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Research on Mathematics Expression Ability among Chinese High School Students

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

Mathematics expression ability is of great significance to the development of students' logical thinking. It is an essential ability required in the new mathematics curriculum standards, and it is also the focus of the current high school entrance examination and National College Entrance examination. This study used the China National Knowledge Internet (CNKI) as a data source to summarize and sort out previous research in order to provide suggestions for current teaching and found that: (1) Current domestic research on mathematics expression ability of high school students mainly focuses on the following five aspects: connotations and classification of mathematics expression ability, development status of mathematics expression ability, evaluation frameworks of mathematics expression ability, strategies for cultivating students' mathematics expression ability, and the mathematics expression ability of special groups of students. (2) There is relatively little research on the evaluation frameworks and influencing factors of mathematics expression ability, and most training strategies focus on how teachers teach, with very few on how students learn. Previous researchers use self-made test papers, questionnaires or interview outlines to investigate and research, and some researchers base their research on theoretical thinking or teaching experience. (3) Therefore, based on current research, future research needs to adopt more scientific research tools, a more reasonable analysis framework, expand the research scope,

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increase validation research, and give more scientific suggestions. So that the research on the mathematics expression ability of high school students is more comprehensive, systematic, and profound.

Keywords: Mathematics expression ability; high school; students; mathematics education.

1. INTRODUCTION

The implementation of the Mathematics Curriculum Standards for Senior High School (2017) has clarified the specific requirements for Mathematical Expression in the level division of six key competencies: thinking and expression, communication, and reflection, reflecting the important content of mathematical key competencies [1]. The Mathematics Curriculum Standards for Compulsory Education (2022) also specifies the key competencies of the compulsory education stage, one of which is being able to express the real world in mathematical language' [2]. Based on the requirements of the mathematics curriculum standards, mathematics expression ability is also a key focus of the examination [3]. Therefore, mathematics expression ability is significant for current high school students. So far, there are more and more studies on mathematics expression ability, but there is no content to analyze and evaluate them. To find out the current situations, deficiencies, and gaps in this direction, the author analyzes the previous relevant research and tries to provide experiences and references for the subsequent research and improvement of high school students' mathematics expression ability level, to promote the continuous development and deepening of this direction.

The main research questions in this paper are as follows:(1) What are the main aspects of the current research on mathematics expression ability in high school, and what are the results of each aspect? (2) What are the deficiencies and gaps in the current research on mathematics expression ability in high school?

2. METHODS

2.1 Data Source

This paper adopts the method of literary analysis and takes the literature in the database of CNKI as the data source. CNKI provides a multidisciplinary database and is a powerful retrieval tool. It contains a wealth of documents and has a great academic impact. Therefore, it is selected to ensure the reliability and persuasiveness of the research.

2.2 Data Collection

To avoid literature omission, both direct retrieval and reference guidance method were used. The Literature from 2008 to the present is selected, and the source of journal literature is academic journals. Firstly, the author searched with mathematics expression ability and 372 results were retrieved. After reading through and screening, 28 pieces of literature were selected. Then, 2 articles were selected from the references of literature in the process of data compilation. Finally, a total of 20 results were referenced, read, and analyzed.

2.3 Data Collation

Firstly, the above literature is sorted, numbered and read in detail, and then the research content, research results and research methods mentioned therein are recorded. Finally, the results are counted and summarized.

3. RESULTS

After sorting and analyzing the previous studies, it is found that the current domestic research on mathematics expression ability of high school students mainly focuses on the following five aspects: connotations and classification of mathematics expression ability, development status of mathematics expression ability, evaluation frameworks of mathematics expression ability, strategies for cultivating students' mathematics expression ability, and the mathematics expression ability of special groups of students. The results of each aspect are discussed below.

3.1 Connotations and Classification of Mathematics Expression Ability

With the advancement of the research on mathematics expression ability, researchers have interpreted and classified mathematics expression ability from different perspectives, and their main viewpoints are as follows.

Liang, Zhou, and others believe that mathematics expression ability is that learners can use mathematics language to write mathematics problems (that is, 'writing mathematics') and discuss mathematical problems in the form of oral expression (that is, 'discussing mathematics') in the process of learning mathematics. The former is written expression ability and the latter is oral expression ability [4-7]. Leng thinks that the expressive ability of mathematical language is to internalize mathematical knowledge and then express them in both oral and written forms[8].Wang proposes that the specific meaning of mathematics expression ability is that students can properly use mathematical professional vocabulary, symbols, and graphics, and accurately explain their understanding and thinking process orally and in writing [9]. Zhao believes that mathematical language expression ability refers to the ability to use mathematical language to express one's views, opinions, thoughts, and emotions on thinking problems, which is the best embodiment and reflection of mathematical subject ability. And it includes several forms such as oral expression ability, written expression ability, symbol expression ability, and graphic expression ability [10].

The above researchers divided mathematics expression ability into oral expression ability and written expression ability in terms of formal distinction. In addition, Zhao further added symbolic expression ability and graphical expression ability.

Zuo believes that mathematics expression ability refers to the ability of students to use mathematical language in the process of learning mathematics or real life to accurately explain and express mathematical problems [11]. Rao and Gu's definition of mathematics expression ability is students' ability to use appropriate mathematical language to understand mathematical objects and to accurately, rigorously, and clearly express the process of solving mathematical problems [12,13]. Dong believes that mathematics expression ability refers to the thinking process that students can correctly express problem-solving information in mathematical language when they read mathematical problems, especially in geometry teaching [14]. Wen suggests that mathematics expression ability is the ability to use mathematical language. From the expression process of mathematical language, he divides mathematics expression ability into reading ability, transformation ability, and application ability of mathematical language [15]. Gu and Li believe that from the content expressed, mathematical language expression ability can be understood as the ability to express knowledge and skills, the ability to express mathematical logic, the ability to express processes and results, and the ability to express emotions and attitudes [13,16].

Previous researchers had two main definitions of mathematics expression ability. One was to introduce mathematical oral expression ability and written expression ability respectively; Another definition is the regulation of details such as the thinking process, mathematical language, and ability goals in mathematical expression. The classification of mathematics expression ability is mainly based on three perspectives: expression forms, expression processes, and expression contents.

3.2 Development Status of Mathematics Expression Ability

Concerning the development status of the mathematics expression ability of high school students, previous researchers mainly collected data through questionnaire surveys, tests, and interviews, and then analyzed the data to conclude. The previous research conclusions mainly focus on two levels: the current situation of students' mathematics expression ability and the current situation of the cultivation of mathematics expression ability.

3.2.1 Current situation of students' mathematics expression ability

Previous researchers generally believed that the overall mathematics expression ability of middle school students was at a moderate or even lower level. Many researchers have also conducted more targeted research, analyzing the status of high school students' mathematics expression ability and various deficiencies from different research perspectives. The specific conclusions are as follows.

Previous researchers generally believe that the mathematics expression ability of high school students was at a moderate or even lower level. Many researchers have also carried out more targeted research. They start from different research angles and analyze the situation of high school students' mathematics expression ability and their deficiencies in various aspects. The specific conclusions are as follows.

From the perspective of the learner, Huang, Tian, and Zhong point out that high school students are more casual in writing, non-standardized in expression, non-rigorous in thinking, and inflexible in conversion in mathematical expression [17]. Cao and Zai believe that students do not pay enough attention to mathematical expression, lack self-confidence and good habits in mathematical expression, and are unwilling to actively express themselves [18,19].

From the perspective of the expression of different mathematics languages, Zai reports that there is a lack of logic in the expression process of mathematical oral language; In the process of mathematical language expression, the writing is not standardized, and details are omitted; Misuse of symbols often occurs in the expression process of mathematical symbolic language; There are problems in reading image information and drawing in mathematical graphical language expression [18]. Leng believes that it is difficult for students to use symbolic language to express solid geometry [8].

From the perspective of the expression process of mathematics language expression, Zhang, Wen, Wang, and Wang analyze the current situation of high school students' mathematics expression ability in different ways.

Zhang finds that five types of mathematics language learning obstacles exist in senior high school students' learning process, namely mathematics language recognition obstacles, conversion obstacles, comprehension obstacles, construction obstacles, and organizational expression obstacles. Among them, conversion obstacles and organizational expression obstacles are more prominent [20]. Wen believes that high school students have poor mathematical language acceptance, transformation, mutual translation, and application abilities [15]. Wang finds through testing and investigation that students perform poorly in the construction, transformation, and execution stages of mathematics language expression [9]. Wang Jing's research shows that at least one of the three sub-abilities of mathematics expression ability is at an average level, and there is a lack of depth in mathematics language understanding. Students' mathematical language translation ability performs well, and the accuracy and conciseness of their mathematical expressions need to be improved [21].

Regarding the differences between urban and rural areas, Rao finds that the gap between urban and rural students is larger in both the overall situation and in each of the sub-dimensions, with the overall situation in urban areas being better than that in rural areas [12].

Regarding gender differences, Rao concludes that there is no significant gender difference in the level of mathematics expression [12]. Gu proposes that girls have some difficulties in understanding mathematics graphical language and mathematics symbolic language compared to boys [13].

3.2.2 Current situation of the cultivation of mathematics expression ability

In terms of teachers, they do not attach enough importance to the cultivation of students' mathematics expression ability [11,17-19,20]. Zuo analyzes the problems that exist in teachers' teaching: 1) Teachers overlook the connection between language and thinking. 2) The teaching method is outdated, and there is less dialogue and communication in mathematical language. 3) Lack of teacher language expression demonstration function[20]. Zai and Cao also mentioned the lack of teacher demonstrations [18,19]. Huang, Tian, and Zhong believe that teachers neglect students' memory of mathematics symbol language and the training of students' expression ability. Students do not fully experience the process of knowledge formation and are not good at using mathematics language for thinking. Memory, understanding, and training all affect students' mathematics expression ability [17]. In terms of environment, Zai believes that the school has not formed a good atmosphere for mathematics language expression. The increase in senior high school mathematics learning content and deepening of learning knowledge have also led to an increase in the difficulty of students' mathematics language expression [18]. Cao believes that there is a lack of atmosphere in the classroom and a lack of practical activities outside the classroom to enhance students' mathematics expression ability [19].

The previous study investigated the current status of students' mathematics expression ability and the current situation of the cultivation of mathematics expression ability. Regarding the state of students' mathematics expression ability, the main focus was on the students themselves, the different perspectives of mathematics expression ability, and the variability of the

groups. The conclusions are the same, i.e., there is still much room for improvement in the current mathematics expression ability of high school students. The main conclusions about the status of cultivating students' mathematics expression ability mainly focused on teachers and the environment.

3.3 Evaluation Frameworks of Mathematics Expression Ability

Correctly assessing the level of students' mathematics expression ability is an important basis for adjusting the direction and strategies of teaching and learning. Regarding the evaluation of students' expression ability, in previous studies, researchers divided different evaluation dimensions and specified indicators at all levels. Their main viewpoints are as follows.

Wang constructs an evaluation framework for mathematics expression ability based on the expression process. She believes that mathematics expression ability includes three sub-abilities: mathematics language understanding ability, mathematics language translation ability, and mathematics language expression ability. The above three sub-abilities are used as primary indicators. Under the mathematics language understanding ability, two secondary indicators are set, namely the understanding of mathematical concepts and the understanding of mathematical sentences. Then, two third-level indicators are set, which can recognize the meaning expressed by the initial concept and understand the logical relationship between mathematics language relationships. Three second-level indicators are set under the mathematics language translation ability, namely: mutual translation of words and symbols, mutual translation of words and diagrams, and mutual translation of diagrams and symbols. Then, based on this, two three-level indicators are set under each dimension, that is, two-way conversion between corresponding languages can be realized. For example, in terms of mutual translation between words and symbols, it is set to be able to convert text language into symbol language for discussion and to convert symbol language into text language for discussion. Under the mathematics language expression ability, there is only one second-level index of mathematics language expression, and then there are two third-level indicators, including the precise content of the expression and the neatness of the written expression process [21].

Rao constructs a framework for evaluating mathematics expression ability from the content of mathematical expression. The evaluation index system includes three primary indicators: mathematical text language expression ability, mathematical symbol language expression ability, and mathematical chart language expression ability, as well as 13 secondary indicators. Among them, there are three secondary indicators of mathematics text language expression ability: understanding of mathematical terminology, ability to convert into written language, and implementation ability of written language expression; There are five secondary indicators for the expression ability of mathematical symbol language: recognition and reading of mathematical symbol language, writing of mathematical symbol language, understanding of the meaning of mathematical symbol language, ability to convert into symbol language, and implementation ability of symbol language expression; There are five secondary indicators for mathematical chart language expression: the drawing of mathematical charts, the understanding of information expressed in mathematical charts, the selection of mathematical chart expression forms, the ability to convert into chart language, and the execution ability of chart language expression. And then, each indicator was weighted [12].

In previous studies, there was relatively little systematic research on the evaluation of high school students' mathematics expression ability. These two researchers provided a relatively complete indicator system from the perspectives of the process and content of mathematics expression.

3.4 Strategies for Cultivating Students' Mathematics Expression Ability

Regarding the cultivation strategies of students' expression ability, previous researchers mainly analyzed and discussed the following four aspects: the teachers' level, teaching, mathematical language expression, and other important aspects.

3.4.1 Teachers' level

At the level of teachers themselves, they should attach importance to cultivating students' mathematics expression ability and play a good exemplary role.

Firstly, teachers need to understand mathematics language, understand the different connotations and expression processes of mathematics language. Then teachers should attach importance to the teaching of mathematical language [19,22].

Teachers should play a demonstrative role. Tian, Cao, and others believe that teachers' mathematics expression directly or indirectly affects students' mathematics expression. Teachers' language expression in the teaching and guidance process should be correct, concise, flexible, and infectious. They should set a good example [5,11,13,14,19,22,23,24]. In addition, Liang, Li, and others also require drivers to achieve clear levels and rigorous logic in the process of narrative analysis and reasoning [4].

3.4.2 Teaching

3.4.2.1 Clearly express goals and teaching methods

Zuo proposes that in the process of mathematics teaching, teachers should clarify teaching objectives and make students understand them from three aspects: knowledge and skills, process and methods, and emotional attitudes and values [11]. Zuo and Tian propose that in the teaching process, teachers should change the traditional teaching mode and adjust it according to the classroom atmosphere [11, 22]. Mao finds through tests and surveys that flipped classrooms are good at improving students' mathematics expression abilities. Teachers need to summarize the results of students' discussions at the end of a class [6].

3.4.2.2 Enhance classroom experience and guide students to actively participate in the expression

Participating in discussions and communication is the best way to improve language expression skills. Tang, Ma, and others believe that the creation of situations strengthens the connection between mathematics and the real world, making it easier for students to accept [23,25]. Zhao, Wang, and others have suggested that students should be allowed to express their ideas [10,13,14,21,23]. Wang and Gu believe that students can be assigned to express their opinions on some simple mathematics problems and conduct a classroom summary [10,13]. Tian, Cai, and others mentioned organizing group collaboration through design experiments, problems, etc., to enable everyone to participate [10,22,26]. In this process, teachers need to standardize students' mathematical language expression forms [6]. Zhao proposes that based on the expression in the group, each group selects a representative to carry out the expression in the class [10]. In addition, it is necessary to create a good atmosphere for classroom expression and encourage students to elaborate their views [19,25,27]. For the practice in the back of the book, students should be allowed to think for themselves and participate in expression freely and actively [10].

3.4.2.3 Apply modern educational tools

Tian mentioned that in geometry teaching, combined with multimedia teaching, dynamic and multi-angle displays of geometric shapes, exercise the students' ability to transform the language of mathematics [22]. Liang, Lai et al. propose to use modern educational technology, projection, geometric drawing board mind maps, etc. to lay the foundation for better expression of mathematical problems [4,28].

3.4.2.4 Reasonably assign and grade assignments

Leng proposes that the teaching strategy of arranging gradient homework is mainly to re-adapt according to the difficulty and type of exercise questions, to cultivate students' written expression ability [8]. Liang, Zhou, and others point out that strict correction is a powerful measure for students to develop good expression habits, and to standardize written expressions in students' homework [4,5].

3.4.2.5 Strive to create diverse activities

Cao believes that in mathematics learning, teachers should not only limit themselves to the cultivation of students' mathematics expression ability in the classroom, but also explore a variety of activities outside the classroom, such as lecture contests, mind maps, and mathematics diaries [19].

3.4.3 Mathematical language expression

At the expression level of mathematical language, we should pay attention to the understanding of mathematics language, the conversion training of different language forms, and the role of graphic language.

Zhao believes that in order to develop students' mathematics expression ability, they must understand mathematics language correctly. He emphasized the need to pay attention to the revelation of the meaning and essence of mathematical symbols, the teaching of semantics and syntax in mathematical language, and the explanation of related words in mathematical propositions [10]. Wang emphasizes the explanation and understanding of specific vocabulary in mathematical language [21].

If students have low mathematical language comprehension ability and difficulties in mutual conversion, it will limit their development of mathematics expression ability. Tian, Zhang, and Li believe that attention should be paid to the pairwise translation between symbolic language, written language, and graphic language [11,13,14,20-22]. Zhao and others believe that language conversion training should be emphasized in teaching different contents - concepts, theorems, problem-solving, and extracurricular training [10,19,20].

Cao proposes to strengthen the teaching of graphic language in geometric algebra learning [19]. Wang believes that graphic language is the carrier of visual thinking, and teachers should cultivate students' good habits of sketching [9].

3.4.4 Other important aspects

3.4.4.1 Cultivate the mathematics expression ability of high school students through the integration of Chinese and math

Tang, Xie, and Wang believe that interdisciplinary teaching is a new direction and approach that can be attempted from four aspects of the Chinese language: listening, speaking, reading, and writing, to cultivate students' mathematics expression ability [23].

3.4.4.2 Emphasize mathematics reading

Zhou, Yan, and others believe that mathematics reading ability is closely related to mathematics expression ability. Through a lot of reading, students can master mathematics language faster and build their mathematics language system [5,11,13]. Firstly, we should attach importance to textbook reading. Dong, Zhao, and others believe that the teaching content involved in textbooks is the essence and foundation of mathematics, and teachers must pay attention to guiding students to read textbooks carefully [19,14,15]. Zhou believes that in learning, students must be able to narrate in their language in order to achieve a basic understanding. For content that cannot be repeated in their language, further reading and learning are necessary [5]. Then we should pay attention to extracurricular reading. Wang believes that relying solely on mathematical textbooks and the mathematics language taught by teachers in the classroom is difficult to meet practical needs, and it is necessary to strengthen mathematical reading training [21]. Tian proposes that students learn to take reading notes while reading, enrich their language, and choose different recording methods such as transcription based on their level [22].

3.4.4.3 Students' level

Give full play to the subjective initiative of students. Dong and others hope to develop the habit of thinking from different perspectives, cultivate students' ability to check for gaps, learn to reflect, and accumulate experience [13,14]. In the process of mathematics teaching activities, the laws of students' psychological development must be followed, and the gender differences that appear cannot be ignored. It is necessary to teach students in accordance with their aptitude [13].

In this part of the research, the role of mathematics reading has received greater attention, and it is generally believed that reading has a strong relationship with expression, including reading in class and reading outside class.

Previous researchers have proposed a relatively comprehensive training strategy on how to cultivate students' mathematics expression ability, including four aspects: the teacher's level, the teaching level, the level of mathematics language expression, and other important aspects. At the teacher's level, teachers attach importance to cultivating students' mathematics expression ability and play a good exemplary role. The teaching level is the level that has received the most attention, and the vast majority of researchers have mentioned guiding students to actively participate in expression and improve in training. At the expression level of mathematical language, we should pay attention to the understanding of mathematics language, the conversion training of different language forms, and the role of graphic language. In other important aspects, the role of mathematics

reading has received greater attention, and it is generally believed that reading has a strong relationship with expression, including reading in class and reading outside class.

3.5 Mathematics Expression ability of Special Groups of Students

Not all high school students are in the same learning background environment. In terms of mathematics expression ability, the groups that are quite different from ordinary high school students are mainly hearing-impaired students and ethnic minority students. In the previous research, regarding these two special groups, there are some special conclusions besides the conclusions similar to those of ordinary Han students, as follows.

3.5.1 Hearing-impaired students

Regarding the mathematics expression ability of hearing-impaired students, Zuo and Yang believe that hearing-impaired students are affected by hearing impairment in junior high school mathematics learning, and their language development level is lower than that of normal students. They lack daily life experience, and their language expression ability is not strong. There is a bigger gap in mathematics language expression ability between them and normal students [29,30].

In the cultivation of mathematics expression ability for hearing-impaired students, Zuo proposes to train them on mathematical content, basic sentence structures, and mathematics language to address issues such as reverse word order and unclear sentences [29]. Yang mentions that it is necessary to encourage hearing-impaired students to participate more in the operation to express their thinking and reasoning processes. Give deaf students as many opportunities as possible to practice language expression, and use illustrations, teaching tools, and exercises to cultivate their abilities

3.5.2 Ethnic minority students

Ethnic minority students have special language backgrounds, and naturally, their mathematics expression abilities may vary. Liang finds through testing and investigation that there is a significant difference in mathematics expression ability between Miao students and other minority students in ethnic minority areas [7]. Li concludes that the mathematical written expression abilities of high school students in Lhasa are at an average level, and there is still great room for improvement in this area. Boys have better-written expression skills in graphic language than girls [16].

Li emphasizes the importance of learning Chinese in cultivating the mathematics expression ability of ethnic minorities. During the process of problem-solving, students who have weak language ability first need to convert Chinese questions into Tibetan for understanding, and then connect with the corresponding mathematics language. This conversion process adds some difficulty to students [16]. Ren suggests reducing the language complexity of academic tests for ethnic minority students, helping students focus on the task itself and demonstrate their skills in the target field, and improving the quality of test paper preparation [31].

In previous studies on the mathematics expression ability of special groups, the main focus was on hearing-impaired students and ethnic minority students. Based on the special circumstances of these two groups, some targeted special conclusions have been drawn.

4. DISCUSSION

Current domestic research on mathematics expression ability of high school students mainly focuses on the following five aspects: Connotations and classification of mathematics expression ability, development status of mathematics expression ability, evaluation frameworks of mathematics expression ability, strategies for cultivating students' mathematics expression ability, and the mathematics expression ability of special groups of students.

There are two main ways to define the connotation of mathematics expression ability, one is in the form of conceptual extension; Another type is the agreement on details such as the thinking process, mathematical language, and ability goals in mathematics expression. The classification of mathematics expression ability is mainly based on three perspectives: expression form, expression process, and expression content. The concepts and classification methods based on oral and written language expression are widely used and relatively unified.

Concerning the development status of mathematics expression ability of high school students, previous research conclusions mainly

focus on two levels: the current situation of students' mathematics expression ability and the current situation of the cultivation of mathematics expression ability. Given that the references are all within the last few years, and despite the differences in regional schools, almost all of the results show that there is still much room for improvement in the overall level of survey respondents. However, the test questions, questionnaires, or interview outlines used by the researchers in the survey process are self-made and have different standards.

Regarding the evaluation framework of mathematics expression ability, researchers have used different entryways of expression process and expression content. There is relatively little systematic research in this area and there is great room for unified development. Research on special groups has drawn some targeted special conclusions, which also account for a large proportion in China and are worthy of attention.

The cultivation strategies of students' mathematics expression ability are the most concerned aspect by previous researchers, and they have given more comprehensive training suggestions, including four aspects: the teacher's level, the teaching level, the level of mathematics language expression, and other important aspects. The teaching level is the level that has received the most attention, and the vast majority of researchers have mentioned guiding students to actively participate in expression. The role of mathematics reading has also received greater attention. The main target audience for the development of mathematics expression ability is students, but most of the strategies are about how teachers teach and very few about how students should learn. while some researchers infer from the survey results or theoretical thinking, lacking empirical research to verify the effectiveness of a certain method.

There are some gaps in previous studies. Firstly, there is relatively little research on the evaluation frameworks of mathematics expression ability. And then, most training strategies focus on how teachers teach, with very few on how students learn. Finally, previous researchers use self-made test papers, questionnaires or interview outlines to investigate and research, and some researchers base their research on theoretical thinking or teaching experience. The effectiveness and reliability of these studies still need to be discussed. So the current research is not very rigorous and scientific.

There are some gaps in previous studies. Firstly, Regarding the influencing factors of students' mathematics expression ability, only the low level caused by the current situation has been clarified, without specialized research. Secondly, the strategies for cultivating students' mathematics expression ability put forward by researchers lack practical verification to scientifically judge whether these suggestions and strategies are effective. Finally, the test papers, questionnaires, and interview outlines used in previous studies were designed by the researchers themselves, and there was no uniform standard research procedure and measurement questionnaire. Also, due to different geographical conditions, educational environments, and other factors, the foreign analytical framework does not apply to China. Therefore, domestic research lacks localized research tools and a systematic analysis framework.

5. CONCLUSION AND RECOMMENDA-TIONS

By analyzing the previous research on mathematics expression ability, the following conclusions are drawn:

(1) Current domestic research on mathematics expression ability of high school students mainly focuses on the following five aspects: Connotations and classification of mathematics expression ability, development status of mathematics expression ability, evaluation frameworks of mathematics expression ability, strategies for cultivating students' mathematics expression ability, and the mathematics expression ability of special groups of students.

The cultivation strategies of students' mathematics expression ability are the most concerned aspect by previous researchers, and they have given more comprehensive training suggestions, including four aspects: the teacher's level, the teaching level, the level of mathematics language expression, and other important aspects. Previous researchers have adopted different approaches and perspectives on the connotation and classification of mathematics expression ability. Concerning the development status of the mathematics expression ability of high school students, previous research conclusions mainly focus on two levels: the current situation of students' mathematics expression ability and the current situation of the cultivation of mathematics expression ability. Research on special groups has focused on

hearing-impaired students and ethnic minority students. There are few achievements in the evaluation framework of mathematics expression ability.

(2) The cultivation strategies for mathematics expression ability are mostly about how teachers teach, with few students learning, and there is a lack of empirical research. There is relatively little research on the influencing factors of mathematics expression ability. Therefore, these aspects should be expanded. Researchers use self-made test papers, questionnaires or interview outlines to investigate and research, and some researchers base their research on theoretical thinking or teaching experience, lacking domestic and local research tools and systematic analysis framework, which should be improved.

Therefore, based on current research, future research needs to adopt more scientific research tools, a more reasonable analysis framework, expand the research scope, increase validation research, and give more scientific suggestions. So that the research on the mathematics expression ability of junior high school students is more comprehensive, systematic, and profound.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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