Research on Measurement and Evaluation of Mathematical Data Analysis Literacy

Abstract: By measuring and evaluating the mathematical data analysis literacy of high school students, the obtained results can provide an important reference and basis for high school mathematics teachers to develop students' mathematical data analysis literacy. However, there is a dearth of research on how to measure mathematical data analysis literacy of high school students. In order to give a scientific and reasonable assessment scheme, this paper takes the General High School Mathematics Curriculum Standards (Revised 2020, 2017 Edition) as the basis and core of assessment, and discusses and interprets the three levels and four dimensions of data analysis literacy by means of theoretical thinking, which can be measured by means of paper-and-pencil tests. On this basis, the use of assessment methods, the setting of test questions, the selection of scorers, and the determination of evaluation results are analyzed in turn. For high school students with a low level of data analysis literacy, teachers can guide students to master the basics of probability statistics and experience the whole process of data analysis. This study can provide a reference for further exploration of mathematical data analysis literacy in the future.

Keywords: High school student, Data analysis literacy, Test and evaluate, Test topic, Scoring criteria

1. INTRODUCTION

Measuring mathematical data analysis literacy of high school students not only provides insight into the current state of data analysis literacy of high school students, but also provides leadership and reference for instructional design that points to the development of data analysis literacy. However, there are very few of the current studies on data analysis literacy have addressed how to measure mathematical data analysis literacy. Wu et al. (2021) studied the historical lineage of data analytic literacy development, and they found that domestic studies related to the level of data analytic literacy development among high school students were scarce, and the existing studies were mostly focused on master's theses [1]. Therefore, it is necessary to establish a scientific and reasonable way to measure mathematical data analysis literacy. This study intends to investigate how to measure mathematical data analysis literacy of high school students, give suggestions about the setting of questions and scoring criteria, take the definition of data analysis literacy in the new curriculum as the standard and core, and summarize the ideas of assessment, in order that the results of the study can provide a reference for measuring data analysis literacy in the future.

2. ANALYSIS OF MATHEMATICAL DATA ANALYSIS LITERACY

The new standard states that data analysis refers to the literacy of obtaining data for the research object, using mathematical methods to organize, analyze and make

inference from the data, and generating knowledge about the research object [2]. Data analysis literacy is divided into three levels and four dimensions, and the division is based on the curriculum standard, which is the starting point of all the data analysis literacy assessments in China, and the details are shown in Table 1.

Table 1. Division of three levels and four dimensions of mathematical data analysis literacy

Level	Dimension	Content
Level 1	**Context and Problem**	Be able to understand random phenomena and simple probability or statistical problems in familiar situations.
	Knowledge and Skill	Be able to select an appropriate probability model to solve familiar probability problems; Be able to select appropriate sampling methods to collect data for familiar statistical problems, master the basic statistical methods of describing, characterizing and analyzing data, and solve problems
	Thinking and Expression	Be able to combine familiar examples and realize that probability is a measure of the possibility of random phenomena, which can be obtained by definition or estimated by statistical methods; Be able to express simple random phenomena in the language of probability and statistics.
	Communication and Reflection	Be able to explain familiar random phenomena with statistical charts and simple probability models in the process of communication.
Level 2	**Context and Problem**	Be able to identify random phenomena in related situations, know the relationship between random phenomena and random variables, and find and put forward probability or statistical problems.
	Knowledge and Skill	Be able to select discrete random variables or continuous random variables to describe random phenomena, understand the statistical significance of sampling methods, and be able to use appropriate probability or statistical models to solve problems.
	Thinking and Expression	Be able to understand the idea of inductive reasoning and the significance of statistical conclusions in the process of using statistical methods to solve problems; Be able to analyze random phenomena with probability or statistical thinking, and express the statistical law of random phenomena with probability or statistical model.
	Communication and Reflection	Be able to explain random phenomena with the law of data presentation in the process of communication.
Level 3	**Context and Problem**	Be able to find and put forward random problems in a comprehensive situation.
	Knowledge and	Be able to comprehensively or creatively use probability

Skill	and statistical knowledge to construct corresponding probability or statistical models to solve different problems; Be able to analyze the essence of random phenomena, discover the statistical laws of random phenomena and form new knowledge.
Thinking and Expression	Be able to understand the importance of data analysis in the era of big data; Be able to understand that data contains information. Through the processing of information, we can obtain the knowledge and laws provided by data and express them in probability or statistical language.
Communication and Reflection	Be able to identify random phenomena and express them in appropriate language in the process of communication.

2.1 Analysis of Content Related to Level 1

2.1.1 Context and Problem

Familiar contexts refers to things and phenomena that are directly related to the content, common in daily life, within mathematics and in other sciences, and well within the students' existing knowledge and cognitive level [3]. *Understanding* means that it is sufficient to know the meaning of a concept or knowledge content at a certain level, not to know why [4]. Thus, *Understand random phenomena and simple probability or statistical problems in familiar contexts* refers to identify random phenomena and probability or statistical problems in common contexts in life, mathematics, and other sciences.

2.1.2 Knowledge and Skill

Probability problem refers to the study of random phenomena and the measurement of the probability of the occurrence of random events [2]. Appropriate is not simply right or wrong, but good or bad according to the context of the problem [5]. Therefore, to choose an appropriate probability model for a familiar probability problem and solve one has to apply the mathematical knowledge and make sound judgments.

Statistical problem may be solved through data analysis [2]. *Collecting data* using a survey method to obtain relevant data for the problem one has to master the method of data collection. *Mastering basic statistical methods* refers to make a reasonable choice according to actual needs [5]. *Basic statistical methods for describing, portraying and analyzing data* mainly refers to statistical charts, which include bar graphs, line graphs, pie charts, histograms of frequency distribution, etc. Therefore, *Choose the appropriate sampling method to collect data for familiar statistical problems, to master the basic statistical methods of describing, portraying and analyzing data, and to solve problems* refers to choose the appropriate sampling method in the process of collecting data in the face of familiar statistical problems in life, and to be able to use charts to portray and analyze the data obtained [6].

2.1.3 Thinking and Expression

Appreciate that probability is a measure of the likelihood of a random phenomenon which refers the meaning of probability through the process of calculating probability. Therefore, *combining familiar examples to appreciate that probability is a*

measure of the likelihood of a random phenomenon occurring and can be obtained by definition or estimated by statistical methods refers to the understanding of the meaning of probability through practical examples, and to know that probability can be obtained by two different methods.

Random phenomena are abundant, and the language of probability and statistics is a mathematical description of random variation that can help us make rational decisions [7]. Therefore, *Express simple random phenomena in the language of probability and statistics* refers to represent randomly changing phenomena in the language of probability and statistics.

2.1.4 Communication and Reflection

Explain familiar random phenomena using statistical graphs and simple probability models to explain phenomena with uncertain outcomes with the help of statistical graphs or simple probability models that you have learned.

2.2 Analysis of Content Related to Level 2

2.2.1 Context and Problem

Associated contexts are contexts that are created based on familiar situations, which facilitate students to ask further questions based on the connections between the contexts [3]. *Identifying random phenomena* refers to recognize and find all random phenomena in the context of the association. *The association between random phenomena and random variables* refers to the introduction of random variables, the classification of random variables according to their essential characteristics, the selection of different mathematical tools to represent the probability distribution of random variables, and the establishment of various probability distribution models, which can be used to describe random phenomena easily and effectively [5].

2.2.2 Knowledge and Skill

Select discrete random variables or continuous random variables to describe random phenomena for a specific problem means introduce appropriate random variables to represent the probability distribution of random variables for a specific problem, and then use probability models to describe random phenomena [8]. *Understand the statistical significance of sampling methods and to be able to use appropriate probability or statistical models to solve problems* refers to know the scope of application of sampling methods and the significance of the data obtained through sampling, and to use probability or statistical models to solve problems [9].

2.2.3 Thinking and Expression

Inductive reasoning refers to the method of reasoning from the particular to the general, that is, the method of reasoning based on the same nature of some phenomena in a class of things to introduce the general conclusion that the class of things have this nature [10]. *The meaning of statistical conclusions* refers to reflect and analyze the quantitative characteristics of things as a whole, to observe the essence of things and the laws of their development, and to make correct judgments. Therefore, *the use of statistical methods to solve problems, perceive the idea of inductive reasoning, and understand the meaning of statistical conclusions* means that in the process of collecting, organizing and analyzing data, to appreciate the idea of moving from the particular to the general and from the part to the whole, and to make judgments based

on the conclusions after obtaining them.

Statistical thinking is a mode of thinking that is expressed through the process of collecting large amounts of data, extracting data, extracting information, and testing the reliability of the results. Probabilistic thinking is a way of thinking and analyzing problems using mathematical probability, which is essentially the use of mathematical and logical tools to estimate the probability of an outcome. Therefore, *the use of probability or statistical thinking to analyze random phenomena* refers to use the knowledge and methods of probability or statistics to think about and analyze problems.

Probabilistic model refers to a mathematical model that describes the relationship between different random variables, usually depicting the probabilistic relationship between one or more random variables in a mutually nondeterministic way. Statistical model can be understood as most statistical tests. *The statistical regularity of random phenomena* means that random occurrence have their chance side and their inevitable side, and this inevitability is expressed in the stability of the frequency of random events in a large number of observations or trials, that is, the frequency of a random event often oscillates around a certain fixed value, and the more trials, the less the oscillation in general. Therefore, *Express the statistical regularity of a random phenomenon by probability or statistical model* refers to explain the inevitability of a random occurrence by probability or statistical model.

2.2.4 Communication and Reflection

Data is divided into two categories, one is the information we get from looking at things in general, and the other is the results of repeated experiments. *Explanation of random events* refers to random events that do not appear to have a pattern, but when the same kind of random events are repeated in large numbers, some kind of pattern can be found. Therefore, *Explain random events by the patterns presented in the data during the communication process* refers to derive a pattern based on information from daily life or experimental results, and explain a certain problem by this pattern.

2.3 Analysis of Content Related to Level 3

2.3.1 Context and Problem

Synthesized context is a synthesis of related contexts based on related contexts, which contain more basic information and familiar elements of mathematics [3]. Random problem is a problem that contains random mathematical phenomena. Therefore, *Identify and formulate random problems in integrated contexts* refers to formulate problems containing random mathematical phenomena in contexts with a higher level of abstraction and complexity.

2.3.2 Knowledge and Skill

Integrating knowledge means that the method used to solve a problem contains more than one piece of knowledge at the same time. *Creative use of knowledge* refers to the use of uncommon ideas to solve a problem. The probability models commonly used in high school include classical probability, geometric probability, conditional probability, binomial distribution and hypergeometric distribution. Therefore, *Solve problems by combining or creatively applying knowledge of probability and statistics to construct probability or statistical models* refers to combine other knowledge points,

mathematical ideas or uncommon ideas to construct probability models to solve problems.

The essence of random circumstance is inevitability and randomness, inevitability means that there is bound to be a result, and randomness means that the result is random. *Statistical laws of random phenomena* means that random circumstance have their chance side and their inevitability side, and this inevitability is expressed in the stability of the frequency of random events in a large number of observations or experiments. *Develop new knowledge* refers to gain knowledge that was not previously known or at a deeper level. Therefore, *Analyze the nature of random phenomena, discover the statistical regularity of random phenomena, and form new knowledge* refers to recognize the essential characteristics of random circumstance, to understand the inevitable side of random circumstance, and to form the original unknown or deeper knowledge.

2.3.3 Thinking and Expression

Data analysis refers to the acquisition of data for the subject of study, the use of mathematical methods to organize, analyze, and infer the data, and the formation of knowledge about the subject of study. Therefore, *Understanding the importance of data analysis in the era of big data* refers to express the importance of data analysis in this era and feel the benefits of data analysis.

Data is the result of facts or observations, the logical summary of objective things, and the raw, unprocessed material used to represent objective things. *Information processing* refers to the process of identifying, filtering, classifying, sorting, analyzing, and recreating information so that the information collected becomes information that can meet our needs. Therefore, *Understand that data contains information, process the information, obtain knowledge and laws provided by the data, and express them in the language of probability or statistics* refers to extract information from the data, to obtain new knowledge and laws by processing the preliminary information, and finally to express them in the language of probability or statistics. The final result can be expressed in the language of probability or statistics.

2.3.4 Communication and Reflection

Appropriate language means appropriate and suitable language. Therefore, *Identify random phenomena in the process of communication and express them in appropriate language* means being able to identify random occurrence in the process of communication with others, and being able to use appropriate language to explain them.

3. ANALYSIS OF MATHEMATICAL DATA ANALYSIS LITERACY MEASURES

3.1 Assessment Analysis of Level 1

3.1.1 Context and Problem

From the above analysis in 2.1.1, the dimension of Context and Problem can be set as a test point, which is understanding random occurrence and simple probability or statistical problems in familiar contexts.

For this test, the questioner can give students familiar situations and ask them to identify random occurrence and probability or statistical problems in them, and see if

they find them correctly and if they can find them all.

It is thus argued that there could be 1 big question with 20 points, and students would be awarded 1 point for each accurate judgment, and eventually their current status on the dimension of Context and Problem would be judged based on their scores.

3.1.2 Knowledge and Skill

From the above analysis in 2.1.2, the dimension of Knowledge and Skill can be divided into two examination points. The first point is choosing an appropriate probability model to solve a familiar probability problem. The second point is choosing the appropriate sampling method to collect data for familiar statistical problems, and mastering the basic statistical methods to describe, describe and analyze data to solve problems.

For point 1, the questioner can give probability problems that are often encountered in life, ask students to choose an appropriate probability model based on the probability problem, and use the chosen probability model to solve the problem. In this way, students are tested to see whether they can choose the appropriate probability model and whether they can use the probability model correctly to solve the problem.

For point 2, first of all, the questioner can give students more familiar statistical problems, let students choose the sampling method according to the needs of the problem, to see whether students can select, and whether the selection is appropriate; secondly, the questioner can give some data, let students use the statistical methods they have learned to describe and portray them, and at the same time analyze the collated data to solve the corresponding problems, to see whether students have mastered the basic statistical methods of organizing and analyzing data.

From this, it is believed that the dimension of Knowledge and Skill can be set up with 3 major questions and 5 subtests for a total of 20 points. The first major question has 10 points, the second major question has 2 points, and the third major question has 8 points. For the first major question, 2 subtests can be set with 5 points each; for the second major question, no more subtests are set with 2 points; for the third major question, 2 subtests can be set with 5 and 3 points assigned according to the difficulty of the question. Ultimately, the students' current status in the dimension of Knowledge and Skill will be judged based on their scores on each sub-question.

3.1.3 Thinking and Expression

From the above analysis in 2.1.3, the dimension of thinking and expression can be divided into two examination points. The first point is appreciating that probability is a measure of the likelihood of a random phenomenon, which can be obtained by definition or estimated by statistical methods. The second point is expressing simple random phenomena in the language of probability and statistics.

For point 1, the questioner can first give an existing experiment and the data obtained from the experiment, and ask students to calculate the probability of a random phenomenon and explain the meaning of the probability obtained, to see if students understand the essence of probability; and also ask what methods can be used in the process of solving probability, to see if students master the different methods of solving comprehensive probability, and whether the solution is correct.

For Point 2, the questioner can give common random occurrence in life and ask

students to use mathematical methods to study and describe random occurrence to see if they can use probability or statistical language and whether they use it rigorously and accurately.

From this, it is believed that the dimension of thinking and expression can be set with 2 big questions and 4 subtests questions, totaling 20 points. The first major question is 10 points and the second major question is 10 points. For the first major question, 2 subtests of 5 points each can be set; for the second major question, 2 subtests questions can be set, with 6 and 4 points assigned according to the difficulty of the question respectively. Ultimately, the students' current status on the dimension of thinking and expression will be judged based on their scores on each sub-question.

3.1.4 Communication and Reflection

Thus, the dimension of communication and reflection can be set as a test point, which is explaining familiar random events using statistical graphs and simple probability models.

For this point, the questioner can give students familiar random events and ask them to use statistical graphs or simple probability models to illustrate random phenomena to see if they are clear about the characteristics of statistical graphs and whether they can correctly use statistical graphs to explain random events, and if they are clear about the characteristics of probability models and whether they can correctly use probability models to explain random circumstance.

It was concluded that the dimension of communication and reflection could be set with 1 large question and 2 subtests of 10 points each, for a total of 20 points. Ultimately, students' current status on the dimension of communication and reflection will be judged based on their scores on each subtopic.

3.2 Assessment Analysis of Level 2

3.2.1 Context and Problem

From the above analysis in 2.2.1, it is considered that the dimension of context and problem can be set as a test point, which is identifying random phenomena, knowing the association between random phenomena and random variables, and identifying and formulating probability or statistical problems in a context of association.

For this point, firstly, the questioner can give an associated situation and ask students to point out the random phenomenon in it according to the description of the situation, to see whether students know the definition of random phenomenon and whether they can identify it in the associated situation; secondly, on the basis of this situation, students can be asked to propose probability or statistical problems, to see whether they have the awareness of probability statistics and whether they can find probability statistics problems in their lives; finally, some random phenomena can be given and students can be asked to portray random phenomena by introducing random variables, to see whether students are really clear about the association between random variables and random phenomena.

From this, it is believed that the dimension of context and problem can be set with 2 big questions and 5 subtests questions, totaling 20 points. The first major question has 10 points and the second major question has 10 points. For the first major question, 2 subquestions can be set and assigned 6 and 4 points respectively according to the

difficulty of the question; for the second major question, 3 subquestions can be set and assigned 3, 3 and 4 points respectively according to the difficulty of the question. Finally, the students' current status in the dimension of context and problem will be judged based on their scores on each sub-question.

3.2.2 Knowledge and Skill

From the above analysis in 2.2.2, the dimension of knowledge and skills can be divided into three examination points. Point 1 is choosing discrete random variables or continuous random variables to describe random phenomena for specific problems; Point 2 is understanding the statistical significance of sampling methods; Point 3 is using appropriate probability or statistical models to solve problems.

For point 1, on the one hand, the questioner can give a question involving discrete random variables and ask students to introduce suitable random variables according to the problem and use mathematical tools to solve probability problems for random events. On the other hand, the questioner can give a question involving continuous random variables and ask students to solve probability problems based on the characteristics of continuous random variables to see if they understand the meaning of discrete and continuous random variables and if the portrayal of random phenomena is correct.

For point 2, the questioner can give a statistical scheme and ask students to choose the appropriate sampling method according to the purpose of the scheme and the premise of ensuring the representativeness of the sample, and see if they are clear about the characteristics and conditions of application of the sampling method.

For point 3, the questioner may give a model prediction problem and ask students to construct a probabilistic or statistical model based on the problem and then solve the problem to see if they can build an appropriate model and if they have solved the problem.

From this, it is believed that the dimension of knowledge and skill can be set with 3 major questions and 4 subtests, totaling 20 points. The first major question is 8 points, the second major question is 4 points, and the third major question is 8 points. For the first major question, 2 subtests of 4 points each can be set; no more subtests will be set for the second and third major questions. Ultimately, students' current status on the dimension knowledge and skill will be judged based on their scores on each subtopic.

3.2.3 Thinking and Expression

From the above analysis in 2.2.3, the dimension of thinking and expression can be divided into two examination points. The first point is using statistical methods to solve problems, perceiving the idea of inductive reasoning, and understanding the meaning of statistical conclusions; the second point is using probability or statistical thinking to analyze random phenomena, and using probability or statistical models to express the statistical laws of random phenomena.

For point 1, first of all, a statistical problem can be given, and students can be asked to use statistical methods to find out the relevant statistics to see if they can use statistical methods correctly; secondly, students can write out what the statistical conclusions they get mean to see if they are clear about the meaning of statistical conclusions; again, students can talk about the application of inductive reasoning with

the process of doing problems to see if they are clear about what inductive reasoning is.

For point 2, a random phenomenon can be given first, and students can be asked to judge which possible outcome is more favorable based on what they have learned about probability statistics, to see if they have the thinking of probability statistics, and whether the judgment is reasonable; secondly, a probability or statistical model can be given, and students can be asked to explain the law expressed according to the known model, to see whether students can understand the information conveyed by the probability or statistical model.

From this, it is believed that the dimension of thinking and expression can be set with 2 big questions and 5 sub questions, totaling 20 points. The first major question has 10 points and the second major question has 10 points. For the first major question, 3 subtests can be set, with 4, 4, and 3 points assigned according to the difficulty of the question; for the second major question, 2 subtests can be set, with 5 points each. Ultimately, students' current status on the dimension of thinking and expression will be judged based on their scores on each subtopic.

3.2.4 Communication and Reflection

From the above analysis in 2.2.4, it is considered that the dimension of communication and reflection can be set as a test point, which is explaining random circumstance with the patterns presented by any given data in the process of communication.

For this test point, the questioner can give life information or experimental data and ask students to summarize the patterns presented by the data by observing the data or processing the data appropriately, and ask them to use the obtained patterns to explain the random phenomena to see if they can find the patterns presented by the data directly or indirectly, and if they can explain the random phenomena according to the patterns.

It is thus considered that the dimension of communication and reflection can be set with 2 major questions for a total of 20 points. The first major question is worth 10 points and the second major question is worth 10 points. Ultimately, students' current status on the dimension of communication and reflection dimension will be judged based on their scores on each question.

3.3 Assessment Analysis of Level 3

3.3.1 Context and Problem

From the above analysis in 2.3.1, it is believed that the dimension of Context and Problem can be set as one test point, which is identifying and asking random questions in an integrated context.

For this test point, the questioner can start with a real-life situation that students are familiar with, abstract and elevate it to get a comprehensive situation, and ask students to read the situation and ask random questions.

It was concluded that one large question with 20 points could be set for the dimension of situation and problem. Ultimately, students' current status on the dimension of communication and reflection will be judged based on their scores on this question.

3.3.2 Knowledge and Skill

From the above analysis in 2.3.2, the dimension of knowledge and skill can be divided into two examination points. The first point 1 is using knowledge of probability statistics in an integrated or creative way to construct probability or statistical models to solve different problems. The second point is analyzing the nature of random phenomena, discovering the statistical laws of random phenomena, and forming new knowledge.

For point 1, on the one hand, the question maker can give a probability problem, and let the students choose a suitable probability model to solve it to see if the students can flexibly use the knowledge they have learned; On the other hand, they can give a statistical problem and ask students to build a statistical model based on known conditions to see if they can build a knowledge network and apply it in a comprehensive way.

For point 2, the questioner can give a random phenomenon and ask students to guess the result of a certain situation to see if they understand the essence that a random phenomenon is a phenomenon with uncertain results; secondly, they can give a model construction problem and ask students to write a statistical law by constructing a model to see if they can discover the law presented in the phenomenon; finally, they can give a prediction problem and ask students to draw a new conclusion based on what is known and what has been asked to see if they can form a new knowledge and whether the formation is correct.

From this, it is believed that the dimension of knowledge and skill can be set with 2 major questions and 5 subtests, totaling 20 points. The first major question has 10 points and the second major question has 10 points. For the first major question, 2 subtests can be set, each with 5 points; for the second major question, 3 subtests can be set, with 3, 4, and 3 points assigned according to the difficulty of the question respectively. The final judgment of students' current status in the dimension of knowledge and skill will be based on their scores on each subquestion.

3.3.3 Thinking and Expression

From the above analysis in 2.3.3, the dimension of thinking and expression can be divided into two examination points. Point 1 is understanding the importance of data analysis in the era of big data. Point 2 is understanding that data contains information, and that the knowledge and patterns provided by data can be obtained by processing the information and expressing it in the language of probability or statistics.

For Point 1, the questioner can give a passage describing the era of big data and ask students to write about what they think is the significance of their knowledge of probability statistics in the era of big data, taking into account the material and their own experience, to see if they recognize the importance of data analysis in the current society.

For Point 2, the questioner may present a large amount of data or graphs and ask students to first write down the information obtained directly or indirectly (through calculations), thus examining whether they can extract the information and process the extracted information. Then they ask them what the information can tell us and ask them to express it in probability or statistical language, so as to check whether they can extract the patterns provided by the data and whether they can use the language of

probability and statistics in a standardized way.

From this, it is believed that the dimension of thinking and expression can be set with 2 major questions and 3 subtests for a total of 20 points. For the first major question, 10 points, and for the second major question, 10 points. For the first major question, no more subquestions will be set; for the second major question, 2 subquestions can be set and assigned 4 and 6 points respectively according to the difficulty of the question. The students' current status on the dimension of thinking and expression will be judged based on their scores on each sub-question.

3.3.4 Communication and Reflection

From the above analysis in 2.3.4, the dimension of communication and reflection can be set as a test point, which is identifying random phenomena in the process of communication and to use appropriate language to express them.

For this test point, the questioner can give common topics in the process of daily communication, simulate the communication process, and let students judge to identify the random phenomenon in it.

From this, it is concluded that there could be 1 large question with 20 points for the dimension of communication and reflection. Ultimately, students' current status on the dimension of communication and reflection will be judged based on their scores on this question.

3.4 Analysis of Overall Measurement

3.4.1 Assessment questions and score settings

According to the above analysis of the three levels and four dimensions of data analysis literacy, when preparing the test questions, 22 test questions can be set, with 240 points, and the questions corresponding to each of the 12 parts composed of the three levels and four dimensions account for 20 points, and the test time is set at 120 minutes.

3.4.2 Scorers and score calculation

To ensure the reliability of the scores, multiple raters should be asked to evaluate each question, and then the average of the scores scored by multiple raters should be taken as the final score of each question. In particular, the scorers should have strong data analysis skills and extensive teaching experience. For example, a graduate student mathematics and a high school mathematics teacher were invited as scorers.

If the difference is less than or equal to 3 points, the average of the two scores is taken as the final score of the question; if the difference is greater than 3 points, another high school mathematics teacher is invited to score the question, and the above two scorers need to re-score the question, and finally the average of the three scores is taken as the final score of the question. Finally, the final scores of the 22 questions were added together to get the total score to get the final score of this test paper.

3.4.3 Evaluation results

From the overall perspective of the three levels and four dimensions of mathematical data analysis literacy, the total score is 240 points. If the total score of a student is between 144 and 180 (60% to 75% of the total score), the student is considered to have a low level of mathematical data analysis literacy; if a student's score on this part of the question is between 181 and 216 (76% to 90% of the total

score), the student is considered to have an intermediate level of mathematical data analysis literacy ; If the student's score in this part of the topic is between 217 and 240 (91% to 100% of the total score), the student is considered to have a high level of mathematical data analysis literacy.

4. CONCLUSION

From the definition of data analysis literacy, it can be seen that to measure the mathematical data analysis literacy of high school students, we mainly look at the degree of achievement of the three levels and four dimensions, and this process can be achieved by analyzing the scores of the problems students do. Therefore, in the process of assessing the mathematical data analysis literacy of high school students, the use of assessment methods, the setting of test questions, the selection of scorers and the giving of evaluation results should closely follow the specific provisions of the Curriculum Standards on the three levels and four dimensions of data analysis literacy, and take them as the basis and core of the assessment. This also coincides with previous studies, in which Yu et al. (2021) used the definition of the six core literacies in the new curriculum as the first-level indicators in evaluating the core literacy of high school students, and used a paper-and-pencil test to measure and evaluate the current state of students' core literacy in mathematics [11]. Only in this way, the final evaluation results obtained are more convincing and can ensure good reliability and validity.

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