Research on the Cognitive Degree of Pre-service Junior High School Mathematics Teachers for Data Concept Literacy in China

Comment [A1]: It would be nice not to include the word "research" in the title.

ABSTRACT

Educational issues about data concept literacy have recently received widespread attention from all sectors of society in China. there have been studies on data concept literacy, but there have been no studies on pre-service junior high school mathematics teachers' cognition of data concept literacy. In this study, 22 master's degree holders in education from two grades at a university were investigated for their data concept literacy cognition using the semi-structured interview method. Through the analysis, it was found that in China pre-service junior high school mathematics teachers: 1. were not accurate and reasonable enough in their cognition of the content related to data concept literacy; 2. did not have a wide range of cognition of data concept literacy, and the pre-service teachers' cognition of data concept literacy was mainly focused on the content that was more general and closely related to their own lives; 3. the overall cognition of data concept literacy was shallow and mainly focused on a lower level; 4. The overall cognitive clarity of data concept literacy is low, and fewer points can be recognized clearly. It is thus suggested that: 1. special training and education about core literacy should be strengthened in the training of pre-service teachers so that data concept literacy can be emphasized; 2. pre-service junior high school mathematics teachers should take the initiative to learn the core literacy and improve their knowledge of data concept literacy.

Keywords: Pre-service teachers; Data Concept literacy; Cognitive degree.

1. INTRODUCTION

Comment [A2]: Kindly add GAP research analysis

Data concepts focus on having a clearer understanding of the meaning and randomness of data. Knowing that data contain information; the need to determine the methods of data collection, organization, and analysis according to the context of the problem and the question to be studied; knowing that quantitative methods can be used to describe the trend of random phenomena and the likelihood of the occurrence of random events. The Curriculum Standards for Compulsory Education in Mathematics (2022 Edition) issued that the formation of a conception of data is helpful in understanding and expressing the laws of the occurrence of random phenomena in life, perceiving the importance of data analysis in the era of big data, and develop a scientific attitude that emphasizes evidence and reason [1], and explicitly states that data concept literacy should be comprehensively implemented in junior high school. However, many scholars and teachers have studied the current situation of data concept literacy of junior high school students and found that the current data conceptual literacy of junior high school students is not high, and data

concept literacy has not been well implemented in actual teaching. How exactly should we cultivate students' data concept literacy? This is an issue worth studying.

2. LITERATURE REVIEW

2.1 Data Concept Literacy Measurement and Status in Junior High School

Before and after the promulgation of The Curriculum Standards (2022 Edition), various scholars have investigated the current status of data literacy among junior high school students. The main direction of the investigation is to study the development of students' "data conception" in terms of gender, grade level, region, etc., with the gender factor having almost no effect on the level of junior high school students.

Tong and others drew on the SOLO classification, a method for establishing the level of statistical thinking in foreign countries, to divide the dimension and level of "data concept" from the awareness and perception of data, data analysis methods, and randomness of real phenomena. On this basis, the dimensions were roughly divided into three levels, level 0: no data analysis concept, level 1: with a one-sided data analysis concept, and level 2: with a comprehensive and correct data analysis concept, thus initially establishing an evaluation framework for data analysis concept [2]. Zhu [3] and He[4] conducted relevant studies based on Tong's evaluation framework respectively. In addition, Kang, based on Tong's evaluation framework, divided the conceptual development level of junior high school students into seven dimensions, and each dimension was divided into several levels, with a total of 28 levels, this framework was used to investigate and analyze the development level of junior high school students' statistical concepts [5].

Li conducted questionnaires and interviews with seventh-grade students to analyze their attitudes toward data, information awareness, and cognition of randomness in statistical data from both qualitative and quantitative perspectives and obtained the conclusions that students lacked a sense of intimacy with data, had little willingness to use data methods, and did not have an awareness of randomness [6]. Jiao found that the level of the three grades of junior high school in different dimensions of data conception has variability, the performance level of each grade is different, in which the performance of the seventh and eighth grades is lower than the level of the ninth grade students, and there is no significant effect of gender on the level of data conception in junior high school [7]. Zhang and Ma made statistics and analyses on the scores and level distributions using the data analysis-related topics in the 2016 Jiangsu Primary and Secondary School Academic Quality Monitoring Test to reflect the basic status of the data analysis level of eighth-grade students in Jiangsu Province; the survey reflected that there were differences between rural and urban Jiangsu, southern and northern Jiangsu, and public and private schools, and concluded that, compared with several other mathematical literacies, the students' data analysis level is in the middle to upper level [8].

2.2 Strategies for Developing Data Concept Literacy in Junior High School

The research on the paths and strategies of developing data concept literacy, combined with the existing research found that most of them focus on the specific

aspects of the teaching of statistics and probability, such as focusing on the development of mathematical activity contexts, designing the process of statistical activities, or combining with information technology to improve the way of teaching and learning, and so on.

Jia, Song, and others found that the process of data processing is a necessary path for the development of students' "data concept" literacy, specifically through the creation of relevant problem scenarios, allowing students to experience the complete process of data analysis, experience the information contained in the data, choose the method of analysis, experience randomness [9]. Cheng for junior high school students' "data analysis" training proposed to reasonably create a situation, and pay attention to the emotional experience of students, teachers should pay attention to the creation of a situation emphasizing the combination of mathematical and life, to mobilize students to participate in the learning enthusiasm. It is further emphasized that teachers should make use of information technology to assist teaching, by strengthening the link between statistical knowledge and other knowledge and other strategies [10].

Mou and Zhang[11] take the eighth-grade lesson "Average" as an example of teaching practice and reflection from the teaching objectives to the teaching links to design to develop students' data concept. Zhang pointed out that there are three important stages in cultivating primary students' concept of data analysis, the first is from the intuitive understanding of data to the stage of perception, the second is from perception to the stage of thinking and analyzing hierarchically and logically, and the third is from thinking and analyzing to the stage of inferring and predicting based on the data and applying it in real life. After that, she combined the methods of creating situations, carrying out practical activities, and experiencing the process of data analysis to explain how to carry out the implementation of teaching[12]. Shen and Xu proposed a study on project-based learning that points to the cultivation of "data concepts" and designed a teaching method using a seventh-grade lesson as an example, pointing out that project-based learning has the characteristics of authenticity and contextualization, and is therefore highly compatible with literacy-oriented education [13].

In summary, the research on the development of data literacy strategies is mainly conducted by educational experts and scholars, focusing on teaching strategies, mainly on the research on the elements and manifestations of the elements of the development of "data literacy" in the process of teaching and learning, as well as the strategy of the development of outward behaviors.

The degree of cognition generally includes cognitive accuracy, cognitive breadth, cognitive depth, and cognitive clarity. Therefore, the main question studied in this paper is:

1. How accurate are current pre-service junior high school math teachers' cognition of data concept literacy in China?
2. How widespread is current knowledge of data concept literacy among preservice junior high school math teachers in China?
3. How knowledgeable are current preservice junior high school math teachers about data concept literacy in China?

4. How clear are current pre-service junior high school math teachers' cognition of data concept literacy in China?

The current research indicates that the current level of data concept literacy among junior high school students is low and that the level of teachers' knowledge of data concept literacy is an important factor in influencing students' data concept literacy; therefore, the hypothesis of this study are:

Hypothesis 1: Current pre-service junior high school math teachers' cognition of data concept literacy is not accurate;

Hypothesis 2: Current pre-service junior high school math teachers do not have a wide range of knowledge about data concept literacy;

Hypothesis 3: Current pre-service junior high school math teachers do not have in-depth knowledge of data concept literacy;

Hypothesis 4: Current pre-service junior high school math teachers' cognition of data concept literacy is unclear.

3. THEORETICAL BASIS

There has been a wealth of previous research on what data concept literacy is, how it manifests itself, and what its value is.

"Data concept" is the core concept of statistics and probability in junior high school mathematics. Before the proposal of "data concept" in the New Curriculum Standard, the literature has mainly studied the concepts of "data analysis concept", "data analysis literacy", "statistical conception", "statistical thinking" and other related concepts. Through the development of the connotation of "data concept", it can be found that its connotation and the development of curriculum standards show a certain stage. It has gone through three stages: one is to pay attention to the teaching of knowledge and skills of data analysis, the second is to pay attention to the concept and ability cultivation, and the third is to cultivate students' literacy in data analysis as the goal [14]. In 2001, China's "Compulsory Education Mathematics Curriculum Standards (Experimental Draft)" put forward for the first time the "concept of statistics", which was the first time that the concept of "data concept" was introduced from the stage of the "data concept". From the research on the connotation of "data concept" at this stage, researchers mostly focus on statistical knowledge and statistical skills in statistics teaching, although the attention to statistics and probability content has been increased, teachers continue the traditional teaching method of algebraic knowledge in specific teaching, focusing on statistical formula calculation and chart selection and identification, and do not know "statistical concept". The connotation of "statistical concept" is only a concrete or operational extension based on the concepts related to the curriculum standard [15]. The meaning of the "concept of data analysis" in The Curriculum Standards (2011) can be summarized as being able to appreciate that data contain information, choosing appropriate methods of data analysis according to specific problems, and understanding the randomness of real events through data analysis [16]. In the interpretation of the connotation of "data concept" in the New Curriculum Standard, more emphasis is placed on the mastery of the meaning of data than in the original curriculum standard, and it is proposed that the

understanding of randomness should be further improved to further enhance the ability of students to understand the objective world from the perspective of uncertainty, as well as the ability to describe the trend of the random phenomena and the likelihood of the occurrence of random events in a quantitative way [1].

"Data literacy" in foreign literature is mostly expressed as statistical thinking or statistical literacy. Wallman considers statistical literacy as the ability to critically understand and evaluate statistical results in everyday life [17]. Delma explains statistical literacy as the ability to translate and evaluate every statistical data disseminated in society through various communication media [18]. It includes the following: (1) reasoning about data; (2) reasoning about basic statistical concepts and terminology used in statistics; (3) reasoning about data collection and processing in descriptive statistics; (4) the ability to translate data at a basic level; and (5) the ability to communicate data and research results at a basic level.

The Ministry of National Education comprehensively summarizes the above ideas and gives the most formal statement in the latest version of The Compulsory Education Mathematics Curriculum Standards (2022 Edition) issued in 2022. The new standards state that data conception mainly refers to having a relatively clear understanding of the meaning and randomness of data. The teaching requirements of data conception are: to know that data contain information and that methods of data collection, organization, and analysis need to be determined according to the background of the problem and the question to be studied; to know that quantitative methods can be used to describe the trend of random phenomena and the likelihood of the occurrence of random events. The standard also explains that the significance and value of the concept of data is that the formation of the concept of data helps to understand and express the pattern of random phenomena in life, perceive the importance of data analysis in the era of big data, and cultivate the scientific attitude of emphasizing evidence and reasoning [1].

To ensure the objectivity of the study, the study used the definition of data concept literacy in the Compulsory Education Mathematics Curriculum Standards (2022 Edition) to examine the pre-service junior high school mathematics teachers' cognition of data concept literacy.

4. RESEARCH METHODS

Comment [A3]: Kindly include the type of research and data analysis used.

4.1 Participants

To faithfully reflect the pre-service junior high school mathematics teachers' perception of data concept literacy, this study selected 22 Master of Education (M.Ed.) majors in subject teaching (mathematics) of two grades in the School of Mathematics and Statistics, Shandong Normal University, of which 16 were female and 6 were male, who all held the qualification certificate for teaching mathematics and had the intention to go to junior high schools for employment in the future.

4.2 Instrument

To solve the real cognitive situation of pre-service junior high school mathematics teachers on data concept literacy, this study adopts the semi-structured interview method to carry out the investigation, and three questions are designed in the

interview, for example, "What do you think is data concept literacy, please fully and accurately state your understanding," and so on, and adopts the semi-structured interview method because it is flexible, and the conversation has flexibility, which is conducive to in-depth investigation and obtaining deep and more authentic and reliable information. The semi-structured interview method is used because it is flexible, and the conversation is flexible, which is conducive to in-depth investigation and obtaining deeper and more authentic and reliable information.

4.3 Data Collection

In this study, 22 M.Ed. students were interviewed individually, one by one, using the semi-structured interview method, and the interviews were audio-recorded after asking for permission to process the results. The interviews lasted a total of 140 minutes, an average of about 6 minutes per respondent, and were conducted as a one-time interview with no follow-up.

4.4 Data Processing

The content of the Curriculum Standards (2022 Edition) regarding data concept literacy was first divided and coded, with A, B, and C indicating the meaning of data conceptualization, the requirements in the standards, and the significance. From this, a total of three aspects A-C and six items A1-C2 were divided, and the specific contents are shown in Table 1. Subsequently, the contents of the interview recordings were converted into text, and the contents were organized strictly according to the original words spoken during the interviews except for the intonations such as hmmm, ah, and uh, etc., and were compared with the coded the contents of the interviews were compared one by one, and if the contents were similar in meaning, it was assumed that the respondents were able to recognize it, and in addition, the level of awareness was determined according to the completeness and accuracy of the respondents' expressions. The two researchers independently coded the results of the interviews and classified the level of accuracy and clarity to ensure the reliability of the study. Finally, the number of people who mentioned each item was counted and the corresponding percentage was calculated.

Table 1 Content coding for data concept literacy

Category	Label	Content
A Meaning	A1	Have a clearer understanding of the significance and randomness of the data.
B standard requirements	B1	Know that data holds information.
	B2	Methods of data collection, organization, and analysis need to be determined based on the context of the problem and the questions to be studied.
	B3	Know that trends in random phenomena and the magnitude of the likelihood of random events can be described in quantitative terms.
C	C1	Developing data concepts helps to understand and express the patterns of random phenomena that occur in life.

Meaningful value	C2	It helps to perceive the importance of data analysis in the era of big data and to develop a scientific attitude that emphasizes evidence and reasoning.

5. RESULTS

5.1 Cognitive Accuracy

In this study, the content related to data concept literacy in The Curriculum Standards (2022 Edition) is divided into six elements, including one meaning, three requirements in the curriculum standards, and two values of meaning, in which the largest number of people can recognize the second requirement and meaning of data concept literacy, 18 people, accounting for 81.82% of the total number of people, and the number of people who can recognize the meaning of data concept literacy is also higher, amounting to 17 people, accounting for 77.27% of the total number of people; 14 people, accounting for 63.64% of the total number of people, can accurately recognize the second requirement of data concept literacy; no one can recognize the first meaning of data concept literacy in the textbook, "Formation of a conception of data helps to understand and express the laws of occurrence of random phenomena in life", and the number of people who can recognize the Only 4 people could recognize the third requirement of the standard and no one could recognize this item accurately, as shown in Table 2.

It can be seen that the number of pre-service junior high school mathematics teachers cognizant of such generalized content as meaning is large, and the accuracy reaches half; on such open content as meaning, the number of people who can cognize it is more than half, but the number of people who can accurately cognize it is very small, which shows that pre-service teachers are not able to accurately cognize the meaning and value of the literacy of the concept of data and can only talk about their ideas in a general way; on the cognition of the requirements of the literacy of the concept of data in the curriculum standard The number of people is not large, only the second requirement is recognized more, the vast majority of pre-service teachers can summarize the corresponding requirements from the word data conception, and less awareness of random phenomena. Overall, the accuracy of preservice teachers' knowledge of the requirements of the standards in data conceptions was low.

Table 2 Statistics of Recognition Accuracy Results

Category	Label	Number	Percentage	Accurate	Percentage
A Meaning	A1	17	77.27	8	36.36
B standard requirements	B1	12	54.55	7	31.82
	B2	18	81.82	14	63.64
	B3	4	18.18	0	0
C Meaningful value	C1	0	0	0	0
	C2	18	81.82	8	36.36

Comment [A4]: Kindly explain whether the findings obtained are supported by previous research or expert opinion that strengthens or weakens the research in discussion.

5.2 Cognitive Breadth

From the above statistical results, it can be seen that the current pre-service junior high school mathematics teachers can recognize five of the six items related to data concept literacy, accounting for 83.33% of the total number of points. The second requirement of data literacy is "to determine the methods of data collection, organization, and analysis according to the background of the problem and the problem to be studied" and the meaning "to help perceive the importance of data analysis in the era of big data, and to cultivate a scientific attitude that emphasizes evidence and reasoning". "These two points were recognized by a large number of people, 18 people each, accounting for 81.82% of the total number.

From different aspects, the "standard requirements" of data concept literacy in junior high school teaching are divided into three points, and the research subjects can recognize three points, accounting for 100% of the total points; the value of data concept literacy is described in the curriculum standard as the following two points: "The formation of data concepts helps to understand and express the patterns of random phenomena in life" and "It helps to perceive the importance of data analysis in the era of big data and develop a scientific attitude that emphasizes evidence and reasoning". The value of data concept literacy is described in the curriculum standard as the following two points: "The formation of data concepts helps to understand and express the laws of random phenomena in life" and "It helps to perceive the importance of data analysis in the era of big data and to develop a scientific attitude that emphasizes evidence and reasoning", and the subjects recognize the importance of data concept literacy in the era of data and its influence on students' scientific attitude, and have many different opinions. , but could not recognize the impact of data conception on random phenomena in life, the specific results are shown in Table 3.

More than half of the awareness of data concept literacy, but most of the research subjects' awareness is concentrated on individual points, and the number of people who can accurately recognize the content of data concept literacy is very small, and even individual recognition is not possible. In terms of specific content, the research subjects have a high level of awareness of the more generalized content of data literacy that is closely related to their own life and learning, such as the second item of "meaning" and "significance", and a low level of awareness of some of the details stipulated in the Curriculum Standards (2022 Edition). The level of awareness of some details stipulated in the Curriculum Standards (2022 Edition) is low, such as the specific content of the "standard requirements", and the awareness of the significance of the concept of data in students' lives is not in place, so that they cannot closely relate data to their lives.

Table 3 Breadth of understanding result statistics

	A Meaning	**B standard requirements**	**C Meaningful value**
Cognitive Points	1	3	2
Total Points	1	3	1
Percentage	100	100	50

5.3 **Cognitive Depth**

Most of the six points related to the content of data concept literacy in this study can only four or less of them, accounting for 95.45% of the total, and no one can recognize all six items, and even 22.73% of the pre-service teachers can only recognize two or less of the items in the curriculum standard about data concept literacy. The pre-service teachers' cognitive content is concentrated on the second item of meaning, requirement, and significance, and they do not have in-depth knowledge of the requirements in the standard involving random phenomena, and the specific results are shown in Table 4.

It can be seen that the current pre-service junior high school mathematics teachers have a more in-depth and comprehensive understanding of the "meaning" of data literacy and other generalized content, while the details of the requirements of the standards are more superficial, involving life-related content, such as random phenomena, life laws, pre-service teachers can not be well recognized. Overall, the current pre-service junior high school mathematics teachers have a low depth of knowledge of data concept literacy, and the vast majority of pre-service teachers are not able to recognize the data concept literacy in the standards in depth.

Table 4 Cognitive depth result statistics

Recognizing points	1	2	3	4	5	6	1
Number of people	2	3	8	8	1	0	2
Percentage of total	9.09	13.64	36.36	36.36	4.55	0	9.09

5.4 Cognitive Clarity

In this study, the level of awareness was determined based on the completeness and accuracy of the respondents' expressions, and the percentages of the total number of respondents with high and low levels of awareness were calculated separately. Through the survey statistics, it was found that the current pre-service junior high school mathematics teachers' cognitive clarity is "the requirements of data concept literacy - the need to determine the methods of data collection, organization, and analysis based on the context of the problem and the problem to be studied", and the number of people who have cognitive clarity is high, and the percentages of cognitive clarity are all 22.22:77:78. On the contrary, the percentage of clarity of pre-service teachers' awareness of the requirement of data literacy in the standard "to know that quantitative methods can be used to describe the trend of random phenomena and the likelihood of random events" is 0.00:100.00, and only a very small number of respondents can recognize the requirement of data literacy in the standard. Very few respondents recognized it, but their cognitive clarity was extremely low.

It can be seen that the current pre-service junior high school mathematics teachers have a less clear understanding of data concept literacy, mainly focusing on the "meaning" and the second requirement, while they either do not recognize or have a vague understanding of other points. On the whole, the current pre-service junior high

school mathematics teachers' knowledge of data concept literacy is vague, as shown in Table 5.

Table 5 Cognitive Clarity Results Statistics

Category	Label	Clarity percentage (low degree: high degree)
A Meaning	A1	52.64：47.06
B standard requirements	B1	41.67：58.33
	B2	22.22：77.78
	B3	100.00：0.00
C Meaningful value	C1	0.00：0.00
	C2	55.56:44.44

6. DISCUSSION

6.1 Cognitive Accuracy

From the data analysis above, it is clear that the current pre-service junior high school mathematics teachers' perception of data concept literacy is low in accuracy. Specifically, the number of pre-service teachers' cognition of the requirements related to their learning in the data concept literacy of the curriculum standard is large and accurate, but they do not recognize most of the contents, such as the other two requirements of the curriculum standard and the meaning and value related to the laws of life, and they are not able to accurately express them, or they cannot even cognize them. Regarding this issue, Li found through investigation that teachers' teaching style affects the development of students' data concepts, but students lack intimacy with data and have little willingness to use data methods [6]. It can be seen that pre-service junior high school mathematics teachers do not perceive data concept literacy accurately, and hypothesis 1 is verified.

5.2 **Cognitive Breadth**

From the above analysis of the data, it can be seen that the pre-service junior high school mathematics teachers can know more than half of the range of data concept literacy, but most of the research participants' knowledge in data concept literacy focuses on individual points. Overall, their knowledge of data concept literacy is not broad enough. For specific content, pre-service junior high school mathematics teachers' knowledge of the standards on data concept literacy is concentrated on generalized content such as meanings and requirements, and the scope of their knowledge of detailed content and random phenomena in the requirements of the standards is less, and they even fail to know the individual requirements of the standards. Regarding this problem, Zhao and Pan have found through a survey that many high school mathematics teachers had low literacy in mathematics subjects [19]. From this, it can be seen that pre-service junior high school mathematics teachers do not have a wide range of knowledge about data concept literacy, and Hypothesis 2 is verified.

5.3 Cognitive Depth

From the analysis of the above data, it can be seen that the current pre-service junior high school mathematics teachers have a more in-depth and comprehensive understanding of the "meaning" of data literacy and other generalized content, while their understanding of the details required by the standards, and the content related to random phenomena and other laws of life, is relatively superficial and incomplete. On the whole, the pre-service junior high school mathematics teachers' knowledge of data concept literacy was shallow and mainly concentrated at a lower level. Using the semi-structured interview method, it was found that most of the pre-service teachers only knew that they had to cultivate students' ability to analyze and use data and that data conception was a core literacy that students should possess, but they lacked in-depth knowledge of data conception literacy. From this, we can see: that the overall depth of knowledge of current pre-service junior high school mathematics teachers about data concept literacy is low, and Hypothesis 3 is verified.

5.4 Cognitive Clarity

From the analysis of the above data, it is clear that the current pre-service junior high school mathematics teachers have fewer points of clear understanding of data concept literacy and are mainly focused on the second requirement and meaning, while most of the other points are either unrecognizable or vaguer. Overall, the current pre-service junior high school mathematics teachers have a vague knowledge of data concept literacy. Regarding this issue, Zhou[20] found through interviews, questionnaires, and other methods that teachers' understanding of data conception is rather vague, and they cannot clearly express the corresponding content of data conception. From this we can see: the current pre-service junior high school mathematics teachers' cognitive clarity of data concept literacy is low. Hypothesis 4 is verified.

7. CONCLUSION

Previous studies have shown that the level of teachers' perception of data concept literacy affects the cultivation of junior high school students' data concept literacy, and the current level of junior high school students' data concept literacy is generally low, so is it true that teachers do not have a high level of perception of data concept literacy? For this reason, this study selected 22 masters of education in two grades as research subjects and used semi-structured interviews to investigate the pre-service junior high school mathematics teachers' cognitive level of data concept literacy in China. Through the interviews and analysis, we can get that the current pre-service junior high school mathematics teachers in China: 1. do not have enough accurate and reasonable cognition of data concept literacy; 2. do not have a wide range of cognition of data concept literacy; 3. have a shallow overall cognition of data concept literacy and do not have a good understanding of the data concept literacy; 4. have a low level of clarity of the overall cognition of data concept literacy and fewer points that can be recognized.

Through the above analysis, it is recommended that: in the training of pre-service teachers, special training and education on core literacy, especially data concept literacy, should be strengthened so that pre-service teachers can fully understand and pay attention to data concept literacy; at the same time, pre-service junior high school mathematics teachers should actively and proactively learn the core literacy and deepen their knowledge and understanding of data concept literacy so that they can: (1) have a comprehensive understanding of the relevant contents of data concept literacy; (2) deeply learn the meaning, requirements, significance, and other specific contents of data concept literacy in the standard; (3) be able to correctly and clearly express data concept literacy, so that they can better cultivate students in teaching.

The sample size of the research participants selected for this study was small and focused on masters of education from the same institution, and other groups of pre-service junior high school mathematics teachers were not involved, making the sample selection narrower. Therefore, in the future, it is necessary to expand the scope of the research sample to further conduct a more in-depth study of pre-service junior high school mathematics teachers' knowledge of data concept literacy, using a variety of research methods, to find out more detailed and comprehensive results.

REFERENCE

1. Ministry of Education of the People's Republic of China. Compulsory Education Mathematics Curriculum Standards (2022 Edition). Beijing: Beijing Normal University Press, 2022.
2 Tong L, Zhang N, Zhang N. Constructing an evaluation framework for students' conception of data analysis in compulsory education. Journal of Mathematics Education,2014,23 (02): 45-48.
3 Zhu Y. Survey and research on the development level of junior high school students' concept of data analysis. Master's thesis, Tianjin Normal University, Tianjin; 2019.
Available: https://kns.cnki.net.
4 He Y. Research on the instructional design of statistics and probability in junior high school for developing students' concept of data analysis. Master's thesis, Chongqing Normal University, Chongqing; 2017.
Available: https://kns.cnki.net.
5 Kang K. A study on the current situation of the development level of statistical concepts of junior high school students. Master's thesis, Jiangxi Normal University, Nanchang; 2016.
Available: https://kns.cnki.net.
6 Li HM. Awareness of data analysis concepts and investigation and analysis - an example of seventh-grade students. Journal of Mathematics Education,2014,23(04):78-82.

7 Jiao Y. A survey study on the current situation of the development level of middle school students' concept of data analysis. Master's thesis, Yunnan Normal University, Kunming;2019.
Available: https://kns.cnki.net.
8 Zhang AP, Ma M. An investigative study on the development of data analysis of middle school students based on quality monitoring. Journal of Mathematics Education, 2017,26(01): 28-31.
9 Jia FL, Song YH, Zhang D. Understanding the concept of data analysis-The Mathematics Curriculum Standards for Compulsory Education(2011) (Yearly Edition). Elementary Mathematics Education,2012(Z2):34-35.
10 Chen QL. Research on the cultivation strategy of middle school students' concept of data analysis. Master's thesis, Jiangsu Normal University, Xuzhou;2014.
Available: https://kns.cnki.net.
11 Mou TW, Zhang Y. Teaching practice and thinking focusing on developing students' concepts of data analysis--Taking the teaching of Grade 8 Mean as an example. Mathematics Bulletin,2016,55(10):39-43.
12 Zhang J. Three stages of cultivating primary school students' concept of data analysis. Teaching and Management,2017(23):41- 43.
13 Shen WW, Xu MQ. A study on project-based learning pointed to the cultivation of the concept of data analysis--Taking the example of "Data and Statistical Graphs" in the second semester of VII. Middle School Mathematics Monthly,2022(01):51-53.
14 Wu LB, Xin SJ. Historical lineage and empirical insights of the development of data analysis literacy. Curriculum, Teaching Materials, Teaching Methods, 2021,41(03):69-75
15 Ministry of Education of the People's Republic of China. Mathematics curriculum standards for full-time compulsory education: experimental draft. Beijing Normal University Press, 2001.
16 Ministry of Compulsory Education, People's Republic of China. Mathematics Curriculum Standards for Compulsory Education (2011 Edition). Beijing. Beijing Normal University Press, 2011.
17 Wallman K K. Enhancing Statistical Literacy: Enriching Our Society. Journal of the American Statistical Association,1993,88 (421): 1-8.
18 Delmas R C. Statistical Literacy, Reasoning, and Thinking: A Commentary. Journal of Statistics Education, 2002,10 (2):1-11.
19 Zhao SL, Pan C. Core qualities and components of secondary school mathematics teachers. Journal of Mathematics Education,2021,30(02):48-54.
20 Zhou X. Study on learning factors affecting the improvement of high school students' literacy in mathematical data analysis. Master's thesis, Shandong Normal University, Jinan;2023.
Available: https://kns.cnki.net.