

Research Article

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Research on Higher Order Thinking in Primary School Mathematics

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Abstract: With the development of society and the deepening of education, higher-order thinking is becoming a hot key word of The Times, which is crucial to the overall and healthy development of students. At present, the research on higher order thinking in primary school mathematics is mostly in the exploratory stage, and there are many problems such as single research perspective, low implementability and low universality. In the future, relevant research should be carried out in a more comprehensive, open and in-depth manner to promote the comprehensive development of students.

Key words: Primary school mathematics; Higher order thinking; The research reviewed.

1. INTRODUCTION:

As the society has put forward higher requirements on people's comprehensive quality and innovation ability, a large range of investigation and research on higher order thinking has emerged in China. The continuous introduction of relevant policies reflects China's attention to the cultivation of students' higher-order thinking, but also sends a signal to all educators that education reform needs to pay attention to the comprehensive development of students. Taking "higher-order thinking" as the search term, we conducted an advanced search on CNKI, and found that there were 1193 related articles about higher-order thinking published from 2018 to January 2022. Related studies started late and the number of relevant literature was small. It started in 2018, surged in 2019 and 2020, and reached a peak in 2020. But mathematics accounts for only 1% of all higher-order thinking literature, averaging about 20 per year. However, if we focus on the primary school stage and take "higher-order thinking" and "primary school mathematics" as the keywords, we can search CNKI and find that there are only 220 relevant literatures, all of which were published no earlier than 2016, which is relatively close to now. Therefore, it can be seen that the research status of higher order thinking in primary school mathematics is not optimistic, and educators must pay attention to it. Based on the above situation, the author focuses on primary school mathematics and takes "higher-order thinking" as the entry point to collect and sort out relevant research results. The review is as follows:

2. The Current Situation on Cultivation of Advanced Thinking in Primary School Mathematics

The SKILLS for the 21st Century Program was launched in 2002 to better help the U.S. education system meet the challenges of The Times, with a special focus on developing students' creativity, critical thinking and problem solving skills. The National Curriculum Framework document issued by the British Ministry of Education in 2014 also requires students to "apply mathematical knowledge to conventional and unconventional problem solving with increasing difficulty", and proposes to promote the cultivation of students' higher-order mathematical thinking ability. Singapore's "Ideal Education Outcomes", released in 2009, also includes four higher-order thinking skills, namely "reasoning and decision-making", "reflective thinking", "curiosity and creativity" and "the ability to deal with complex and fuzzy problems". It can be seen that higher-order thinking ability is a hot spot in international education research at present, and countries all over the world attach great importance to the cultivation of higher-order thinking ability.

However, although the degree of attention is high, the cultivation of mathematics advanced thinking of primary school students is constantly on the decline. With "Advanced Thinking in Primary School Mathematics" and "cultivation status" as the search terms, we conducted an advanced search on CNQI and found only 14 relevant literatures. The

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number of relevant literatures is small, and the earliest one was published in 2018, which is relatively close to now. Most of the literature pointed out that the current high order mathematical thinking ability of primary school students is low and the cultivation status is not optimistic. In 2018, the earliest Wu Hong from higher-order thinking "and" close at the heart of the word "deep learning" to carry on the back, in the profound analysis the depth of the elementary school mathematics learning, on the basis of the research status, through data collection and processing, embarks from the elementary school mathematics teaching practice, this paper discusses the current situation of the depth of the elementary school mathematics teaching, finally it is concluded that the depth of the elementary school mathematics teaching level is not high. We should enhance the level of cultivation on the basis of relevant theories "(2018). It also laid a solid foundation for the research of higher order thinking in primary school mathematics in the later stage. Since then, Liu Hui using literature method, questionnaire survey method, interview method, classroom observation, the Ordos city informatization elementary school mathematics teaching and the present situation of the development of higher-order thinking depth fusion, pointed out that "the information technology teaching in training high order thinking less of the application of" is the elementary school mathematics higher-order thinking a major reasons of the status quo is not optimistic; On this basis, Liu Hui for the first time put forward the new concept of deep integration of information teaching and the cultivation of advanced thinking in primary mathematics(2019). In addition, cable wisdom is also found in a related field at present primary school mathematics high-order thinking ability is low, its cultivation by less than, the main reason is lack of core mathematics accomplishment of orientation, lack of challenging activities for students to experience, it is difficult to construct rich and associated information classroom teaching environment, lack of high quality problems, reflection is difficult to touch the soul, and so on(2020). Shang Xuan distant is the "questionnaire before the sampling measurement to higher-order thinking ability and thinking strategies counselling to test evaluation after" the path of the mainly explores the sixth grade students of higher order thinking ability cultivation of the status quo, it is concluded that primary school students in mathematics associated with similar problems and return to the topic of high-order thinking ability is relatively low, and in the mathematical thinking is to solve the problem of concrete transition from lower order to higher order. There is no gender difference in the development of pupils' mathematical thinking ability but their reasoning and reverse thinking ability need to be strengthened.

In a word, the current situation of the cultivation of higher-order thinking in primary school mathematics is not optimistic. Related researches are few and not deep enough. In addition, they focus on theoretical research and lack of connection with specific teaching practice. Therefore, relevant practical research needs to be developed.

3. The Cultivation Value of Higher Order Thinking in Primary School Mathematics

"Higher-order thinking in Primary School Mathematics" and "value" are the key words. Only 40 relevant literatures can be found in an advanced search on CNKI. The number of literatures is small, and the earliest one was published in 2018, which is relatively close to now. It can be found from the study of relevant literature that most of the discussions on the cultivation value of higher-order thinking in primary school mathematics are found in the literature of cultivation strategies mentioned below. Therefore, it can be seen that exploring the cultivation value of higher-order thinking in primary school mathematics is a key part of exploring related cultivation strategies. Most scholars believe that higher order thinking in primary school mathematics plays an important role in promoting both the comprehensive development of students and the educational reform. Yao Xiaoqin pointed out that with the current mathematics teaching from the "knowledge" era to the "core literacy" era, teachers should take students' thinking as the breakthrough point, through promoting the visualization, structuralization and mathematics of students' thinking to promote the improvement of students' mathematical core literacy and higher-order thinking ability (2018). Wang Jinzhu did not directly mention the core word "higher-order thinking" in his article "Research on In-depth Teaching Strategies of Primary School Mathematics from the Perspective of Core Literacy", but adopted a relatively similar concept -- "deep learning". She pointed out that in the face of the current predicament of the teaching content of primary school mathematics education is too simple and compact, and the teaching mode is specialized, teachers must transform their thinking and promote the depth of teaching content, teaching mode and students' thinking mode, and the last part of the above three is corresponding to the concept of "higher-order thinking" (2020). In addition, Guo Zhanwen pointed out that the cultivation of higher-order thinking in primary school mathematics can not only effectively improve students' ability to master mathematical knowledge and flexible application ability, but also keep pace with The Times of education reform. From the perspective of "the educational value of mathematics", Pu Dayong discusses the value of the rational spirit, scientific spirit and innovative ability manifested by higher order mathematics thinking to the development of primary school students(2021).

Generally speaking, the number of relevant studies on the cultivation value of higher-order thinking in primary school mathematics.

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4. The Cultivating Strategies of Higher Order Thinking in Primary School Mathematics

Taking "advanced thinking in primary mathematics" and "cultivation strategy" as the key words, an advanced search on CNKI found about 150 relevant literatures. It can be seen that most of the literatures related to advanced thinking in primary mathematics focus on their cultivation strategies, and the strategies tend to be diversified due to different cultivation angles. Wang Yu was the first to suggest the cultivation of pupils' higher-order thinking ability in mathematics: primary school mathematics classroom teaching should be designed based on effective questions to make students learn to think, doubt and solve real problems, so as to improve their higher-order thinking ability. On the basis of analyzing the characteristics of higher-order thinking(2019), Ding Jing proposed that the cultivation strategy of higher-order thinking of primary school students in mathematics can be optimized by optimizing teaching methods, using mathematical modeling, designing flipped teaching, creating student groups and other strategies (2020). Zhang Yingyu advocated that primary school mathematics teachers should reduce the polarization of class students through the hierarchical teaching of mathematics advanced thinking(2021). On the basis of analyzing the students' cognition, Zheng Lianjuan first proposed the cultivation mode of contextualized higher-order thinking(2021). Wang Jinzhu, combining with the hot topics of The Times, proposed the cultivation strategies of primary school students' higher-order thinking ability in mathematics from the perspective of core literacy: digging deeply into textbooks and understanding basic principles of mathematics; Build a real situation, learn to solve mathematical problems; Pay attention to the study of critical thinking, cultivate higher order thinking ability. Only in this way, students can maximize the core quality of mathematics and higher-order thinking ability, understand the connotation of mathematics more deeply, and experience the real charm of mathematical language(2020). In addition, some scholars explored strategies based on specific primary school mathematics teaching cases: Chen Meiging gave a more maneuverable training strategy based on the concept of "student-based classroom" and took the "trapezoidal area" lesson as an example(2020). Nong Meiying, for example, pointed out that "students' thinking should evolve from a single-point structure to a multi-point structure, so as to improve their higher-order mathematical thinking."(2021)Ju Xiaofang from "the application of a variety of methods, highlighting the students' dominant position: Carry out inquiry activities to cultivate students' analytical ability: Construct a complete framework to cultivate students' comprehensive ability; Optimize teaching design and cultivate students' innovation ability; Pay attention to students' evaluation and cultivate students' evaluation ability(2022). Later, kuang Yan, Li Na and other scholars put forward the cultivation strategies of primary school students' higher-order mathematical thinking ability based on the previous studies and more specific mathematical teaching cases.

In brief, there are only a few studies on the cultivation strategies of higher-order thinking ability in primary school mathematics at present, and they are in the stage of continuous improvement, which needs to be further deepened and strengthened with specific primary school mathematics teaching practice.

5. CONCLUSION:

Existing research literature, the author integrated the related study of elementary school mathematics higher-order thinking to make the following assessment:

First of all, on the research Angle of view, the existing research unilaterally to discuss the cultivation of the students of higher order thinking ability, is not associated with the specific subject teaching, and teaching practice from lead to cultivate strategies can not get effective implementation and results of the inspection. Secondly, in terms of research methods, the existing researches are mostly theoretical ones, while the practical ones need to be developed. For example, based on the analysis of existing cases and data in China, there are few in-depth studies through experiments or field investigations, resulting in the lack of effective data support for relevant domestic studies, and unable to put forward effective suggestions for the comprehensive cultivation of Chinese primary school students' higher-order mathematical thinking. Thirdly, in terms of research objects, existing studies are mostly limited to a certain primary school, and the results are not universal enough.

Finally, in terms of the research conclusion, there are few feasible strategies to promote the improvement of pupils' higher-order thinking ability, and the practicality of the strategies needs to be strengthened.

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