengjuan, Bao Jiguang, Ren Zichao and Chen Ang believe that for open-ended test questions, the consistency of thinking and conclusion is an important principle of evaluation. As long as the students' thinking and conclusions are consistent, the results of the answer should be judged as correct, and should not be constrained to specific problem-solving methods and conclusions, which can encourage candidates to think and solve problems from multiple perspectives. If the candidate is more deeply analyzed, the conclusions obtained are more accurate, and the teacher can add points to the limit of the test paper (Hu, F. J. & Bao, J. G. & Ren, Z. C. & Chen, A., 2017) [4].

Hu Dianshun, Lei Peiyao and Liu Ting believe that researchers can establish a descriptive test score scale for test results to distinguish different levels of topic characteristics and students' performance characteristics. The teacher can also link the scores of the questions to the student's ability level, so that each question can reflect which level the student's corresponding ability is at. Based on this, the teacher then conducts a detailed analysis of the established cognitive requirements of the test questions, so as to understand what the student's scores can and cannot do (Hu, D. S. & Lei, P. Y. & Liu, T., 2017) [8].

Xu Binyan and Cai Jinfa believe that in the mathematical communication of the core literacy of mathematics, the quantitative overall scoring method and the qualitative analysis scoring method can be integrated to make a reasonable and comprehensive evaluation of the mathematical communication literacy. The quantitative overall scoring method not only measures the correctness of the answer, but also tests the solution process, including mathematical communication, solution strategies, and mathematical errors. The qualitative analysis scoring method is carried out from two perspectives: the quality of communication and the characterization of communication. The quality of communication includes the correctness and clarity of communication. The characterization of communication includes the mathematical communication patterns students use to find answers (Xu, B. Y. & Cai, J. F., 2017) [11].

Zheng Qiongliang believes that in the scoring of subjective questions: on the one hand, the reviewers should abandon the simple answer of the standard answer, but should squat down and think about mathematics in the eyes of students, allowing students to think diversely and enrich the diversity of answers. On the other hand, as a reviewer, you can't use the established reference answer as an absolute standard. You should respect the students' ideas, allow students to have multiple expressions, and allow students to have different unique thinking. For the answers that are outside but reasonable, they should be fully affirmed and encouraged to cultivate students' sense of different thinking and innovation, form courage to innovate, be willing to show, and boldly express the quality of learning that has already been seen (Zheng, Q. L., 2018) [9].

3.6 Evaluation Function

Chen Liuyi and Liu Xiaoping believe that the function of the core literacy evaluation is to promote the active and natural use of mathematical symbolic language, natural language, and choose the appropriate language description problem for different problems. Let students gradually learn to use mathematics to reason (Chen, L. Y. & Liu, X. P., 2017) [12].

Sun Xiangyu believes that according to the different performances of students in the evaluation process, the performance of students of different grades is different. Behind the performance are their differences in the areas of knowledge, skills, strategies, and attitudes. However, students of the same level have commonalities in their studies and can be guided. Therefore, the purpose and function of the assessment are to find out the common problems of the students and the individual problems of each student, so that students can get targeted feedback (Sun, X. Y., 2018) [13].

Chen Kun believes that the traditional mathematics evaluation pays too much attention to the status of fragmented knowledge and standard answers. It has great disadvantages for students' innovation ability, practical ability and the cultivation of emotional attitudes and values. Therefore, he advocates the core literacy assessment of mathematics through multiple angles, so that students' thinking truly undergoes the process of mathematics, expands the space of thinking, and consciously trains students to use mathematical concepts, principles, and methods to explain phenomena in the real world and solve problems in the real world (Chen, K., 2007) [1].

Zhang Junzhen believes that mathematical evaluation should play its guiding role, and it is necessary to form a stepwise, three-dimensional, multi-faceted mathematical literacy effective connection evaluation system. Therefore, teachers

can propose constructive learning suggestions for students' individualized learning based on the test results (Zhang, J. Z., 2016) [10].

4. Comment on Current Studies

In summary, it can be seen that the research on mathematical evaluation based on core literacy mainly focuses on the current lack of the evaluation of students' core literacy and the improvement measures of mathematical evaluation based on core literacy.For the current lack of the evaluation of students' core literacy, everyone's research and conclusions have reached certain unity, mainly focused on the indicators, content and methods of evaluation. Test indicators and content are too focused on examining students' basic knowledge of mathematics and basic skills, while ignoring the evaluation of the cognitive and value areas of team students. The paper-and-pencil test and the score quantification method, which have been used in the test method, are roughly classified into students and do not pay attention to the comprehensive development of students' core literacy. For the recommendations and improvement measures of mathematical evaluation based on core literacy, the predecessors' research is more comprehensive, from the indicators, content and methods of evaluation to the presentation of evaluation, scoring standards and functions. It not only analyzes the indicators and contents of the evaluation from different angles, but also innovates the evaluation methods and tools. It also puts forward different suggestions in the test scores. These measures are both reasonable and practical.

However, it can be seen from the above analysis that some studies are not deep enough. There are two prominent problems: First, there are relatively few mathematical evaluations based on core literacy. Research on core literacy has only begun in recent years. Many educators and front-line teachers have focused on the cultivation of them, but have ignored their evaluation. This article collects relevant literature and tries to sort out the outline of China's core evaluation of core literacy. According to the “Core Literacy” and “Mathematical Assessment”, the search was conducted on the knowledge network. As of October 30, 2016, there were only 44 articles, and only 14 of them were closely related. It can be seen that our current mathematical evaluation of core literacy is not extensive enough. In these 14 articles, the author finds that most of these articles are theoretical discussions. Many researchers start with the concept of core literacy and put forward their own opinions and suggestions. This is understandable. However, the lack of practical verification of the article and the lack of exploration of the current level of primary and secondary school students make the mathematical evaluation of core literacy too strong. Only through profound inquiry and rigorous verification can we guide the advancement of the theory and make the core literacy light up the road ahead, and promote the comprehensive and profound development of the students. As Sun Siyu said, “The goal of education reform is to clarify the background purpose and significance of core literacy and core literacy of the discipline, so as to correctly guide practice”.

Second, in terms of evaluation indicators, since the curriculum standards have proposed six core literacy of mathematics, researchers have little disagreement in the general direction of evaluation indicators, which are basically defined as mathematical abstraction, logical reasoning, mathematical modeling, visual imagination, mathematical operations and mathematical analysis. But what are the indicators for each of these six items that are specifically implemented in the assessment? What are the priorities for these primary and secondary indicators? How many levels of indicators are refined? This is a place where educators have great differences, and it is also a practice point and a difficulty in the real assessment. In other words, the mathematical assessment based on core literacy is too empty and insufficient.

It can be seen that in the future research, we need to increase the evaluation and practice of the core literacy of mathematics and the specificity and practice of the evaluation. Only in this way can we monitor the core literacy of students from different angles of the country, society and individuals, thus promoting the development of students' core literacy.

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