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# Literature Review on the Core Literacy of Mathematical Modeling in High School

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**Abstract** – The main purpose of Chinese education is not to teach students about the already existing, but to the students is not created by the development of learning ability, in a lot of mathematical knowledge, not by direct experience, but is caused by the student's creativity. So high school curriculum standard in the original "mathematics" gradually developed into the current core literacy, mathematics and cultivate students creative thinking ability is to cultivate the students' ability of mathematical modeling. In the new curriculum reform, the first to use mathematical modeling as the core accomplishment, Let students have an accurate understanding of mathematical modeling and make full use of modeling ideas to solve problems. Mathematical modeling is to abstract an actual problem into a mathematical language, and then apply the mathematical language reasonably to other practical mathematical problems, which is the process of mathematical modeling.

**Keywords** – Mathematical Modeling, Core Literacy, Journals Reviewed, Mathematical Ability, Mathematical Model.

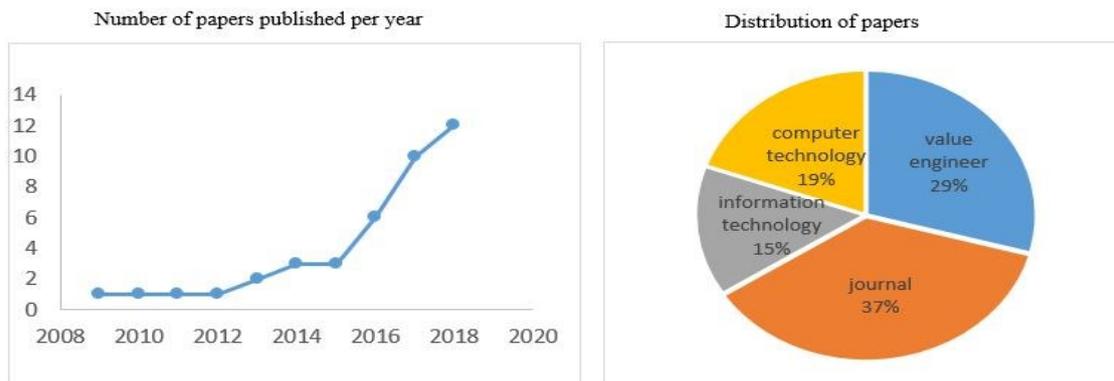
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In September 2016, the press conference of the research results of Chinese students' development core literacy put forward: The fundamental starting point is to put the party's education policy specific and detailed, the implementation of the basic task of khalid ents, cultivate all-round development of people, enhancing core competitiveness in the 21st century national talent [1]. The curriculum standard in China's ordinary high school math courses to further improve, change is the biggest six core literacy, mathematical modeling for the core literacy is not known by students. For most of the ordinary high school students who are not familiar with what is mathematical modeling, and even in some villages and towns school, some students have no heard of mathematical modeling the words. Students can only from the literal meaning to understand in order to establish mathematical model, but don't know what kind of model is set up, how to build a model, etc. In the previous teaching process, most of the teachers do not tell too much about the modeling ideas in class, so students therefore ignore the significant role of modeling on our lives and learning.

In this paper, the key words "mathematical modeling, mathematical modeling core literacy" were input into "China national knowledge network" and "wanfang database". Practice of mathematical thinking in mathematical modeling class; Teaching research of advanced algebra based on mathematical modeling; Research on mathematical modeling competition in independent college; Exploration and research on mathematical modeling teaching in independent colleges; Practice reflection of carrying out mathematical modeling activities in higher vocational colleges; Research on the necessity of integrating mathematical modeling into higher mathematics teaching in higher vocational colleges; Thinking and exploration on the way of mathematical modeling and mathematical experiment curriculum setting." Article 40. The following is 40 articles published each year in nearly a decade the number of line charts and pie charts published journals distribution, can be seen from the diagram, the thesis mainly published in journals and value engineering journal accounts for most of scholars research of mathematical modeling literacy literature is gradually increasing, evident from the trend of the 16 years began to rise, people also pay more attention to mathematical modeling core literacy a hot topic. So, this article mainly around the teaching of mathematical modeling literacy training strategies for the design, the influ-

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-encing factors and the several aspects.



## II. THE LEVEL DIVISION OF CORE ACCOMPLISHMENT IN MATHEMATICAL MODELING

### A. The Connotation of Mathematical Modeling Literacy

As scholars in recent years the study of mathematical modeling quality gradually deepened, people are also on the deep understanding of mathematical modeling are put forward. (1) Lihua Mu<sup>[2]</sup> and other professors in the mathematical modeling of mathematical modeling is defined as: "a mathematical way of thinking, through the abstraction, the simplified build can describe and solve the practical problems of approximate mathematical means" strong; (2) Professor Jinfa Cai<sup>[3]</sup> defined mathematical modeling as "the process of establishing a reversible relationship between the real world and the mathematical world, and then abstracting mathematical problems and solving real problems" in his book on mathematical core accomplishment and its construction. (3) Mingzhen Li<sup>[4]</sup>, a professor of mathematical modeling is defined as: find the inherent law from the actual problem, through digital, graphics, symbols and other forms of the problem, then through mathematics and computer processing, it is concluded that for people to analyze, decision-making, forecast and/or control of quantitative results, the whole process is mathematical modeling. In the 2017 version of the "ordinary high school mathematics curriculum standard" of realistic problem mathematical modeling is put forward mathematical abstraction, expressed in mathematical language problems, using mathematical method to build mathematical model to solve the problem of literacy<sup>[5]</sup>.

Comprehensive the above four on the definition of mathematical modeling can be found that four connotation have in common is a phenomenon or problems on the realistic situation of mathematics abstraction, and then after the abstract model of the specific application to another real situation to analyze and solve the problem. But four definition for modeling the implementation range is not the same. Mother proposed by professor Lihua Mu just for mathematics in terms of a discipline; Professor Jinfa Cai divides it into the real world and the mathematical world. Professor Ming-zhen Li think mathematical modeling is the connection between the practical problems with mathematics. Comprehensive above seems a mathematical modeling to the real world and the external world, is to use mathematics to solve practical problems, one of the most important way to promote the mathematics to develop in the direction of more robust. According to the students of mathematics learning can subconsciously use modeling language and thinking method to put forward problems, analyzing problems and solving the practical problems in life. However, each scholar of mathematical modeling literacy definition does not make students get development generally, nor to establish a link between mathematics and other subjects. So, this question also waits for the scholar further research.

### B. Specific Mathematical Modeling Core Literacy Level Division

Some scholars put forward various classic seven stages of the cycle (Blum & Niss, 1996<sup>[6]</sup>), the four stages (CCSSM, 2010<sup>[7]</sup>) circulation and three phases (PISA, 2012<sup>[8]</sup>) cycle, the cycle are covered mathematical (expressed as mathematical form), mathematics to solve, interpretation and translation three links, stressed mathematical modeling began with no "edit" in the real world, in the mathematics problem is solved, and once the problem solved, also think back to the real world the answer<sup>[9]</sup> in the initial situation. Think high school mainly is to use equation thought to solve problems such as process. In the 2003 national symposium on mathematics education "mathematics modeling cognitive research" by east China normal university professor Zhang Dianzhou and others as the current urgent domestic one of the top ten important problem to study mathematics education<sup>[10]</sup>. Is the rapid development of the 21st century, the latest round of "high school mathematics curriculum standard" in mathematical modeling has become one of the core accomplishment. There are also many experts and scholars believe that mathematical modeling is the teacher give a topic, students accurate analysis on the subject, the mathematical relationship between solving, operation, finally come to the conclusion of a process. In English curriculum according to students for their future development direction, the core literacy levels can be divided into three phases, the first level is mainly for students want to graduate from high school, ability of using mathematical knowledge to solve the problem in a familiar place, to understand and explain the definition of mathematical concept, and what are the requirements, and in the context of familiar with the abstract math problems, combining the reality of life. The second level is mainly for students to attend the university entrance exam continue studies, Require them to be able to out of the familiar with the situation of mathematical language, but also extended to more general situations, and in such a situation will be selective to which the mathematical knowledge, extract the main application methods of mathematical language and thought. The third level is for the university independent recruitment of students do some reference, on the basis of the level 2, can be accurate to express to the real language, feeling principle and phenomena that exist in the nature, to the real world, have a good understanding of realistic problem.

### III. RESEARCH ON TEACHING DESIGN OF MATHEMATICAL MODELING

Although in the previous round of curriculum reform put forward the ideas of mathematical modeling, but due to the shortage of teaching resources, teaching environment and scheduling, inappropriate, so the influence of the last round of curriculum reform, Su-na Li<sup>[12]</sup> scholars should and must incorporate the mathematical modeling ideas in classroom and implement, basically has the following aspects: 1. The problem situation; 2. Independent inquiry; 3. Assist in learning; 4. Model construction; 5. Application development. In the teaching design, creating problem situation can make students fully understand the model answers model is established for students to experience pleasure, after group students collaborative learning helps improve the students' understanding itself is not enough, however, in the process of students to explore middle school students may be because of a certain problem cannot solve cannot proceed, so there should be a specialized, guides the student to avoid the problem of adverse consequences.

Hai Huang and Suihua Lin<sup>[13]</sup> believe that the teaching design of mathematical modeling mainly includes the following stages: 1. Feasibility of integrating mathematical modeling into computer algorithm language courses; 2. Design and selection of modeling cases; 3. Select and compile mathematical modeling problems as supplementary example. In this design, first of all, the selection of modeling cases is mainly based on teaching

materials, and some cases are included, so that students can learn from playing and play through learning, and have a deeper understanding of modeling and application of modeling. However, for students in the compulsory education stage, they do not have good ability of algorithm program. When teachers carry out teaching, they need to bring them into the classroom specifically to find the design method that can adapt to students' ability

Therefore, Daizhong Hou and Ping Yu <sup>[14]</sup> made the following reflections on the design of mathematical modeling topics: 1. Why study this problem; 2. How to study this problem; 3. What is the value of the knowledge. Because of the needs of the development of research on this question is to only, but in order to solve the problem in the study, no matter what kind of in the process of research is closely related to mathematics history, so their interest in learning when students. So in front of the research question may, in accordance with the existing knowledge transformation of thinking and logical reasoning, used to the new knowledge, although for solve students' knowledge, but it is not conducive to the development of students' knowledge and thinking ability of the creative process.

So, teaching design, both to improve the comprehensive quality of teachers, also want to consider student's ability to accept knowledge, make students produce strong interest in the learning process, so that the students love math, for don't let students feel confused and helpless, the process of modeling is to let students to solve problems in learning, and can let students experience the fun of mathematical culture, experience the beauty of mathematics, and will further improve creative ability.

#### IV. STUDY ON INFLUENCING FACTORS OF MATHEMATICAL MODELING

The influence of examination-oriented education, our country present stage of the implementation of mathematical modeling ability is not strong enough, cognitive level is not high enough, Lei Shi <sup>[15]</sup> scholar has put forward the main factors influencing the mathematical modeling of teaching environment, teaching process, social support, and the students expectation. For different students according to their own expertise can know students do not always good at this part of knowledge, so students cooperation is needed to complete. A clear teaching can make students feel happy to learn, natural produce identity to modeling, and in parents, schools and the encouragement of a friend, also is easier to implement.

Mingzhen Li, Zhong Cai and Xinmin Wang <sup>[16]</sup> also proposed that the self-monitoring level, creativity level, mathematical cognitive structure and emotion of mathematical modeling directly affect the academic achievement of mathematical modeling. Cognitive style, creative tendency and mathematical modeling belief directly affect the self-monitoring level of mathematical modeling. Creative tendency and cognitive style directly affect the level of creativity. Creative tendency and cognitive style directly affect mathematical cognitive structure: cognitive style and mathematical modeling belief directly affect mathematical modeling emotion. Every possible influencing factor is connected with each other, so it can be seen that students' satisfaction with mathematical modeling is composed of many factors.

According to the above scholars' research on this survey, I think the factors that affect students' mathematical modeling can be summarized into the following aspects: 1. Mathematics teachers' mathematical modeling of the professional level is not high enough, not enough training, and students alike, they are also recipients of knowledge rather than communicator. Especially for some of the veteran teachers, they may not be willing to accept new knowledge more, without modeling ideas and consciousness, can't accept the good training, therefore, they teach

students is just the tip of the iceberg. 2. The students don't understand more reluctant to accept new knowledge. On a specific problem, students may be due to the strangeness of knowledge of this course, so students may not be willing to accept it, just as college students do when they first take part in a mathematical contest in modeling, students are in a "sluggish" state. 3. There is no deep understanding of modeling ideas between teachers and students. In the teaching of the past, most of the teachers and students is bound for the purpose of imparting knowledge and accept, rather than to apply knowledge to real life to solve practical problems, only in order to seek high marks, so students have no correct understanding, not only the teacher also ignored this important content.

## V. RESEARCH ON CULTIVATION STRATEGY OF MATHEMATICAL MODELING

Wei wei<sup>[17]</sup> argued that in order to better provide students with a profound understanding of mathematical modeling, he proposed the following viewpoints: 1. Apply "problem solving" teaching mode, pay attention to cultivate students' thinking quality of teaching discovery; 2. Desalt the theoretical system of the subject and pay attention to the training of application and practical skills; 3. Take the student as the center to realize the students' interaction 4. Stratified teaching and incentive examination. In his study with the method of stratified teaching, basis for the development of good students can get higher, weak basis for some of the students can fully develop, with students as the main way of answering questions to let the student class discussion on May trigger students' ability of autonomous exploration, exercise the development of students' thinking mode, but hard to avoid some of the students will not good to discuss, according to the requirements of teachers students discuss in class there are likely to encounter difficult problems often cannot continue its interference, therefore, colleges and universities can set up special discussion classes for students to discuss on their own, and teachers can give timely guidance when encountering problems, which will often get twice the result with half the effort.

Ying Sun<sup>[18]</sup> proposed the following teaching strategies to achieve good teaching results: 1. Cultivate the habit of active participation and bold speculation in the open problem situation; 2. Cultivate the learning routine of independent thinking and meditating discovery under the guidance of independent task framework; 3. Train students' cooperative learning routines in the link of cooperation, communication, arrangement and improvement; 4. The construction model of mathematics learning to cultivate students induction, summarize routine. In her study can cultivate students creative thinking, the ability of independent thinking, as well as the spirit of cooperation, but in the team cooperation to division of labor, each person's mission may cause everyone only do their part, you should make the other part can't be improved effectively, so, in the division of labor, should cultivate students' cooperation to complete each task, according to their own advantages and disadvantages, to be able to correct them, try to be in every model has different tasks arranged in cooperation, improve their comprehensive ability.

Qijian Li<sup>[19]</sup> believes that the teaching strategies that enable mathematical modeling literacy to penetrate into the minds of every student are as follows: 1. Strengthen the propaganda of mathematical modeling and competition, and build a system of innovative practical activities for students; 2. Set up a mathematical modeling teaching team and strengthen teachers' ability training<sup>[20]</sup>. 3. Reform teaching methods and integrate mathematical modeling ideas and cases into daily mathematical teaching; 4. Strengthen the training of students' experimental ability and strengthen their modeling ability; 5. Establish mathematical modeling association to "mentoring" to improve students' nationality.

So, since the nineties of the 20th century, every place of school mathematics education in China to apply mathe-

-mational modeling in the mathematics classroom. University, middle school and elementary school in various parts of China are all based on the idea of mathematical modeling to solve the problem, first of all, set up the mathematical contest in modeling, including school, provincial, as well as to the United States to take an active part in mathematical modeling contest. Provide solid foundation for subsequent stages of development. Secondly, most of the early and high school in China opened a school-based curriculum, school-based courses, mathematical modeling of some conditions allow high school even opened mathematics laboratory, dedicated to cultivate students' ability of mathematical modeling, improve students' ability of mathematics. Moreover, pupils will be the training of mathematical ability, mostly embodied in some schools, "the second classroom", "big break" school-based course setup, such as common such as "sudoku" mathematics curriculum.

## VI. CONCLUSION

Mathematical modeling is a new theory, is rarely preciously existing experience, it is difficult to grasp, teachers and students and teaching evaluation on students and the teacher's advantages and disadvantages to break what they consider to achieve the balance between student and teacher, only to break the balance, between teachers and students to effective learning and progress.

Teaching evaluation is necessary, therefore, a teaching link, under the background of new course standard, teaching evaluation to evaluate to everyone, can be their own evaluation, evaluation, can also be carried out within the group can be controlled by parents and relevant experts to evaluate. And for mathematics teaching activities, in a given situation, students must take the initiative to find and ask questions, to know how to build the model, the model bit by bit to improve ultimately achieve the desired effect. For the evaluation results can be applied to the student to detect their own learning, in view of the shortcomings of correct them, to compare good place can enhance themselves in mathematics learning self-confidence, improve the interest in mathematics learning, enables the student to take the initiative to develop a good habit, give full play to their strengths. In the process of evaluation, to avoid using simple evaluation results to evaluate each student, the result of the evaluation should be accord with each student, can reflect the advantages and disadvantages of each student. In the era of modern education, teachers should also make full use of the outstanding information technology analysis of the students' outstanding and deficiency, so as to achieve the effect of their teaching evaluation, reflection of the problems existing in the teaching, To find out the reasons, improve teaching, and better seek accurate evaluation standards for the development of students, so as to help students build a more perfect self in their future development process. Therefore, a good teaching evaluation system is very necessary for the cultivation of mathematical modeling literacy.

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