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# From "Knowledge Transmission" to "Meaning Construction": A Study on the Application of Symbolic Interactionism in High School Mathematics Teaching

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**Abstract:** As a core theory at the intersection of sociology and educational psychology, symbolic interactionism emphasizes the logic of meaning construction that takes symbols as the medium, meaning negotiation as the core, and inter-subjective interaction as the path. It is highly consistent with the symbolic nature, competency-oriented orientation, and classroom interaction attributes of high school mathematics teaching. Currently, high school mathematics teaching generally faces practical dilemmas: "valuing knowledge transmission over meaning construction, valuing algorithm training over symbolic interaction, and valuing one-way lecturing over subject dialogue". Symbolic interactionism provides a brand-new theoretical perspective and practical path to address these dilemmas. This paper systematically elaborates the core connotation and educational implications of symbolic interactionism, and constructs an application framework for high school mathematics teaching from the perspective of symbolic interactionism in line with the core competency requirements of the General High School Mathematics Curriculum Standard (2017 Edition, 2025 Revision). It puts forward specific practical strategies from four dimensions: conceptual symbol generation, problem-solving thinking dialogue, classroom teaching interaction, and core competency development, so as to provide a new paradigm for the theoretical innovation and practice of high school mathematics teaching.

**Keywords:** Symbolic Interactionism; High School Mathematics; Mathematical Symbols; Meaning Construction; Core Competencies.

## 1. Introduction

In the teaching and learning of high school mathematics, the essence of mathematics learning is the process of students' perception, understanding, transformation, application and meaning negotiation of mathematical symbols, and the core of mathematics teaching is the process of interactive practice centered on the mathematical symbol system. In teaching practice, three prominent contradictions prevail in current high school mathematics classrooms. First, the contradiction between the abstractness of mathematical symbols and the concreteness of students' cognition. Teachers mostly present symbol definitions and conclusions directly, ignoring the generation process and meaning interpretation of symbols. As a result, students perceive mathematics learning as "symbol memorization, formula application and mechanical problem drilling", and fail to grasp the mathematical essence behind symbols [1]. Second, the contradiction between the formalization of teaching interaction and the substantiveness of meaning construction. Classroom interaction mostly stays at the superficial behavioral level of "question-and-answer, instruction, and error correction", lacking thinking dialogue, meaning negotiation and idea collision mediated by symbols, so teaching interaction remains on the surface of the classroom. Third, the contradiction between teachers' transmission of symbolic hegemony and students' symbolic expression [2]. Teachers dominate the classroom with an academic and standardized mathematical symbol system, ignoring students' personalized symbolic representations and suppressing their expression and interpretation of symbol meanings, which leads to deviations in students' mathematical understanding.

Theoretically, symbolic interactionism originated from the social psychological thought of George Herbert Mead and was systematically developed by scholars such as Herbert Blumer. Its core proposition is that human social behavior and meaning construction are mediated by meaningful symbols and completed through interactive negotiation between subjects; an individual's understanding of the meaning of symbols determines their behavioral choices, and the meaning of symbols is continuously generated, revised and improved in the course of interaction. Introducing symbolic interactionism into high school mathematics teaching means returning to the symbolic nature of mathematics as a discipline and the interactive nature of teaching. It defines the mathematics classroom as an interactive teaching field "mediated by mathematical symbols, guided by teacher-student interaction, centered on meaning construction, and targeted at competency development", so as to promote the transformation of mathematics teaching from "knowledge-based" to "competency-based".

## 2. Core Connotation and Educational Implications of Symbolic Interactionism

### 2.1. Theoretical Origin and Core Propositions of Symbolic Interactionism

Symbolic interactionism is an important theory in the fields of sociology and social psychology, whose origin can be traced back to the symbolic interaction thought of American social psychologist George Herbert Mead in the late 19th and early 20th century [3]. Mead held that symbols are the core tool for human communication and meaning construction.

Blumer inherited and developed Mead's thought, coined the term "symbolic interactionism", and systematically established its theoretical system in Symbolic Interactionism: Perspective and Method [4]. He put forward three core premises of symbolic interactionism: First, human beings act toward things on the basis of the meanings that the things have for them. An individual's behavioral choice is determined by their interpretation of the meaning of the stimulus object. The same thing carries different meanings for different individuals, and accordingly their behavioral choices vary. Second, the meaning of things derives from social interaction between individuals. The meaning of symbols is gradually formed through dialogue, negotiation and consensus in the interaction between social subjects [5]. Third, individuals constantly revise and improve their interpretation of the meaning of things through the process of interacting with them [6]. In interaction, individuals continuously adjust their understanding of symbol meanings according to others' feedback and their own practical experience. Meaning construction is a dynamic, continuous and cyclical process, rather than a static result completed once and for all.

## 2.2. Educational and Teaching Implications of Symbolic Interactionism

Applying symbolic interactionism to the field of education and teaching enables a brand-new interpretation of the essence of teaching, the nature of learning, teacher-student relationship and classroom interaction, thus forming a symbolic interaction view of teaching. Its core educational implications can be summarized into four aspects:

First, the essence of teaching is inter-subjective meaning negotiation mediated by symbols. Teaching is not a process of teachers unilaterally delivering knowledge to students, but an activity where teachers and students, as well as peers, jointly construct knowledge meaning and develop thinking ability through equal dialogue and two-way interaction with teaching symbols as the medium. The core of teaching is not to make students memorize symbolic conclusions by rote, but to guide them to understand the meaning generated by mathematical symbols and independently construct a complete knowledge system.

Second, the nature of learning is the process in which individuals actively construct meaning through symbolic interaction. Learning is not a process of students passively receiving knowledge. Instead, based on their original cognitive experience, students perceive, interpret and transform new knowledge symbols through symbolic interaction with teachers, classmates and teaching texts, and gradually revise, improve and deepen their understanding of knowledge meaning, so as to realize meaning construction and cognitive development.

Third, the teacher-student relationship features equal dialogue, two-way interaction and shared meaning construction. Symbolic interactionism emphasizes that teachers and students are equal interactive subjects, both equipped with independent symbol interpretation ability and the right to express meaning. Teachers act as the organizers and guides of symbolic interaction, while students are the participants and interpreters of meaning construction. Through two-way symbolic interaction, teachers and students achieve thinking resonance and common development.

Fourth, classroom interaction evolves from superficial verbal interaction to deep thinking interaction. Symbolic interactionism reconstructs the connotation and criteria of classroom interaction: truly effective classroom interaction is not behavioral interaction such as superficial question and answer, discussion and activities, but thinking interaction and meaning construction mediated by symbols. The value of classroom interaction lies in providing a field for meaning negotiation for students and promoting their symbolic meaning construction from the superficial level to the deep level.

## 2.3. Discipline-Specific Connotation of Symbolic Interactionism from the Perspective of Mathematics Teaching

Combined with the symbolic nature, knowledge logic and classroom teaching characteristics of high school mathematics, this paper integrates symbolic interactionism into the discipline and interprets it in a localized context, forming the core connotation of symbolic interactionism from the perspective of mathematics teaching (as shown in Figure 1).

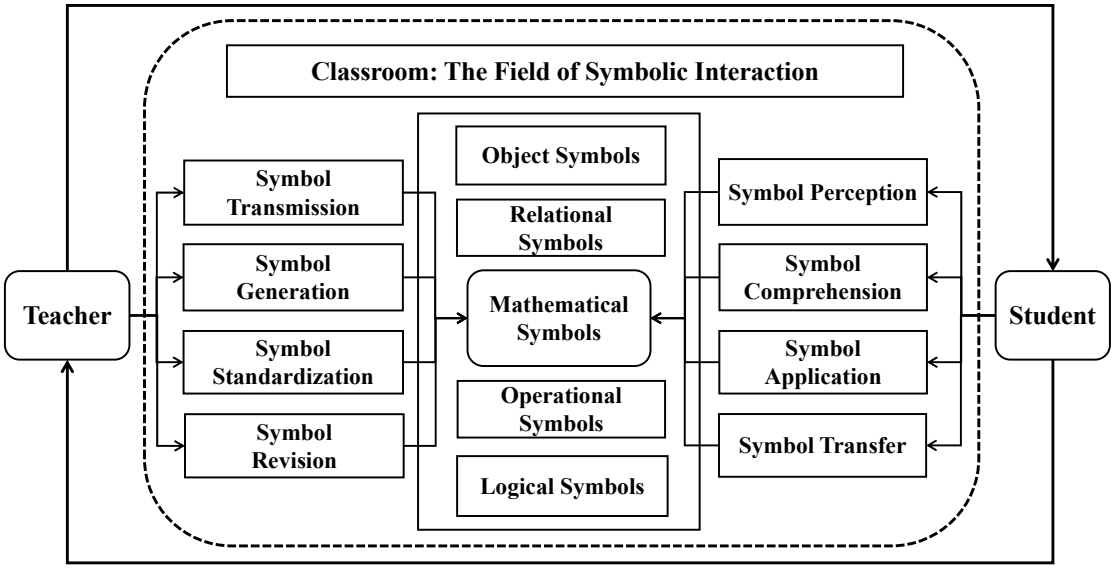



**Fig 1.** Overall structural model of classroom symbolic interaction

Symbolic interaction in high school mathematics classroom teaching is a systematic and spiraling dynamic

process. First, teachers transmit and generate symbols through situational introduction, and students perceive and experience symbols intuitively, forming initial symbolic perception. Second, students interpret the meaning of mathematical symbols based on their original cognitive experience, express their own interpretations and listen to others' views through multi-subject interaction. Teachers conduct symbol standardization and revision, negotiate with students to correct deviations in symbol understanding, deepen their comprehension of symbols, complete the independent construction of mathematical meaning in interaction, and form stable and accurate mathematical cognition [7]. Finally, through exercise application and problem solving, students realize the migration and application of symbolic meaning, and further consolidate and improve their cognitive system.

#### 2.3.1. Core medium: Mathematical Symbol System

Mathematics is a symbolic logical language, and mathematical symbols are a unique attribute of the discipline of mathematics [8]. The highly abstract, precise and formalized system of these symbols constitutes the core medium of interaction in mathematics teaching. The high school mathematical symbol system can be divided into four categories: The first category is object symbols, such as numbers, letters, sets, functions, vectors and geometric figures, which represent mathematical objects. The second category is relational symbols, such as "=, ≠, >, <, ⊥, ∽ ,⊆,..."which indicate the relationships between mathematical objects. The third category is operational symbols, such as "+, −, ×, ÷, ∫, ∑ , log..."which represent mathematical operations. The fourth category is logical symbols, such as "∀, ∃, ∵, ∴, ⇒ , ⇔..."which express mathematical logical reasoning.

#### 2.3.2. Interactive Field: Multi-subject Interaction

Symbolic interaction in high school mathematics classrooms is a systematic interaction involving multiple subjects, encompassing three core dimensions: First, teacher-student symbolic interaction. Teachers and students carry out two-way dialogue centered on mathematical symbols: teachers guide students to interpret the meaning of symbols, while students express their own understanding of symbols; when deviations occur, the two sides negotiate revisions and reach a consensus in comprehension. Second, student-student symbolic interaction. Through group cooperation, discussion and exchange, as well as mutual evaluation and deliberation, students share their respective understandings of symbolic representations, problem-solving ideas and meaning interpretations, and further deepen their mathematical comprehension through the collision of ideas. Third, self symbolic interaction. Individual students reflect on and revise their own symbolic cognition, problem-solving processes and thinking errors through self-reflection and self-dialogue, so as to realize internal meaning construction and thinking improvement.

#### 2.3.3. Interactive Goal: Cultivation of Core Competencies

The ultimate goal of symbolic interaction in high school mathematics is not to have students simply memorize mathematical symbols and mechanically apply formulas and conclusions for problem drilling. Instead, through symbolic interaction, it helps students truly grasp the essential meaning, logical relationships, thinking methods and application value behind mathematical symbols, and independently construct a complete system of mathematical knowledge and meaning. Meanwhile, in the process of symbolic interaction, students' six core competencies—mathematical abstraction, logical reasoning, mathematical modeling, intuitive imagination, mathematical operation and data analysis—are cultivated, and their symbolic awareness, mathematical thinking, expressive ability and cooperative spirit are developed.

## 3. Application Framework and Practical Strategies of High School Mathematics Teaching from the Perspective of Symbolic Interactionism

Based on the core connotation of symbolic interactionism and integrating the whole process and all links of high school mathematics teaching, this paper proposes specific and operable practical strategies and a teaching application framework from four dimensions: the interactive generation of mathematical concept symbols, the interactive dialogue in mathematical problem-solving processes, the construction of multi-subject interaction in classroom contexts, and the advanced interaction of symbol-based core competencies. The framework aligns with the reality of high school mathematics teaching and guides classroom teaching practice.

### 3.1. Dimension 1: Interactive Generation of Mathematical Concept Symbols

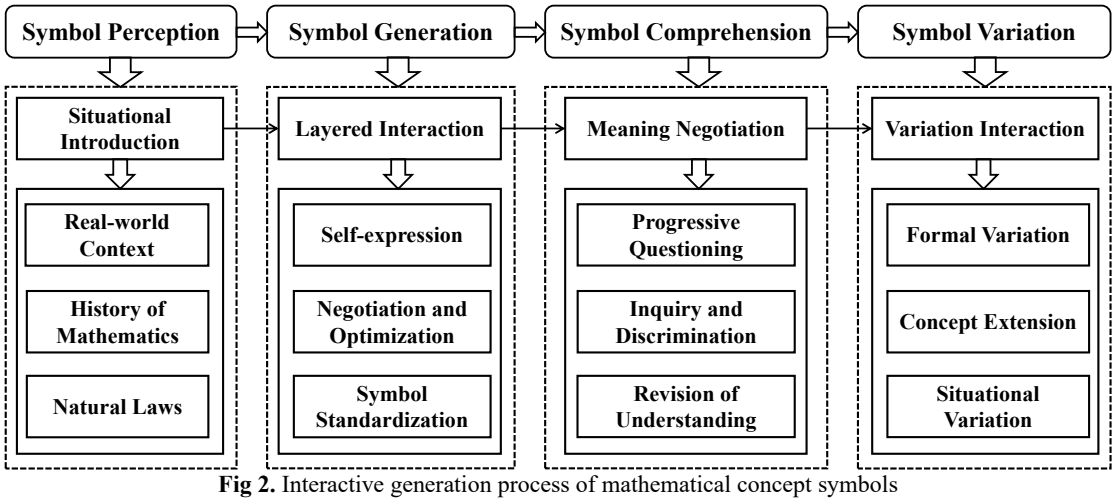



**Fig 2.** Interactive generation process of mathematical concept symbols

Mathematical concepts are the cornerstone of the mathematical knowledge system, and all mathematical concepts are presented with symbols as their carrier. The core misconception in current concept teaching lies in "directly presenting symbol definitions, ignoring the generation process, and mechanically memorizing concepts", which leads students to only retain the formal appearance of symbols without deeply understanding the essence of the concepts. The core of concept teaching from the perspective of symbolic interactionism (as shown in Figure 2) is to engage students in the generation process of mathematical symbols and help them grasp the essential meaning of concept symbols through interactive negotiation.

#### 3.1.1. Symbol Perception Stage

The abstract nature of concept symbols determines that students cannot directly comprehend their meaning; thus, concrete situations must serve as the carrier. In instruction, teachers should integrate life-based concrete scenarios to guide students to perceive problems and discover patterns within contexts, enabling them to understand "why this symbol is introduced, what it intends to express, and what problems it addresses" [9]. For example, when teaching the concept of *monotonicity of functions*, teachers can present concrete scenarios such as temperature change curves and stock price fluctuation trends, guide students to observe the "rising and falling" trends of graphs, and describe the pattern of "y increases/decreases as x increases" in everyday language. This fosters an internal demand for "expressing this pattern with precise and concise mathematical symbols", laying a perceptual foundation for subsequent instruction.

#### 3.1.2. Symbol Generation Stage

Teachers should design layered interactive inquiry sessions to guide students to gradually complete the abstraction, refinement, standardization and formation of symbols through teacher-student and student-student interaction, rather than directly presenting standardized symbols. First, encourage students to express themselves and respect their personalized symbolic representations. Second, organize group discussions for students to compare different symbolic representations and analyze their respective strengths and weaknesses, with teachers guiding students to gradually approach standardized mathematical symbols. Finally, standardize the interaction of symbol generation: teachers guide students to jointly refine symbolic representations and form standardized mathematical concept symbols, while helping them understand the meaning of each component within the symbols.

#### 3.1.3. Deep Understanding after Symbol Formation

After symbols are generated, the core of teaching is not to memorize symbols and definitions, but to comprehend the conceptual essence behind symbols and resolve misunderstandings through interactive negotiation [10]. Teachers should design progressive question chains to guide students in interactive dialogue around concept symbols, to question, discriminate and revise their understanding of symbol meanings, and to grasp the connotation and extension of concepts. For example, after formulating the symbolic definition of monotonicity, design an interactive question chain: *"In the notation $\forall x_1, x_2 \in D$, can the universal quantifier 'for all' be replaced with 'there exists'? Why?"* and *"If the domain D is removed, does the symbolic definition still hold?"* Organize students to debate and express ideas in groups, with teachers providing guidance and correction, so that students truly understand the essential meaning of concept symbols rather than their superficial form through interactive negotiation.

#### 3.1.4. Symbol Variation Practice

Through variation interaction of concept symbols, symbol variations are presented from different perspectives and in different forms, guiding students to distinguish similarities and differences between symbols, grasp the essential attributes of concepts, and improve the conceptual meaning system. This includes variations in symbol form, variations in concept extension, and variations in situational application, enabling students to achieve deep understanding and flexible transfer of the meaning of concept symbols through variation-based interaction.

### 3.2. Dimension 2: Interactive Dialogue in the Process of Mathematical Problem Solving

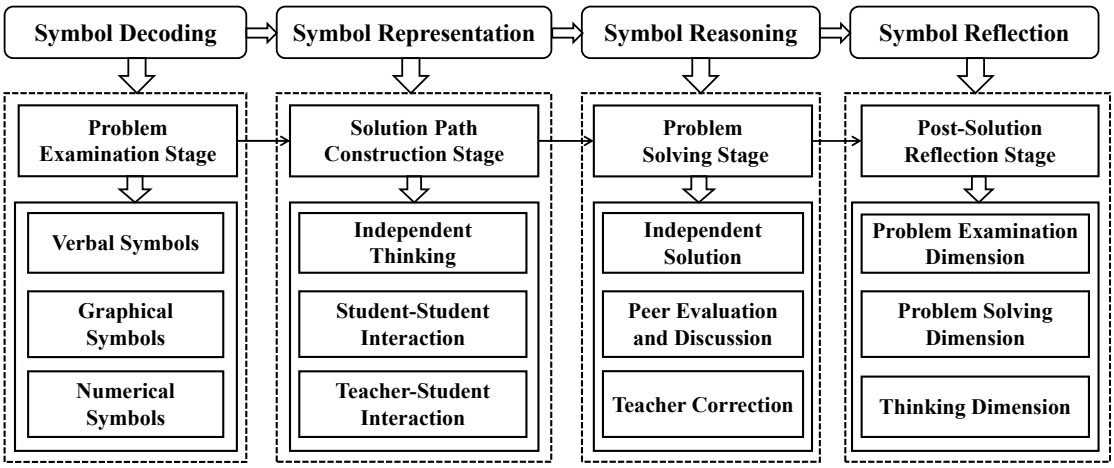



**Fig 3.** Symbolic interaction dialogue system in mathematical problem-solving process

Problem-solving instruction is a core component of high school mathematics teaching. The prevailing misconception in current problem-solving teaching is that "teachers lecture on examples while students mechanically apply problem patterns, and results are valued over processes". As a result, students can only solve problems by rigidly applying symbols and fail to cope with even slightly modified problems [11]. From the perspective of symbolic interactionism, the core of problem-solving teaching lies in constructing an interactive dialogue system of "symbol decoding – symbol

representation – symbol reasoning – symbol reflection" (as shown in Figure 3) with mathematical symbols as the medium, transforming the problem-solving process into a journey of symbolic interaction, thinking development and meaning construction.

#### 3.2.1. Problem Examination Stage

The essence of problem examination is to decode verbal symbols, mathematical symbols and graphical symbols in the problem, so as to comprehend the conditions, relationships and questions embedded in the symbols [12]. In teaching, teachers should guide students to engage in symbol decoding: students independently mark the core mathematical symbols, condition symbols and question symbols in the problem, and interpret the meaning, implicit conditions and constraint scope of each symbol one by one. Students are organized to share their decoding results interactively, complementing and correcting each other. Targeting students' misunderstandings in decoding, teachers guide them to discriminate the connotations of symbols, such as distinguishing easily confused pairs: *there exists* vs. *for all*, *always holds* vs. *can hold*, and *projection of a vector* vs. *projection vector*.

#### 3.2.2. Solution Path Construction Stage

After problem examination, constructing a problem-solving approach is essentially a process of using mathematical symbols to establish associations between problem conditions and questions and build a logical chain of relations [13]. Teachers guide students to carry out symbolic representation interaction, encouraging them to express their problem-solving ideas without requiring standardized writing—only the thinking process needs to be presented. Based on the symbolic expressions of students' ideas, teachers provide guidance, prompts and optimization to help students refine their solution paths. Through symbolic representation interaction, students learn to organize their thinking and construct ideas with mathematical symbols, and develop their logical reasoning ability.

#### 3.2.3. Problem Solving and Presentation Stage

The process of writing out solutions is a process of conducting logical reasoning and standardized expression with mathematical symbols. Teachers guide students to engage in symbolic reasoning interaction, emphasizing not only the correctness of the final result, but also the rigor, standardization and logical validity of symbolic reasoning throughout the process. Students are organized to conduct mutual evaluation and discussion, examining the rigor of symbolic reasoning, the completeness of steps and the standardization of expression. Teachers provide guidance and correction for symbolic errors, logical loopholes and missing steps in problem solving, and standardize students' symbolic reasoning and written expression. Through interaction, students develop rigorous logical reasoning habits and standardized symbolic expression competence.

#### 3.2.4. Post-solution Reflection Stage

Teachers guide students to carry out symbolic reflection interaction, conducting interactive reflection, summary and sublimation around the use of symbols, thinking methods, and mistakes and lessons learned in the problem-solving process [14]. For example, design interactive reflection questions: *"What symbol transformations and reasoning methods are employed in the problem-solving process? What mathematical ideas do they embody?"* and *"What misunderstandings did I encounter in the reasoning process? How can they be corrected?"*. Students are organized to share their reflection outcomes interactively. Teachers guide students to extract the mathematical ideas underlying problem solving, such as the function-equation thought, the number-shape integration thought, the classified discussion thought, and the transformation and reduction thought. This shifts the problem-solving process from "mechanical problem drilling" to "thinking construction and meaning sublimation".

### 3.3. Dimension 3: Construction of Multi-Subject Interaction in Classroom Contexts

Symbolic interactionism emphasizes that meaning construction is the outcome of multi-subject interaction. Symbolic interaction in high school mathematics classrooms is not a single teacher-student question-and-answer exchange, but a systematic and ecological interaction system composed of three dimensions: teacher-student interaction, student-student interaction and self-interaction (as shown in Figure 4). In teaching practice, it is necessary to break teachers' symbolic hegemony, build an equal, democratic and open classroom interaction ecology, and realize symbolic interaction, meaning negotiation and outcome sharing among multiple subjects.

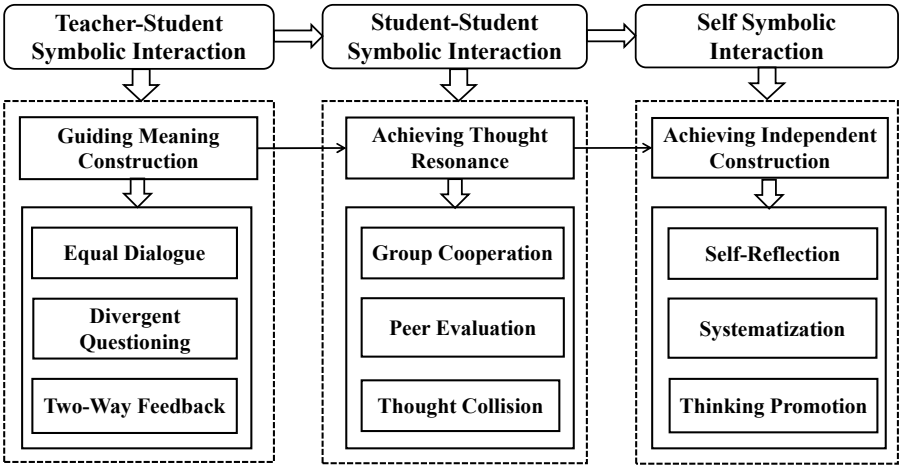



**Fig 4.** Construction system of multi-subject symbolic interaction in classrooms

#### 3.3.1. Teacher-student Interaction

Teacher-student interaction is the core dimension of classroom symbolic interaction. It is essential to thoroughly transform the one-way indoctrinating interaction pattern of "teachers lecturing while students listen", and construct a

teacher-student symbolic interaction model featuring equal dialogue, two-way communication and guided construction [15]. Teachers should abandon symbolic hegemony, respect students' personalized interpretation and expression of symbols, and refrain from rashly negating students' viewpoints. Instead, they should guide students to independently correct cognitive deviations through dialogue. By designing open, inquiry-oriented and speculative interactive questions, teachers leave room for students to express symbols, expand thinking and interpret meanings. In addition, two-way feedback interaction can be implemented: not only do teachers provide feedback and evaluation to students, but students are also encouraged to share their understanding, confusion and alternative viewpoints with teachers, so as to achieve two-way interaction and mutual development in teaching and learning.

#### 3.3.2. Student-student Interaction

In teaching practice, first, cooperative groups can be established. Heterogeneous grouping is carried out based on students' cognitive levels, expressive abilities and thinking characteristics, with clear division of labor for group interaction, ensuring that every student can participate in symbolic interaction and express their own perspectives. Second, group inquiry interactive tasks can be designed. Centering on cooperative inquiry tasks such as meaning interpretation of mathematical symbols, concept discrimination, idea exploration and problem variations, students share symbolic representations and interpret meanings within groups. Third, peer evaluation and discussion can be organized. Targeting students' symbolic expression, problem-solving processes and conceptual understanding, students are guided to evaluate, correct and inspire one another, deepening their symbolic understanding and refining their thinking systems through peer assessment.

#### 3.3.3. Self-interaction

In high school mathematics teaching, students should be guided to engage in self symbolic interaction and develop learning habits of self-reflection, self-dialogue and self-improvement. First, self-reflection question chains can be designed to facilitate self symbolic dialogue and internal reflection at key stages such as concept learning, problem completion and class summary. Second, students can be guided to sort out their symbolic cognitive system. Through self-interaction, students clarify the connections between mathematical symbols, independently construct the symbolic system of mathematical knowledge, and improve their cognitive structure. Third, students are encouraged to conduct self-correction and self-improvement. They are guided to self-examine and self-correct their own problem-solving processes, symbolic expressions and conceptual understanding, and actively revise cognitive deviations to achieve independent meaning construction. Through self symbolic interaction, students gain awareness of their own mathematical thinking process and symbol application process, and enhance their abilities to monitor, regulate and improve their own cognition.

### 3.4. Dimension 4: Cultivation of Core Competencies Based on Symbolic Interaction

For high school mathematics teaching from the perspective of symbolic interactionism, the ultimate goal is to cultivate students' core competencies in mathematics. The cultivation of all six core competencies can be implemented systematically and throughout the entire process through symbolic interaction-based teaching, integrating competency cultivation into every link of symbolic interaction (as shown in Figure 5).

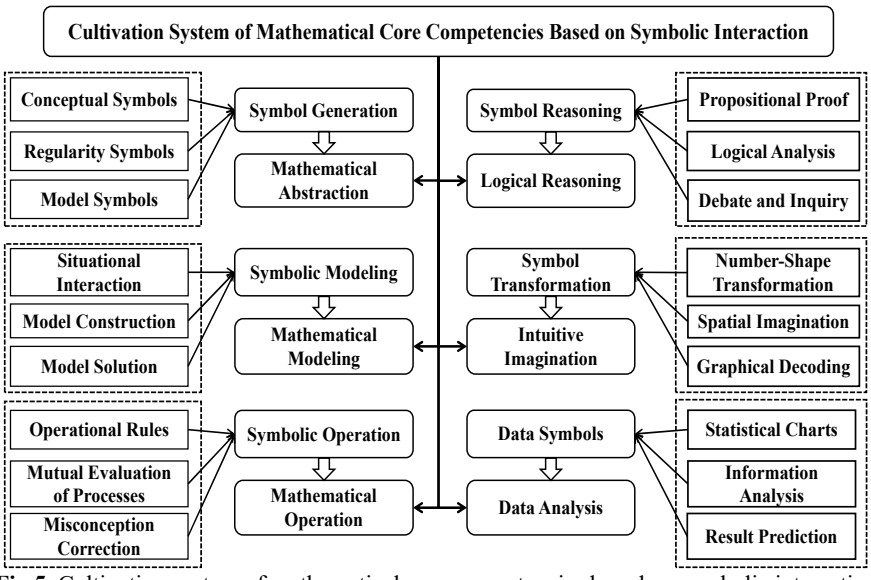



**Fig 5.** Cultivation system of mathematical core competencies based on symbolic interaction

#### 3.4.1. Mathematical Abstraction, Logical Reasoning and Mathematical Modeling

Mathematical abstraction, logical reasoning and mathematical modeling all take symbols as the bond, and core mathematical competencies are cultivated through interaction [16]. Mathematical abstraction relies on the interaction of conceptual symbols, regularity symbols and model symbols. It guides students to discard non-essential attributes from specific situations, represent the essence with mathematical symbols, and complete the leap from perception to abstraction. Logical reasoning promotes students to standardize the deduction process using logical and operational symbols through interactions such as problem-solving symbolic reasoning, propositional proof, analysis of logical symbols, debate and inquiry. In the process of dialogue, students revise logical loopholes, express rigorously, and develop the ability of deductive reasoning. Mathematical modeling emphasizes

the interaction of symbolization of real-world situations, model construction, model solution and interpretation of results. It transforms practical problems into function, equation or statistical models, solves them through negotiation and restores their real-world significance. All three types of interaction take symbols as the medium, enabling students to systematically improve their abilities of abstract generalization, logical deduction and model application in the cycle of generation, reasoning and modeling, laying a solid foundation for mathematical thinking.

#### 3.4.2. Intuitive Imagination, Mathematical Operation and Data Analysis

Intuitive imagination, mathematical operation and data analysis focus on the transformation and manipulation of symbols. Intuitive imagination realizes the intercommunication between numerical symbols and graphs through interactions such as transformation between algebraic and graphical symbols, geometric representation, expression of spatial imagination, and problem-solving with the combination of numbers and shapes. It helps students understand abstract algebra through graphical representation and strengthen geometric intuition. Mathematical operation standardizes the application of arithmetic rules through interactions including interpretation of operational symbols, understanding of arithmetic principles, mutual evaluation of operation processes and correction of common misconceptions. In the process of error correction and conceptual discrimination, students gain a deep insight into the essence of arithmetic principles, and improve the accuracy and standardization of calculation. Data analysis relies on the interaction of data symbol interpretation, statistical chart representation, information analysis and statistical inference. It guides students to organize data, extract key information, conduct probabilistic inference, and identify underlying patterns from charts. These three types of interaction highlight the dynamic transformation and manipulation of symbols: the inter-translation between concrete imagery and abstract concepts, precise execution of algorithms, and mining of data information. They jointly support the coordinated development of intuitive perception, computing ability and data literacy, enabling students to fully grasp the instrumental and ideological nature of mathematics in symbolic interaction.

# 4. Practical Reflection and Optimization Path

## 4.1. Practical Reflection

In the practice of applying symbolic interactionism to high school mathematics teaching, inadequate understanding of the theory and imprecise teaching design can easily lead to the following misunderstandings.

First, the misunderstanding of formalized interaction. Some people simply equate symbolic interaction with behavioral forms of interaction, ignoring its symbolic essence and thinking connotation. This reduces interaction to "interaction for its own sake", making it impossible to achieve deep meaning construction. Second, the misunderstanding of symbolic hegemony. Teachers hold absolute authority over symbolic meaning, only allowing students to accept standardized symbolic interpretations and suppressing students' personalized symbolic representations and meaning interpretations. This is not equal meaning negotiation, and violates the inter-subjective core of symbolic interactionism. Third, the misunderstanding of disordered interaction. Overemphasis on students' independent interaction in the classroom, without precise teacher guidance and proper teaching design, leads to chaotic classroom order. Fourth, the misunderstanding of polarization. Classroom interaction is dominated by students with active thinking and strong expression ability, while students with learning difficulties cannot participate in symbolic interaction or express their views, which further widens the cognitive gap among students.

## 4.2. Optimization Path

Combined with the reality of high school mathematics teaching, the following optimization paths are proposed to ensure the effective implementation and quality improvement of symbolic interaction-based teaching. First, clarify that the core of mathematical symbolic interaction is "thinking interaction and meaning interaction", rather than behavioral interaction. Teaching design should always center on "the meaning construction of mathematical symbols", and eliminate meaningless formalized interaction. Second, teachers should truly establish a student-centered teaching philosophy, respect students' principal status, respect their personalized symbols and viewpoint expression, and build an equal and inclusive classroom interaction ecology. Students should be allowed to make mistakes and hold different views, and their cognitive deviations should be corrected through equal dialogue. Third, refine teaching design to realize the deep integration of interaction and teaching. Integrate symbolic interaction organically into every link of teaching, so as to achieve the in-depth integration of interaction and instruction. Fourth, pay attention to individual differences, and design layered interaction tasks and questions. This ensures that students with learning difficulties can participate in basic symbolic interaction and gain a sense of achievement. High-achieving students can be guided to help peers with learning difficulties take part in symbolic interaction, so that every student can achieve meaning construction and thinking development in interaction, and polarization is avoided.

# 5. Summary

## 5.1. Research Conclusion

This paper systematically introduces symbolic interactionism into the field of high school mathematics teaching, and completes a systematic study covering theoretical interpretation, framework construction, strategy proposal and practical reflection. The conclusions are drawn as follows:

First, symbolic interactionism is highly compatible with the disciplinary nature, teaching objectives, cognitive laws and practical dilemmas of high school mathematics teaching. It serves as an effective theoretical tool for addressing the current pain points in high school mathematics teaching, promoting teaching transformation, and implementing the cultivation of core competencies, with solid theoretical rationality and practical feasibility. Second, high school mathematics teaching from the perspective of symbolic interactionism is essentially a teaching paradigm that takes mathematical symbols as the medium, multi-subject interaction as the path, mathematical meaning construction as the core, and core competency development as the goal. It can promote the in-depth transformation of mathematics teaching

from "knowledge orientation, symbol memorization and one-way indoctrination" to "competency orientation, meaning construction and equal interaction". Third, the constructed four-dimensional application framework and practical strategies of "conceptual symbol generation, problem-solving thinking dialogue, classroom teaching interaction, and core competency development" fit the reality of high school mathematics teaching, meet the requirements of the curriculum standard, and are operable. They can provide systematic teaching guidance for front-line teachers.

### 5.2. Research Prospects

This study has constructed the theoretical system and practical framework for the application of symbolic interactionism in high school mathematics teaching. Future research can be further deepened and expanded from three directions: First, carry out empirical research. Through teaching experiments, quantitatively verify the improvement effect of symbolic interaction-based teaching on students' mathematics academic performance, core competencies and learning interest. Second, expand domain-specific research. Design more targeted symbolic interaction teaching paradigms for different knowledge areas of high school mathematics, such as functions, solid geometry, analytic geometry, and probability and statistics. Third, combine with the development of information technology. Explore new models of symbolic interaction teaching with online-offline integration under the background of digitalization and informatization, so as to further enrich the application research of symbolic interactionism in the field of mathematics education.

In conclusion, symbolic interactionism provides a brand-new theoretical perspective and practical path for high school mathematics teaching. Integrating the concept of symbolic interaction into the whole process of teaching enables mathematics classrooms to return to the symbolic nature, the interactive nature and the essence of educating people, truly realizes the systematic cultivation of students' mathematics core competencies, and promotes the high-quality development of high school mathematics teaching.

## Author Biography

Zhenqiang Lai is a first-grade secondary school teacher and holds a master's degree from Sun Yat-sen University. His research interests include high school mathematics teaching, mathematics teaching methodology, and related fields.

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