

# Reconstruction of the Mathematics Classroom Teaching System under the New Curriculum Philosophy—Analysis Based on Compulsory Mathematics Curriculum Standards (2022)

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**Abstract:** The introduction of a new curriculum concept for mathematics under compulsory education is characterized as a reconstruction of the mathematics teaching system. Curriculum philosophy is both the basic concept of a discipline and an interpretation of the value orientation of the curriculum. By reviewing and reflecting on the curriculum concept in the Mathematics Curriculum Standards for Compulsory Education (2022 Edition), the study concluded that in mathematics classroom teaching, the formulation of teaching goals should be based on core literacy. The selection of teaching content should be based on the core content and basic ideas. In addition, the design of teaching activities should rely on authentic learning situations, while teaching assessment should be embedded in the learning process. This integrated approach helps to build a more comprehensive and meaningful mathematics learning experience.

**Keywords:** Compulsory education mathematics curriculum standard (2022 edition); Curriculum concept; Core literacy; Core content and basic ideas; Process evaluation

## 1. Introduction

The new curriculum concept requires the reconstruction of the mathematics classroom teaching system to be realized. The biggest change in the new round of curriculum reform is the curriculum philosophy, which, on top of the original foundation, emphasizes nurturing, refines core literacy, updates teaching content, optimizes teaching methods, proposes process evaluation, pays attention to the growth and development of each student, and ensures that everyone benefits from quality mathematics education. These concerns involve the four aspects of curriculum objectives, content, implementation and evaluation, which in turn are the core elements of assessing mathematics classroom teaching. Therefore, this paper will discuss the reconstruction of the teaching system of compulsory mathematics classroom based on the above points and the curriculum concepts advocated by the New Curriculum Standards.

## 2. Establishing the Goals of Math Classroom Teaching Based on Core Literacy

The first concept (establishment of core literacy-oriented curricular goals) identifies the mathematics curriculum as "student development-centered" and highlights the new literacy-oriented goals. But what is the understanding of "core literacy-oriented curriculum objectives"? How can the core literacy-oriented curriculum objectives be translated into actual teaching objectives?

### 2.1 Understanding of "Core Literacy-Oriented Curriculum Objectives"

The uniqueness of the new curriculum can be summarized by one keyword, namely "core literacy", a concept that runs through the entire new curriculum and is regarded as its soul and essence. The so-called core literacy refers to "the correct values, necessary character and key abilities that students gradually develop during the learning process of the curriculum, reflecting the educational value of the curriculum"<sup>[1]</sup>, marking the new standard's emphasis on the overall development of students and the

pursuit of fostering a more comprehensive and all-rounded literacy, rather than focusing on the transmission of knowledge only. The core literacy requirements of the compulsory education mathematics curriculum for students are: to be able to observe the real world with mathematical vision, to think about the real world with mathematical thinking, and to express the real world with mathematical language"<sup>[1]</sup>. The interpretation of "core literacy" in the "new curriculum standard" basically continues the viewpoints of the "General High School Mathematics Curriculum Standard (2017 Edition 2020 Revision)", but there are still some minor differences. First of all, the new standard deletes the word "discipline" in "disciplinary core literacy" and fully adopts the term core literacy, which is a reflection and correction of the irrationality of the previous discussion. Core literacy focuses on the core qualities of students rather than a particular subject. Secondly, the six core literacies of the mathematics subject, including mathematical abstraction, have been specifically refined, including symbolic awareness and abstraction ability, and other core literacies, such as number sense and quantity sense, have been added. Although there are some differences, the overall consistency with the six disciplinary core literacies has been maintained, and a consensus has been formed on the cultivation of the mathematics curriculum. Thirdly, compared with the "subject core literacy", the "New Curriculum" emphasizes more on the sense of application and innovation to meet the requirements of mathematics education in the new era. The introduction of these two awarenesses not only enriches the concrete embodiment of core literacy in compulsory education, but also emphasizes the importance of application and innovation. In addition, there is an interrelationship between "core literacy" and "the core literacy of students cultivated by the mathematics curriculum", which is universal and unique, common and individual, whole and part. The Mathematics Curriculum should give full play to its unique, individualized and localized values and functions to cultivate students' abilities to observe the real world from a mathematical point of view, to think mathematically about practical problems, and to use mathematical language to express real-life situations, so as to promote the all-round development of students' core literacy.

The new curriculum concept clearly advocates the establishment of core literacy-oriented curriculum objectives, which emphasizes the cultivation of students' all-round development, focusing on non-intellectual factors, including emotions, attitudes and values, as well as the comprehensive application of knowledge and skills. The construction of curriculum objectives has gone through the process of "double-basic" - "three-dimensional objectives" - "core literacy". "Core literacy". Compared with the subject-oriented double-basic objectives, the three-dimensional objectives pay more attention to the "human being", especially to the impact on non-intellectual aspects, such as affective attitudes and values, etc. This is a progress, which makes the objectives of the curriculum more focused on the "human being", especially on non-intellectual aspects. This is a progress that makes the curriculum objectives more comprehensive, not only focusing on the transmission of knowledge and skills, but also emphasizing the cultivation of students' comprehensive literacy and character. The core literacy-oriented curriculum objectives are advocated because they are more in line with the needs of today's society for comprehensively qualified people. This goal orientation helps to cultivate students with more comprehensive qualities so that they can better adapt and cope with the complex and changing social environment. Therefore, the establishment of core literacy-oriented curriculum objectives helps to promote education in a more comprehensive and integrated direction. However, the three-dimensional objectives are not entirely consistent with human development, especially in real life, where the three-dimensional objectives are often artificially divided into three parallel, parallel three objectives, which results in a disconnect between classroom teaching and human development<sup>[2]</sup>.

## ***2.2 Characteristics of the Formulation of "Core Literacy-Oriented Teaching Objectives" and Strategies for Their Generation***

In order to achieve the curriculum objectives, it is necessary to be specific through the teaching objectives, and the teaching objectives are the specific embodiment of the curriculum objectives, which can be regarded as the stage-by-stage decomposition and refinement of the disciplinary curriculum objectives in teaching, therefore, in order to truly realize the core literacy-oriented mathematics curriculum objectives, it is necessary to adhere to the teaching objectives oriented in this way. Teaching goal refers to the purpose achieved through teaching activities, which reflects the nurturing value of teaching content. The content of the mathematics curriculum is full of the educational value of core literacy, and this nurturing value is the basic basis for us to formulate the development objectives of core literacy.

"Core literacy-oriented instructional objectives" are generally stated with the following basic characteristics<sup>[3]</sup>:

- 1) Integrity. The core literacy-oriented teaching objectives should be guided by the general objectives

of the Standard. These objectives should not only include knowledge and skills aspects, but also reflect process and method, emotional attitude and values. In the formulation, it is necessary to show not only the explicit objectives such as basic knowledge and basic skills, but also the invisible objectives such as basic activity experience, basic mathematical thinking, learning ability and core literacy in mathematics. Although moderate trade-offs can be made in the specific formulation according to the differences in curriculum content, students' situation and teaching conditions, it is still necessary to explore as comprehensively as possible the core literacy and nurturing values embedded in the content.

2) Integration. When teaching objectives, it is necessary to organically integrate the "three-dimensional objectives", the "four bases and four abilities", and the explicit and implicit objectives into one, rather than dividing them artificially. In this regard, Dr. Jianyue Zhang provided a reference model: "Through (experience) X, can (know) Y, develop (experience, accumulate) Z", where X represents the process of mathematical behavior, Y represents the specific problems that can be handled, and Z represents the core mathematical literacy. In this way, the difficult problem of how to combine the multiple dimensions organically when formulating teaching objectives is well solved. It proposes a highly operational and exemplary model for frontline teachers to express teaching objectives. This model not only makes the individual objectives interrelated, but also ensures the comprehensiveness of the teaching objectives, which not only contain the knowledge and skills objectives, but also cover the implicit objectives of mathematical thinking methods, activity testing, key competencies, and core literacy. Such a comprehensive presentation helps to guide students' learning and development in a more comprehensive way.

3) Specific. The formulation of teaching objectives based on core literacy should contain specific knowledge and avoid vague expressions. First, the process objectives need to be refined, with a clear understanding of the four fundamentals, the four skills and other related concepts. Secondly, the use of behavioral verbs should be specific, and action words more precise than "know, understand, master" should be used. For example, the basic meaning of "understand" in the Standard is: "to understand the characteristics of something through specific examples, or to show the characteristics of something through examples;" "to give examples, identify, recognize" and other action verbs, which express the same meaning as "understand". Action verbs such as "give examples, identify, recognize", which express the same meaning as the "understand" level, but are more specific. In addition, the implicit objectives need to be further refined. For example, instead of generalizing "accumulation of thinking experience" or "experiencing the idea of combining numbers and shapes", the specific thinking experience that students need to accumulate when learning a particular piece of knowledge should be specified, as should the specific aspects of combining numbers and shapes in that piece of knowledge. The following is a list of the core literacy oriented concepts that should be addressed. Specifying the core literacy-oriented teaching objectives will help the teacher to play a guiding role in setting objectives, facilitate the teacher to design teaching activities that can develop students' literacy according to the objectives, and help students to understand the learning objectives of the lesson more clearly<sup>[4]</sup>.

4) Subject. When expressing the "core literacy-oriented teaching goals", it is necessary to be student-centered, student-centered, student-centered, and student-oriented, and at the same time, we should also pay attention to whether the students' final grades have achieved the established teaching purpose.

### **3. Selection of Content for Mathematics Classroom Teaching Based on the Core Content and Basic Ideas of Mathematics**

The second pedagogical concept proposes the design of instructional content that reflects structural features, although it also reflects the importance of the structure of the curriculum, which, in essence, points to the construction of the content of the curriculum. The content of the curriculum is an important means of realizing the goals of the curriculum. Although the themes of each section are different, under the guidance of the New Curriculum, the teaching of the four sections of mathematics, namely, mathematics and algebra, graphing and geometry, and statistics and probability, is carried out step by step with the core contents and basic ideas of mathematics. What are the core content and basic ideas of mathematics? How to choose and determine the teaching contents based on them?

#### ***3.1 Understanding of "Core Contents and Basic Ideas of Mathematics"***

The content of the mathematical core is the basis for all subsequent teaching and learning behaviors. The core content of mathematics refers to the content that can reflect the most important and critical part of the mathematics subject, and also reflects the value of mathematical knowledge. In the compulsory

education stage, basic knowledge, basic skills and basic thinking are the core content of mathematics, and also the foundation of students' development.

What are the basic ideas of mathematics? Ningzhong Shi once pointed out that in order to judge the basic ideas of mathematics, two guidelines should be established: the first, the ideas on which the occurrence and development of mathematics are based; and the second, the basic thinking characteristics that people who have studied mathematics should possess.<sup>[5]</sup> Based on this, the basic ideas of mathematics can be summarized into three core elements: abstraction, reasoning, and modeling. Through abstraction, elements of the real world are extracted into the field of mathematics, forming the object of mathematical research; through reasoning, the nature, relationship and calculation results of the object are logically deduced under some assumptions, promoting the inner development of mathematics; through modeling, people use the language of mathematics, mathematical symbols and mathematical methods to depict real-world situations, building a bridge between mathematics and reality. These three factors are interdependent on each other, and it is not appropriate to make too absolute a division between abstraction and reasoning, abstraction and modeling.

### ***3.2 Paths for creating teaching content based on the core content and basic ideas of mathematics***

The selection of contents for teaching in the mathematics classroom should not only be based on the textbooks, but also take into account the actual teaching situation. Mathematics textbooks under the "New Curriculum" have not yet been revised, and it will take some time before they can even be put into use. Therefore, using the current textbooks based on the core content and basic ideas of mathematics will be a must for mathematics teachers in compulsory education. Facing different areas and topics of mathematical knowledge, different teaching methods are generally adopted. The curriculum content of each domain consists of three parts: "Content Requirements", "Academic Requirements" and "Teaching Tips". Therefore, when teachers are faced with any specific knowledge point in the textbooks, they should, first of all, identify which domain the knowledge belongs to, which section of the domain, and which theme of the section they are working on; secondly, they should identify the relevant content requirements, academic requirements and teaching tips of the theme. Finally, the specific mathematics teaching content should be determined based on a comprehensive consideration of the analysis of the textbook, the content of the curriculum, and the specific learning situation of the students.

## **4. Design of Mathematics Classroom Teaching Activities Focusing on Authentic Learning Contexts**

The new curriculum concept is analyzed and discussed from the perspective of mathematics classroom teaching, with a view to realizing the value conversion and meaning reconstruction from "mathematics curriculum" to "mathematics teaching". The proposal of core literacy-oriented curriculum objectives and changes in curriculum content will inevitably drive changes in the way of teaching and learning activities. The third curriculum concept emphasizes the need to identify and pose problems in authentic situations in effective teaching and learning activities, and the "Teaching and Learning Suggestions" section also explicitly proposes to "strengthen the design of scenarios and the posing of problems", so what are effective teaching and learning activities? What is an authentic math learning situation? How to reasonably formulate mathematical problems? And how to design math teaching activities in math contexts?

### ***4.1 Understanding of "effective teaching and learning activities" and "authentic mathematics learning contexts"***

Teaching involves both teaching and learning, and the relationship between teachers and students is a central one throughout the entire teaching and learning activity. It also constitutes a constant theme in the discussion of teaching and learning activities. UNESCO's 1972 publication *Learning to Live: The World of Education Today and Tomorrow* clearly states: "We are today focusing on the principle of 'self-learning' in the education and learning process rather than on the traditional pedagogical principle of teaching and learning."<sup>[6]</sup> However, teaching at present still fails to substantially change the dominant position of teachers in education and is still dominated by the traditional lecture-based classroom. Against this background, the "New Curriculum" advocates "effective teaching and learning activities", closely linking teaching effectiveness to student learning and teacher instruction. Students are regarded as the core subjects of learning, while teachers are the organizers, guides and partners of learning. From the perspective of teaching and learning, teaching is fundamentally a process of student learning. If there is a lack of learning, the significance of teaching becomes worthless; without learning, the formation of

core literacy is like water without a source, without wood. Of course, teaching also requires specialized educational knowledge, the importance of which cannot be ignored. The key lies in the fact that education should be integrated into the learning process of students, and become a support and boost to promote students' independent and active learning, which requires teachers to utilize heuristic teaching methods in teaching to promote students' better understanding of this knowledge. Mathematical knowledge is relatively abstract and difficult to understand, and the play of student initiative becomes more important.

In the teaching process, teachers adopt inspirational teaching to guide students to take the initiative to learn knowledge, so that they can better understand and master what they have learned. At the same time, teachers can also provide targeted guidance according to the learning situation of students, so that students can continue to explore and innovate in their learning. In addition, the math classroom also needs to be conducted in an authentic math context, that is, following the principle of effectiveness. Mathematics contextual teaching is a teaching method in which the teacher matches the teaching content through visual means, which helps to enrich students' perception and guide them to develop association and imagination. Mathematics learning context is different from other courses, one of its essential characteristics is "authenticity", mathematics is a highly abstract subject, so it is not difficult to understand the need to learn in a more authentic context. "Contextualized teaching and problem solving are widely used in education and teaching, mainly because they can focus students' attention more effectively, help them to be fully engaged in learning, help them to review what they have learned before, and lay the foundation for subsequent learning. This suggests that only by integrating mathematical knowledge into real-world contexts can we better ensure that the practice of teaching mathematics is consistent with the characteristics of the subject and maintains the authenticity and effectiveness of learning. It helps students to devote themselves to learning activities, helps students to review the content of previous learning, and also lays the foundation for students' later learning activities. It can be seen that only by placing mathematical knowledge in an authentic situation can we better ensure that the teaching practice of mathematics is in line with the characteristics of the subject and maintain authentic and effective learning.

#### ***4.2 Strategies for designing teaching activities in real mathematical situations***

Grounded in core literacy and effective instructional activities, the new teaching of mathematics calls for a holistic unit of instruction that focuses on acquiring knowledge from real-life situations and provides students with learning activities that are both challenging and rich in variety. Most of the tasks of teaching mathematics are to be carried out in authentic mathematical contexts. The teaching recommendations also suggest choosing teaching methods that can stimulate students' thinking, i.e. strengthening scenario design and problem posing as well as further enhancing synthesis and practice. How do we create authentic mathematical contexts and design teaching and learning tasks?

For the first three sections of students, we should make full use of a variety of situations, so that math teaching is not "paper", but "down to earth", so that students can really appreciate the practical significance of math teaching and really understand the true meaning of "learning math, using math, loving math". "Learning mathematics, using mathematics, love of mathematics," the true meaning. The following scenarios can be created:

1) Life Situation Teaching: In order to improve the efficiency of students' learning, teachers can combine abstract mathematical knowledge with life situations that students are familiar with in order to make students feel friendly and thus stimulate their desire to learn.

2) Interest-based contextual teaching: Interest is a powerful motivator for learning. While pursuing core literacy, teachers need to adopt creative interest-based contextual teaching methods to motivate students to learn mathematics. In the teaching process, teachers can combine the content that students are interested in to impart mathematical knowledge, so that students can learn in a relaxing and enjoyable atmosphere, and effectively reduce the burden of coursework. Through this teaching method, students will not only have a strong interest in mathematics, but also enhance their desire to learn in the process of learning, which will help them understand new knowledge quickly, thus improving the efficiency of teaching.

3) Reflective contextual teaching: The use of reflective contextual teaching aims at guiding students to think positively, and to develop and cultivate logical thinking and mathematical exploration skills while mastering mathematical knowledge, which is in line with the educational ideology of core literacy. In the process of thinking, students can improve their logical mathematical reasoning ability and their ability to explore, and it also helps teachers to deliver knowledge more effectively, truly realizing the

core objectives of contextual teaching.

For students in Key Stage 4:

1) Use interesting classroom activities to create context. Middle school mathematics contains some complex abstract knowledge, in order to stimulate students' interest in mathematics learning, teachers can organize interesting activities related to mathematical knowledge to create the corresponding teaching context. By participating in fun activities, let the students in a relaxed and pleasant atmosphere be returned to the joy of mathematics. Junior high school mathematics teachers can be based on students' interests, combined with the teaching content to design interesting math classroom activities, knowledge transfer in the game, so as to achieve the purpose of strengthening the "context of teaching".

2) Combine with practical operation to pay attention to students' attention. Because it is difficult for middle school students to stay focused for a long time, the teacher can combine context creation and practical operation, so that students can think while doing, so as to seize their attention. In view of the active nature and strong hands-on ability of middle school students, combining thinking with practice is more likely to stimulate their enthusiasm for learning. Therefore, junior high school mathematics teachers can deliberately arrange for students to participate in hands-on practice in the context creation, and acquire knowledge through practical operation in order to better master, understand and apply mathematical knowledge.

3) Introduce competition mechanism to improve learning efficiency. Most junior high school students have a strong competitive mentality, which teachers can apply to situational teaching. Positive mathematical competitions can stimulate students to explore mathematical knowledge, and are an effective means of motivation.

## **5. Suggestions for Teaching and Evaluating Mathematics Classroom Teaching Embedded in the Learning Process**

The fourth curriculum concept emphasizes the exploration of stimulating learning and improving teaching evaluation, especially in the assessment of the implementation stage of the curriculum, focusing on the organic combination of the "four fundamentals" and "four competencies" of students and the core qualities, and using this as the basis for the assessment of the quality of teaching and learning. In the evaluation recommendations, it is also proposed that the process evaluation should be richer, more diversified, and the subjects should be more diverse. So how can the evaluation of mathematics teaching be carried out throughout the whole teaching process and how can the evaluation of mathematics classroom teaching be designed?

### ***5.1 Understanding of "Understanding Assessment in the Mathematics Classroom"***

Mathematics classroom teaching evaluation is a means of applying educational evaluation theory specifically to mathematics teaching, which is used to assess the teaching effectiveness of mathematics teachers and the learning outcomes of students, and is an important tool for improving the quality of mathematics teaching. It has been the core focus of mathematics education research. The "new standard" requires teachers to establish a "teaching-learning-evaluation" trinity view of teaching. In Bloom's taxonomy of educational objectives, teaching, learning and assessment are all directed toward the purpose of learning. Teachers teach to achieve the purpose of teaching, while students learn to achieve the purpose of learning, and the evaluation of the classroom is to achieve the purpose of learning and evaluation<sup>[7]</sup>. In this way, the integration of "teaching and assessment" can be evolved into a more refined integration of "purpose-teaching-learning-assessment". High-quality mathematics classroom teaching must maintain and pursue its inherent consistency, especially in promoting learning, regulating teaching, and checking objectives. In terms of instructional design, the "reverse instructional design model" is adopted: after the learning objectives are established, it is then necessary to "plan ways and means to confirm that students have achieved the learning objectives" (classroom assessment), and then design the teacher's teaching and students' learning. Design. It is conducive to consciously integrating assessment and classroom teaching to achieve the unity of "purpose-teaching-learning-assessment". At the same time, real-time assessment can be used to dynamically adjust teaching and learning, so that students' learning effects can be better achieved. In addition, in essence, teaching, learning and evaluation are specific activities carried out in the implementation of classroom teaching, such as "assessment", pay more attention to the students' learning achievements, monitoring students' learning achievements.

### ***5.2 Suggestions for optimizing the assessment of teaching and learning in the mathematics classroom***

Since the "new standard" emphasizes three kinds of teaching practices, namely, rich evaluation methods, diversified evaluation dimensions and diverse evaluation subjects, in the "evaluation suggestions", we have been thinking about them. The following suggestions are made:

1) Create a situation to stimulate the motivation of evaluation. In teaching, the function of evaluation is to be able to gain insight into students' learning situation and stimulate students' interest in learning, so as to promote all-round development. Establishing a close relationship between teachers and students and sincere emotions is the basis of a good classroom atmosphere. In the classroom, teachers intentionally set up obstacles, create suspense, guide students to find problems and make suggestions for solutions. Through the teacher's "insist on the wrong" to trigger student debate, and ultimately from "stubborn" to "admit defeat" process, teachers need to use emotion to guide students and encourage them to engage in positive emotional communication with the teacher, thus stimulating all students to participate in the classroom. The teacher needs to guide the students emotionally and encourage them to communicate positively with the teacher in order to motivate all students to participate in learning and assessment activities.

2) Emphasize the diversification of evaluation methods. The complexity of core literacy determines the necessity of adopting diversified evaluation methods. In mathematics teaching, teachers can combine students' self-evaluation and group evaluation, and also invite parents and classmates to conduct two-way or multi-way evaluation among themselves. Evaluation should be rich in language, diversified in form and diversified in objectives, including attitude, body language as well as facial expression. In the teaching process, teachers should give full play to the guiding and motivating functions of evaluation, for example, according to Vygotsky's theory of "Zone of Nearest Development" (ZPD)<sup>[8]</sup>, students are divided into learning groups, so as to build up a learning community, and encourage students to supervise and promote each other, so as to improve students' evaluation ability. In the classroom, the teacher can score the students' answers and have them evaluate each other in order to make progress together in a superior and inferior way. Eventually, teachers can assign homework in layers according to the differences in students' performance and reward the group teams with outstanding and outstanding performance, so as to stimulate students' learning motivation and cultivate their emotional and personality qualities.

3) In teaching practice, focus on respect for the object of assessment. In the teaching and learning process, learning and assessment are student-centered and student-centered. In order to realize effective evaluation, students need to participate fully. In the teaching process, teachers should give full play to students' subjective initiative and cultivate their innovative and creative abilities. Teachers should allow students to express their independent opinions and views, positively recognize their unique evaluation and insights, even for the wrong point of view, but also to respect the students' feelings and personality. Teachers should also provide students with sufficient evaluation time and space to develop their evaluation skills through observation, analysis and comparison activities. Ultimately, the teacher's goal is to guide students in the process of argumentation, rely on students' own subjective initiative to acquire knowledge, rather than teachers unilaterally to instill knowledge into the minds of students unchanged.

## **6. Conclusions**

This paper takes the Compulsory Education Mathematics Curriculum Standards (2022) as the core, and conducts an in-depth exploration of the curriculum concept and teaching system. Through in-depth analysis and classroom research practice, some conclusions are drawn: the teaching objectives of mathematics classroom should be established on the basis of core literacy; It is necessary to select the teaching content of mathematics classroom based on the core content and basic ideas of mathematics; The teaching design of mathematics classroom should be selected in the context of real learning situations. It is necessary to embed the evaluation of mathematics classroom teaching into the classroom. It is hoped that it can provide some help and inspiration for the teaching of mathematics teachers in compulsory education.

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