Research onPre-employmentJuniorHigh School Mathematics Teachers' Perceptions ofModel Concept Literacy in China

Abstract: At present, the educational problem of model concept literacy of students in compulsory education has become one of the focuses of attention in China, and many scholars have conducted research on it, but there are fewer studies on the cognitive level of model concept literacy of pre-employment teachers, and there is still a research gap. In this study, 20 graduate students majoring in subject teaching mathematics and undergraduates who have been admitted to this specialty in a university were surveyed, and the open-ended interview method was used to investigate the model concept literacy of pre-employment teachers. The analysis of the data revealed that (1) pre-employment teachers' knowledge of the content related to the model concept was narrow, mostly focused on individual points; (2) the depth of pre-employment teachers' knowledge of the model concept was shallow and still concentrated at a low level; and (3) the clarity of pre-employment teachers' knowledge of the model concept was low, and they either did not have a full understanding of the model concept or did not have a good understanding of the model concept. Therefore, it is recommended that: (1) pre-employment teachers should have an all-round understanding of the model concept and related contents; (2) they should have an in-depth understanding of the requirements and meanings of model concept at different levels; and (3) they should be able to clearly and accurately articulate the requirements of the Compulsory Education Mathematics Curriculum Standards(2022 edition)and put them into practice.

Keywords: pre-employmentjunior high schoolmathematics teachers, model concept literacy, cognitive level

1. INTRODUCTION

Model concept mainly refers to a clear understanding of the use of mathematical models to solve practical problems. In fact, not only solving practical problems in daily life is inseparable from the model concept, but also the cultivation of mathematical thinking needs to be improved with the help of the model concept. The model concept helps students to establish models with the help of mathematical knowledge, improves the learning efficiency of knowledge, and can understand mathematical knowledge more intuitively, and teachers can improve the teaching level, optimize the teaching mode, and promote the enhancement of teachers' ability, so its educational value cannot be ignored[1].Compulsory Education Mathematics Curriculum Standards(2022 edition) issued by the Ministry of Education of the People's Republic of China emphasizes that a mathematical model is a basic way to

connect mathematics with reality, and the model concept helps to carry out interdisciplinary theme learning and sense the universality of mathematical applications[2]. However, many scholars and teachers have conducted in-depth and extensive research on the current situation of model concept literacy of junior high school students, but it is found that at present, students' model concept literacy is not high, and model concept literacy has not been well implemented, which leads to the fact that students do not have a good model concept literacy, and the reasons for this phenomenon? How exactly should we cultivate students' model concept literacy? This is a question that deserves our research.

2. LITERATURE REVIEW

Regarding the implementation of model concept literacy in the teaching of junior high school mathematics at the stage of compulsory education, there have been quite several studies, and it can be seen by reading and summarizing the literature that the relevant research content mainly focuses on the status quo of the teaching of model concept, the significance of the model concept in junior high school mathematics teaching, and the cultivation strategy of the model concept in three aspects.

2.1 Status of teaching model concept

After the promulgation of the Compulsory Education Mathematics Curriculum Standards (2022 Edition), scholars have begun to study the core literacy, and the investigation of the current status of the teaching of model concept has also begun simultaneously. However, it is found that the current status of the teaching model concept is not satisfactory, and the problems are mainly concentrated in four aspects:

(1) Teachers or students do not pay enough attention to the model concept

Through a theoretical discursive approach and frontline teaching experience, Lei Yehong et al. [3]found that junior high school students have problems such as insufficient attention to model concept, insufficient understanding of knowledge, and being easily influenced by stereotyped thinking; Through a questionnaire survey of students and interviews with teachers, Miao Xingqiao[4] found that junior high school mathematics teachers can realize that model thinking is important for students' mathematical learning and future development, but the number of times model concept are mentioned in the classroom is still very low, so model concept have not really moved from theory to practice; Qiongqiong Hu[5] found that students who can elevate mathematical learning to the level of ideas are very few after the survey, students have a very limited understanding of the model idea, and even close to half of the students have never heard of the model idea, in the teaching, compared to the cultivation of thinking ability and questioning ability, the teacher lies more in the ability to decipher the body and the correct boss, although at present more and more teachers are slowly beginning to pay attention to the introduction of the real situation, and also realize that model Although more and more teachers are slowly beginning to pay attention to the introduction of realistic situations and realize the importance of model thinking, the penetration of model thinking in classroom teaching is still lacking due to the pressure of some realities.

(2) Lack of clear understanding of modelconcept

Ronghua Xu[6] found that in the current penetration of mathematical

modelconcept in the classroom, most teachers only explain how to solve example problems, but almost omit the aspect of constructing models and model ideas, thus resulting in students not knowing how to build model ideas;Through questionnaires and interviews, it is found by Yao Hanyun[7] that students and teachers do not have a thorough understanding of model ideas, teachers lack in-depth research on the integration of model ideas into mathematics teaching, and rarely introduce model ideas and their applications to students in actual teaching, while students' ability to skillfully use model ideas is also lacking.

(3) Weak ability to apply modelconcept

Using questionnaires and interviews, the vast majority of students can recognize that mathematical model concept can connect theory and practice, and more than half of the teachers will often mention model concept in their daily teaching and specialize in lessons about model concept, but the students' ability to apply model concept is low, especially to real problems, which are difficult to be solved by building mathematical models[8]; Using questionnaires and interviews, Wang Lu[9] found more than half of the students could not transform natural language into mathematical language, indicating that these students could not apply model ideas to real problems, thus reflecting a low ability to apply model concept; Through the questionnaire survey of the eighth grade students, Yaqian Liao[10]found that the eighth grade students in this school do not know much about the mathematical model idea, and their understanding and application of mathematical models are very deficient, and almost few of them will apply what they have learned in the classroom to think and solve the problems they encountered in their daily life.

(4) Bias in the motivation of the learning model

Fang Xiuquan[11] found that most students think that learning model concept is only for daily problem solving, which is a one-sided understanding of mathematical model ideas; Wang Xi[12] used questionnaire and interview methods to investigate and analyze the current situation of teaching mathematical models in junior high school, and came to similar conclusions as Fang Xiuquan, that more students think that the role of mathematical models is only to cope with exams, and that only a small number of students are genuinely interested in the learning of models.

2.2 The significance of the model concept in the teaching of mathematics in junior high schools

Through the literature analysis method, it illustrates the necessity of the application of mathematical model in the teaching of junior high school mathematics, junior high school students, through the cultivation of the model concept, can have a good grasp of the methods and skills of using mathematical knowledge to solve real problems, laying a foundation for the application of senior high school and the subsequent study of mathematical models[13] ; Through the analysis of cases, it is proposed that by applying mathematical models, students can understand mathematical knowledge in a more intuitive way[1]; Fang Huiling[14]thinks that by infiltrating model ideas and concept in junior high school mathematics teaching, students can flexibly use the learned mathematical knowledge to solve real-life problems, improve students' abstract generalization ability and innovation

consciousness, and at the same time, in the process of solving mathematical models, it is also a process of awakening the learned knowledge, so that the previous and the subsequent knowledge can be integrated; Zhuang Wenge[15]thinks that model thinking is the most widely used idea in mathematical activities, and the learning of model thinking can greatly improve the efficiency of students in solving mathematical problems, which is an effective way to improve the quality of junior high school mathematics teaching and the quality of students' mathematical learning; Cui Chunchun[16] believes that model thinking in junior high school mathematics geometry teaching can simplify the problem solving process, improve the speed of problem solving, make the problem more intuitive and concrete; Wang Lei[17] believes that the penetration of the model concept in junior high school mathematics teaching can make up for the lack of the ability of junior high school students to apply the model concept in mathematics in the past teaching, can stimulate the desire of junior high school students for knowledge, and at the same time, can motivate mathematics teachers to continue to learn professional knowledge, so that the knowledge system can be updated; Lifen Hua[18] believes that the penetration of the model concept in junior high school teaching helps teachers to find and solve the problems in geometry teaching in a timely manner, and also meets the requirements of the theory of geometry to a deeper level of development.

2.3 Strategies for developing modelconcept

Different scholars have put forward different views on how the model concept can be integrated into teaching and learning. Through reading and summarizing the literature, it is found that it is mainly distributed in the following nine aspects: some scholars put forward strategies based on specific mathematical knowledge points, Lai Li[19]taking the "hidden circle" problem as an entry point, Shanshan Deng et al.[20]based on the model idea of constructivism theory, taking the teaching of quadratic equations as an example, Jieqiong Liang[21]combines the Example of "Inequality and Group of Inequalities", Zhang Jinjiang[22]takes the example of explaining the problems of quadratic equations as an example, explaining how to use mathematical models to solve problems, we should first create a situation, let students abstract and generalize mathematical problems from the situation, mine mathematical materials, and construct living mathematical models; some scholars put forward the cultivation strategy from the understanding of the model concept, From the three aspects of model cognition, revision, and transfer, Hai-bo Li.[23] explains to promote the cultivation of students' Model concept; Yu Qihong[24] illustrates the practice of cultivating students' Model concept from two aspects of mathematical model methods and mathematical model ideas; Huo Xiaoli[25] mainly puts forward teaching strategies from the three aspects of teaching preparation, teaching implementation, and teaching evaluation, and believes that teaching preparation strategies include deep processing strategies of teaching materials and teaching design strategies, teaching implementation strategies include organizational teaching strategies and content teaching strategies, and teaching evaluation strategies include classroom interaction strategies and teaching feedback strategies; some scholars summarize the principles of cultivation based on their understanding, although different scholars have different

emphasis, but focus on the appropriateness of the model. Some scholars summarize the principles of cultivation based on their knowledge, although different scholars focus on different things, but focus on the principle of appropriateness, the principle of gradual progression, the principle of teaching according to student's abilities, and the principle of linking theory to practice.

As can be seen from the above studies, the former researchers have studied the current situation of teaching model concept in junior high school mathematics at the stage of compulsory education, the significance of model concept in junior high school mathematics teaching as well as the strategy of cultivating model concept in a very detailed and sufficient manner, but at the same time, we can also see that there are almost no scholars who study the model concept literacy of teachers, and the degree of cognition about the model concept of teachers belongs to the blank area of the research. School education plays a leading role in the physical and mental development of human beings, and teachers are specialized in education and teaching, and if students want to improve their model concept literacy in the classroom, teachers naturally become a key role, so teachers' model concept literacy will have a great impact on students' model concept, and become an important factor affecting students' model concept. Therefore, the purpose of this paper is to find out the degree of pre-employment teachers' knowledge about model concept literacy through a survey.

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

1. How widely do current pre-employmentjunior high school math teachers perceive model concept literacy?

2. How well do current pre-employmentjunior high school math teachers know about model concept literacy?

3. Are current pre-employmentjunior high school math teachers' perceptions of model concept literacy clear?

Several current studies have shown that the current level of model concept literacy among junior high school students is low and that the level of teachers' knowledge of model concept literacy is an important factor in influencing students' intuitive imagery literacy, which led to the hypotheses of this study:

Hypothesis 1: Current pre-employmentjunior high school mathematics teachers do not have a broad range of knowledge about model concept literacy;

Hypothesis 2: Current pre-employmentjunior high school math teachers do not have in-depth knowledge of model concept literacy;

Hypothesis 3: Current pre-employmentjunior high school math teachers do not have a very clear understanding of model concept literacy.

3. THEORETICALBASIS

There have been detailed studies on what the model concept entails and what are the main aspects that make it up.

The theory of constructivism is very rich, Ausubel, Piaget, and Vygotsky are the representatives of this theory, and its core idea is: student-centered, focusing on the active exploration of knowledge by students, including the construction of meaning

for new information, the transformation and reorganization of the original experience with the use of existing experience, etc., and the knowledge is not gained through the teaching of the teacher, but is obtained by the learner through the construction of meaning in the help of other people with the help of the necessary learning materials in the context of a certain situation, i.e., the socio-cultural background. Knowledge is not gained through the teacher's instruction, but by the learners in a certain context, i.e., socio-cultural context, with the help of others and by utilizing necessary learning materials through the way of meaning construction. The scaffolding approach of constructivism is similar to the integration of mathematical models into junior high school mathematics.[26]

The Compulsory Education Mathematics Curriculum Standard (2011 Edition) puts forward four general objectives, and in the knowledge and skill objectives, it puts forward the need to experience the process of model and the idea of model, which puts forward the requirements for the integration of the idea of model into the classroom teaching from different perspectives, and the idea of model is the only mathematical idea in the ten core concept of the standard, which echoes with the basic ideas put forward in the general objectives. students' existing experience, to make students experience the process of abstracting mathematical problems from real life, building mathematical models, and solving mathematical problems, all of which fully illustrate the importance that educational researchers have attached to the integration of mathematical models into teaching, teaching materials, and classrooms, and have inspired scholars to study the integration of model ideas into teaching from various perspectives.[9] In the General High School Mathematics Curriculum Standards (2017 Edition) issued in 2017, based on the "five competencies" proposed in the General High School Mathematics Curriculum Standards (Experimental), the mathematical model was added, and six core literacies of the mathematical discipline were put forward, and the curriculum content of the course was adopted as "main line, a theme, and a core content". Adopting the curriculum content structure of "one main line, one theme, and one core content", we have set up four main lines, namely, functions, geometry and algebra, statistics and probability, mathematical model activities and mathematical inquiry activities, and we have integrated these four main lines throughout the compulsory, optional compulsory and elective courses, reflecting the system and structure of mathematics itself. The establishment of "mathematical model activities and mathematical inquiry activities" as the main line is a breakthrough, which improves the insufficiency of the content of "mathematical model activities and mathematical inquiry activities" in the "Experimental Mathematics Curriculum Standards for General Senior Secondary Schools", gives clear and specific requirements, and sets a special class time. A special lesson time has been set, and the contents of the compulsory education stage and the general senior high school stage have been unified. Compulsory Education Mathematics Curriculum Standards(2022 edition) (2011 Edition) clearly states: "model is a basic way for students to experience and understand the connection between mathematics and the outside world. The process of building and solving models includes: abstracting mathematical problems from real-life or concrete situations, using mathematical

symbols to establish equations, inequalities, functions, etc. to represent quantitative relationships and patterns of change in mathematical problems, and solving for and discussing the significance of the results."[27] Professor Shi Ningzhong, head of the revision team of the Compulsory Education Mathematics Curriculum Standards and former president of Northeast Normal University, pointed out in Several Thoughts on Mathematics Curriculum Standard that the basic ideas of mathematics refer to the uppermost ideas, and specifically refer to the abstract ideas, reasoning ideas and model ideas.[28] Li Mingzhen analyzes it from a broad perspective and suggests that "the idea of the mathematical model is that we regard all concept, algorithms, laws, theorems and so on as mathematical models in the education of junior high school mathematics classroom, and at the same time, we use these mathematical means and methods to solve the real problems".[29]

The Ministry of National Education comprehensively summarized the above viewpoints, and 2022 issued the latest version of the Compulsory Education Mathematics Curriculum Standards(2022 edition), which gives the most formal statement of the model concept: the model concept mainly refers to having a clear understanding of the use of mathematical models to solve practical problems. It also clearly describes the level that students need to achieve and the value and significance of knowing that the mathematical model is the basic way to connect mathematics and reality; initially perceiving the basic process of the mathematical model, abstracting mathematical problems from real life or specific situations, using mathematical symbols to establish equations, inequalities, functions, etc. to represent quantitative relationships and patterns of change in mathematical problems, and solving for the results and discussing the significance of the results. The model concept helps to carry out interdisciplinary thematic learning and to perceive the universality of mathematical applications.[2] The Curriculum Standard puts forward the core literacy of the compulsory education stage, i.e., "three skills", namely, the ability to observe the real world with mathematical vision, the ability to think about the real world with mathematical thinking, and the ability to express the real world in the language of mathematics. In the compulsory education stage, the language of mathematics is mainly expressed as data awareness or data conception, model awareness or Model concept, and application awareness. Through experiencing the process of expressing simple quantitative relationships and spatial forms in the real world in mathematical language, students have a preliminary sense of how mathematics communicates with the real world; they can consciously use mathematical language to express the nature, relationships, and laws of things in real life and other disciplines, and explain the rationality of the expression; they can perceive the significance and value of data, and consciously use real data to express, explain and analyze To appreciate the simplicity and beauty of mathematical language, to develop the habit of expressing and communicating in mathematical language, and to form an interdisciplinary sense of application and practical ability. The academic requirements at the junior secondary level are to be able to construct mathematical models by analyzing the conditions and expected conclusions of a problem in its context.

For the sake of the objectivity of the study, this paper uses the definition of

Model concept in the Compulsory Education Mathematics Curriculum Standards (2022 Edition) to study the degree of pre-employment mathematics teachers' knowledge of Model concept literacy.

4. METHOD

4.1 Sample

To faithfully reflect the pre-employment junior high school teachers' cognitive degree of model concept literacy, this study selected 20 teacher education students from the School of Mathematics and Statistics of Shandong Normal University as the survey subjects, including 13 graduate students majoring in subject teaching (mathematics) and 7 undergraduate students majoring in teacher education, and the 7 undergraduate students have been admitted into the graduate school majoring in subject teaching (mathematics), of whom 18 are female and 2 are male. All of them have obtained the qualification of teaching mathematics at junior high school and above, and all of them have the employment intention of teaching in junior high schools in the future.

4.2 Instruments

This study adopts the method of open-ended interviews to conduct the investigation, and the interview outline is set with five questions, respectively from the theoretical and practical aspects of the interview, of which three questions are set for the theoretical aspect and two questions are set for the practical aspect; the main reason for adopting the open-ended interview is that the interview content is flexible and is not limited by the text, which makes it easy to obtain direct and reliable information.

4.3 Data collection

To ensure the reliability and objectivity of the data, this study interviewed each of the 20 pre-employment teachers individually and translated the interviews into timely textual representations.

4.4 Data processing

The interviews were converted into text, removing tone words such as uh-ah and retaining only statements and contents that could express opinions, organizing them strictly according to the original words of the pre-employment teachers' answers, and determining the level of cognition based on the similarity between the pre-employment teachers' expressions and Compulsory Education Mathematics Curriculum Standards(2022 edition). Finally, the number of people mentioned on each level of each indicator was counted, the corresponding percentages were calculated, and a statistical table was made.

Compulsory Education Mathematics Curriculum Standards(2022 edition) contains detailed descriptions of the model concept, the requirements students need to meet, and the significance of fostering model concept, i.e., specific guidance has been given for the theoretical cognitive aspects of model concept, which are expressed in this paper in terms of A, B, and C. Three theoretical dimensions are indicated in this paper, and for the responses of the pre-employment teachers, the answers are expressed in terms of 1, 2, and 3, respectively... to indicate the different levels of the answers, of which A1, B1-B5, C1-C2 are the contents explicitly proposed in the

Standards, and the rest of the aspects are the expanded cognition of the pre-employment teachers; however, there is no clear indication on the practical aspects, i.e., how to infiltrate the modelconcept, therefore, this paper combed through the results of the interviews and categorized the results, with the contents of the content of the similar meaning to be categorized as the same level, and the classroom cultivation strategy is divided into four parts, denoted by D1-D4, the actual teaching cultivation strategy on the pre-employment teachers' views are more concentrated, divided into two parts, with E1-E2, the specific content is shown in Table 1.

Table 1: Interview content coding

Norm	Encodings	Element
Model concept understanding	A1	Model concept is mainly about having a clear understanding of the use of mathematical models to solve real-world problems.
	A2	The model concept is the ability to abstract a mathematical model of a real-world problem and solve the problem based on prior knowledge.
	A3	The model concept addresses mostly real-life problems.
	A4	Use mathematical symbols or language to summarize mathematical structures and solve mathematical problems
Students need to meet the requirements	B1	Students know that mathematical model is a fundamental way of connecting mathematics to reality
	B2	Students can have an initial sense of the basic process of the mathematical model
	B3	Students can abstract math problems from real-life or concrete situations
	B4	Students will be able to use mathematical notation to create equations, inequalities, and functions to represent quantitative relationships and patterns of change in math problems
	B5	Students will be able to find the results and discuss the significance of the results
	B6	Students are proficient in applying mathematical models to solve problems
	B7	Use mathematical symbols or language to summarize and represent mathematical structures
Implications of the role of modelconcept	C1	modelconcept helps to develop interdisciplinary thematic learning
	C2	Feel the universality of math applications.
	C3	Helps develop students' abstract thinking and logical reasoning skills
	C4	Analytical and exploratory skills, problem-solving skills

	D1	Pre-lesson preview digging into real-life examples
How classrooms can costermodelconcept	D2	The lesson uses real-life scenarios as examples for students to experience the model process
	D3	The lesson guides students to seize problematic situations, build models, and gradually develop modelconcept.
	D4	Assign homework so that students can use models to solve problems on their own
How practical teaching develops	E1	Create real-life problem scenarios
	E2	Solve problems using the mathematical models developed

5. RESULTS

5.1 Cognitive breadth

In terms of theoretical cognition, A1, B1-B5, and C1-C2 are the contents explicitly proposed in the Standards, except for the expanded understanding of pre-employment teachers, of which 40%, 40%, and 20% respectively can recognize the model concept from other perspectives on the concept understanding of modelconcept; as for the requirements students need to meet, the point that "students can abstract mathematical problems from real life or concrete situations" was recognized by 13 people the most, accounting for 65% of the total, in addition to 40% and 15% can put forward requirements for students from other aspects. For the requirements that students need to meet, "students can abstract mathematical problems from real life or concrete situations" was recognized by the largest number of people, 13, accounting for 65% of the total number of people, in addition to 40%, 15% of people can put forward the requirements for students from other aspects; for the significance of the model concept, in addition to the value of learning put forward by the "Curriculum Standards", the vast majority of the pre-employment teachers (80%) from the aspect of improving the ability of students to cultivate the model concept. competence aspects of the significance of developing modelconcept.

From the perspective of practical cognition, the Standard does not put forward specific requirements for this, according to the pre-employment teachers' answers, most of the strategies in how to cultivate the model concept in the classroom are described from the three phases of preschool, in-school, and after-school respectively, but in the pre-school strategies, 65% of the pre-employment teachers focused on creating specific situations, and the rest of the interviewers did not put forward any specific and feasible strategies; the strategies in the classroom are mainly divided into two parts, with 30% of the pre-employment teachers thought that they should create situations to feel the model process, and 55% of the pre-employment teachers thought that students should be guided to build the model; in the after-class phase, which was limited to only one point, 90% of the pre-employment teachers thought that they

should assign homework so that students could use the model to consolidate in time. In terms of how actual teaching can be fostered, it is mainly divided into two views, 75% of the pre-employment teachers think that situations should be created, and half of the number of pre-employment teachers think that they should learn to solve problems by utilizing the models they have learned.

It can be seen that the pre-employment teachers' knowledge of the content related to the model concept is relatively narrow, mostly focusing on individual points, and their knowledge of the requirements to be met by the students is broader, covering seven aspects, but for the practice strategies, they only focus on a few aspects, and the specific results are shown in Table 2.

Table 2: Cognitive Breadth Result Statistics

Norm	Encodings	Number of people	Percentage
Model concept understanding	A1	10	50.00%
	A2	8	40.00%
	A3	8	40.00%
	A4	4	20.00%
Students need to meet the requirements	B1	10	50.00%
	B2	10	50.00%
	B3	13	65.00%
	B4	9	45.00%
	B5	9	45.00%
	B6	8	40.00%
	B7	3	15.00%
Implications of the role of modelconcept	C1	11	55.00%
	C2	5	25.00%
	C3	4	20.00%
	C4	12	60.00%
How classrooms can costermodelconcept	D1	13	65.00%
	D2	6	30.00%
	D3	11	55.00%

	D4	18	90.00%
How practical teaching develops	E1	15	75.00%
	E2	10	50.00%

5.2 Cognitive depth

Theoretical cognition is partly based on whether or not there is an extension of the content of the Standards; if there is an extension, it is defined as Level III, if it happens to be the requirements of the Standards, it is characterized as Level II, and if it fails to meet the standards cognitively, it is categorized as Level I. Practical cognition is categorized as follows:

Table 3: Table of horizontal divisions

	Level 1	**Level 2**	**Level 3**
Model concept understanding	A3, A4	A1	A2
Students need to meet the requirements	B6, B7	B1, B2, B3, B4, B5	
Implications of the role of modelconcept		C1, C2	C3, C4

According to the above level division, the number of people at each level was counted, and the percentage of people at each level was calculated according to the proportion of the total number of people in this area, and Table 4 was obtained. The results showed that, for the concept understanding of the model concept ideas, the pre-employment teachers knew more about Level 1, and only 26.7% of the pre-employment teachers were able to recognize Level 3; in terms of the requirements for the students to meet, the vast majority of the pre-employment teachers were able to understand what was required in the Curriculum Standard requirements but had no knowledge of deeper levels of understanding beyond the Standards, i.e., Level III; in terms of the significance of the role of modelconcept, half of the pre-employment teachers were able to reach Level II, and 50% of the pre-employment teachers were also able to provide new insights based on the Standards to reach the Level III level.

It can be seen that in terms of theoretical cognition, for the understanding of the model concept, most of the pre-employment teachers are still focused on Level 1 and Level 2, and in terms of the requirements that students need to meet, the cognition is relatively shallow, and no one can extend it further based on the Curriculum, but in terms of the roles that the modelconcept can play, the depth of cognition of most of the pre-employment teachers can reach Level 3, and for the significance of cultivating

the modelconcept is in-depth.

Table 4: Cognitive depth result statistics

	Level 1	Level 2	Level 3
Model concept understanding	40%	33.3%	26.7%
Students need to meet the requirements	17.7%	82.3%	0%
Implications of the role of modelconcept	0%	50%	50%

5.3 Cognitive clarity

We classified the cognitive clarity of the pre-employment teachers according to the accuracy and completeness of their answers to the interview questions and calculated the number and percentage of high and low clarity respectively. However, the pre-employment teachers were only able to describe in general terms what the Standards require, and no one was even able to clearly articulate the requirement that "students can solve for and discuss the meaning of the results"; the percentages of clarity regarding the meaning of the model concept were 9.09:90.91 and 0.00:100.00, respectively.

This shows that pre-employment teachers have a low level of theoretical cognitive clarity about the model concept, and although they can recognize the requirements of the Standards, they cannot clearly articulate them, either incompletely or inappropriately, and have a vague cognition overall.

Table 5: Cognitive Clarity Result Statistics

Norm	Encodings	Percentage clarity (high: low)
Model concept understanding	A1	30.00: 70.00
Students need to meet the requirements	B1	20.00: 80.00
	B2	10.00: 90.00
	B3	30.80: 69.20
	B4	22.22: 77.78
	B5	0.00: 100.00
Implications of the role of modelconcept	C1	9.09: 90.91
	C2	0.00: 100.00

6. DISCUSSION

6.1 Cognitive breadth

From the analysis of the above data, it can be seen that pre-employment teachers' cognition of the content related to the Model concept is relatively narrow, mostly focusing on individual points; in terms of theoretical cognition, the cognition of the requirements to be met by the students is the widest in scope, covering seven aspects, but is limited to only a few aspects in terms of the concept and meanings; in terms of the cognition of the practical strategies, the cognition is even more limited, concentrating on only two or three aspects, and on the whole, the pre-employment teachers Overall, pre-employment teachers' perceptions of modelconcept were not extensive. Hypothesis 1 was tested.

6.2 Cognitive depth

From the analysis of the above data, it can be seen that the depth of pre-employment teachers' cognition of the model concept is relatively shallow. In terms of concept, most of the pre-employment teachers are still concentrated at Levels I and II, mainly at lower levels; in terms of students need to meet the requirements, the majority of them have a shallow cognition, and no one can extend further based on the Curriculum Standard; however, in terms of the roles that can be played by the model concept, the depth of pre-employment teachers' cognition Most were able to reach Level 3, which shows that the pre-employment teachers' overall depth of knowledge about modelconcept is relatively shallow. Hypothesis 2 was tested.

6.3 Cognitive clarity

From the analysis of the above data, it is clear that pre-employment teachers have low cognitive clarity about the model concept, and can recognize fewer points in the Standards, either incompletely or inappropriately, and overall, pre-employment teachers have vague cognitive clarity about the model concept. Hypothesis 3 was validated.

7. CONCLUSION

Model concept is one of the core mathematical literacies that students need to establish in compulsory education, meanwhile, not only solving practical problems in daily life is inseparable from model concept, but the cultivation of mathematical thinking also needs to be improved with the help of model concept. Teachers' cognitive level of model conception also affects the formation of students' model conception to a certain extent. Therefore, this paper adopts the interview method to investigate 20 pre-employment teachers, aiming to understand the current pre-employment teachers' cognitive level of model concept. Through the survey and analysis, the following conclusions are obtained: (1) the scope of pre-employment teachers' cognition of the content related to the Model concept is relatively narrow, mostly focusing on individual points; (2) the depth of pre-employment teachers' cognition of the Model concept is relatively shallow, mainly focusing on a lower level; (3) the clarity of pre-employment teachers' cognition of the Model concept is relatively low, with either an incomplete understanding or an inadequate understanding.

From the above conclusions, this paper suggests; to improve the importance of

teachers' cognition of the model concept, to open relevant training courses to comprehensively interpret the requirements of the Model Concept in the Curriculum Standard; at the same time, pre-employment teachers should consciously improve their learning motivation, take the initiative to study the content of the Curriculum Standard, and improve their own professionalism and quality development, to achieve (1) an all-rounded understanding of the concept of the Model Concept and the relevant content; (2) an in-depth understanding of the requirements and meanings of model concept at different levels; (3) be able to clearly and accurately articulate the requirements of the Curriculum Standards and put them into practice.

A total of 20 pre-employment teachers were surveyed in this paper. Although it covers undergraduate and master's degree students, the sample size is small and all of them come from the same college in the same school, and other types of pre-employment junior high school mathematics teachers have not been covered, so the sample size and scope are not enough. The next step will be to expand the scope of the study, increase the number of samples, and adopt various research methods to study in-depth the level of pre-employment teachers' perceptions of the model concept, to obtain more objective and comprehensive results.

REFERENCE

1. Liu HY. Discussion on the Flexible Application of Mathematical Models in Junior High School Mathematics Teaching. Math big world (upper), 2018,(08): 91.
2. Ministry of Education of the People's Republic of China. Compulsory Education Mathematics Curriculum Standards(2022 edition). Beijing: Beijing Normal University Press, 2022: 5-10.
3.Lei YH, Lu HL. Analysis of Strategies for Cultivating Students' Mathematical ModelLiteracy in Junior High School Mathematics Teaching. Mathematics Learning and Research, 2022,(06): 113-115.
4.Miao XQ. Research on Contextual Teaching of Junior High SchoolMathematics Based on ModelIdeas. Henan Normal University, 2019.
5. Hu QQ. Research on ModelIdeas and Their Teaching in Junior High SchoolMathematics. Wenzhou University, 2016.
6. Xu RH. The Establishment of Mathematical Model Ideas for Classroom Teaching Under Core Literacy. Tianjin Education, 2021,(24): 26-27.
7. Yao HY. Research on Model Ideas in Junior High School Mathematics Teaching.Ludong University, 2017.
8. Li Q. Research on the Current Situation and Teaching Strategy of ModelIdeas Penetration in Junior High School Mathematics. Shandong Normal University, 2022.
9. Wang L. Research on the Teaching and Learning of ModelIdeas in Junior High school mathematics. Yili Normal University, 2021.
10. Liao YQ. Research on the Instructional Design of Permeating ModelIdeas in Junior High School Mathematics Teaching. Chongqing Normal University, 2021.
11. Fang XQ. Exploring the Way of ModelIdeas into Junior High SchoolMath

Teaching. Exam Weekly, 2019,(A0): 59-60.
12. Wang X. Analysis of the Current Situation and Strategy Research on the Penetration of Mathematical ModelIdeas in Junior High School. Yan'an University, 2021.
13. Han ZP. The Application of ModelIdeas in Junior High School Mathematics Teaching. Qinghai Education, 2021,(Z2): 73-75.
14. Fang HL. The Penetration of Mathematical ModelIdeas in Junior High School Mathematics Teaching. Exam Weekly, 2017,(93): 76.
15. Zhuang WG. Effective Strategies for ModelIdeas Cultivation in Junior High SchoolMath Activities. Exam Weekly, 2017,(21): 97-98.
16. Cui CC. ModelIdeas to Build Efficient Classroom Teaching of Junior High SchoolMath Geometry. Literature and Science Navigation(junior), 2021,(08): 27.
17. Wang L. Exploration of the Penetration Strategy of ModelIdeas in Junior High School Mathematics Teaching. New Curriculum Research, 2021,(15): 133-134.
18. Hua LF. Discussing the Way of Using Model Teaching in Junior High SchoolMath Geometry Teaching. Exam Weekly, 2018,(62): 66.
19. Li L. The Construction of A "Hidden Circle" Model to Find the Most Value of Line Segment Under the Perspective of Core Literacy. Secondary Mathematics Research (South China Normal University), 2022,(18): 36-38.
20. Deng SS, Sang Haifeng. Thinking about Teaching and Learning to Penetrate the ModelIdea in Primary Equations in Junior High School Mathematics. Mathematics Learning and Research, 2020,(13): 105-106.
21. Liang JQ. Suggesting the Penetration of ModelIdeas in Junior High School Mathematics Teaching--Taking the Teaching of "Inequalities and Groups of Inequalities" as an Example. Math Teaching Newsletter, 2018,(29): 24-25.
22.Zhang JJ. Infiltration of Disciplinary Core Literacy in the Use of Mathematical Models in Junior High School. Test and Research, 2019,(18): 174.
23.Li HB. The Practice and Thinking of "Model" in Junior High School Mathematics. Mathematics Teaching Newsletter, 2022,(05): 28-29.
24. Yu QH. Strengthening Mathematical Model to EnhanceCoreLiteracy. Secondary Mathematics, 2020,(20): 85-86.
25. Huo XL. Research on Junior High SchoolClassroom Teaching Strategies Based on Mathematical ModelIdeas in Core Literacy. Shaanxi University of Science and Technology, 2018.
26. Li LJ. A Practical Study on the Integration of Mathematical ModelIdeas into Junior High School Mathematics. Luoyang Normal College, 2021.
27. Ministry of Education of the People's Republic of China. Compulsory Education Mathematics Curriculum Standards (2011 Edition). Beijing: Beijing Normal University Press, 2011.
28. Shi NZ. Reflections on the Mathematics Curriculum Standards. Mathematics Bulletin, 2007,(05): 1-5.
29. Li MZ. Teaching Junior HighSchool Mathematics Based on Model Ideas. Proceedings of the First Chinese Conference on Mathematics Education.,2014:394-396.