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# *Optimization Strategies for Interdisciplinary Teaching of Elementary School Mathematics Based on Core Literacy*

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***Abstract:*** Compulsory education curriculum program emphasizes that the mathematics curriculum should carry out interdisciplinary theme learning, and it is particularly important for elementary school teachers to have interdisciplinary teaching strategies. Based on this, the thesis firstly points out that with the deepening of the curriculum reform, it is of great significance to carry out interdisciplinary teaching in elementary school mathematics curriculum, which mainly includes cultivating students' comprehensive literacy, enhancing students' sense of innovation, and improving the ability to solve practical problems. Secondly, the constructivist learning theory and multiple intelligences theory of interdisciplinary teaching of elementary school mathematics are elaborated. The current problems in interdisciplinary teaching of elementary mathematics are analyzed again, including unclear interdisciplinary goals, lack of integration of interdisciplinary content, single interdisciplinary teaching method, and unreasonable evaluation methods. Finally, the optimization path of interdisciplinary teaching of elementary mathematics based on core literacy is proposed: clarifying interdisciplinary teaching goals; integrating teaching resources to optimize teaching content; innovating interdisciplinary teaching methods; and establishing a diversified evaluation system.

## 1. Introduction

With the continuous deepening of education reform, elementary school mathematics teaching is facing unprecedented challenges and opportunities. Traditional teaching methods often focus on the instillation of knowledge points and the training of test-taking skills, which to a certain extent limits the overall development of students. Against this background, the Compulsory Education Mathematics Curriculum Standards (2022 Edition) came into being, followed by research and practice on interdisciplinary teaching of elementary mathematics. Interdisciplinary teaching emphasizes breaking down disciplinary barriers and integrating diversified knowledge, with the ultimate goal of enhancing students' core literacy. It helps students build a more complete knowledge system and improve their problem-solving ability by integrating knowledge and methods from different disciplines. In elementary school mathematics teaching, interdisciplinary teaching can integrate knowledge from science, art, society and other fields, so that students can feel the practicality and interest of mathematics in the process of solving practical problems, thus

stimulating students' interest in learning and desire to explore. [1]

However, the implementation of interdisciplinary teaching is not an easy task. It requires teachers to have interdisciplinary knowledge reserves and teaching ability, and it also requires students to have certain independent learning and cooperative learning ability. Therefore, how to effectively implement interdisciplinary teaching and enhance students' core literacy has become an urgent problem in the field of elementary mathematics education.

## 2. The significance of interdisciplinary teaching of elementary mathematics

Interdisciplinary teaching of elementary school mathematics is of great significance in enhancing students' core literacy. It not only helps to broaden students' knowledge horizons and expose them to more diversified knowledge systems, but also plays an active role in promoting the development of students' thinking ability, innovation ability and practical ability. In elementary school mathematics teaching, focusing on interdisciplinary integration can help students better understand the nature and value of mathematical knowledge. Mathematics as a basic subject, its knowledge and way of thinking are closely related to other subjects. Through interdisciplinary teaching, teachers can guide students to discover the commonalities between mathematics and other disciplines, thus deepening students' understanding of mathematical knowledge and increasing their interest and motivation in learning.

### 2.1. Developing students' comprehensive literacy

The implementation of interdisciplinary teaching in elementary school mathematics education is of remarkable significance to the cultivation of students' comprehensive literacy. By breaking down disciplinary barriers and promoting the organic integration of mathematics with science, art, sports and other disciplines, interdisciplinary teaching provides students with a broader vision of knowledge and learning space. Under this teaching mode, students can not only master math knowledge in depth, but also exercise and improve their observation, imagination, expression and other comprehensive literacy in practice.

In the interdisciplinary integration of mathematics and science in elementary school, students can explore the connection between mathematics and natural science through observation and experimentation. For example, when learning units of measurement, by combining scientific experiments, students can experience the differences and importance of different units of measurement in practical applications, thus deepening their understanding of mathematical concepts and cultivating the scientific spirit and practical ability. The combination of art and mathematics can stimulate students' creativity and aesthetic feelings. By appreciating and analyzing the aesthetic elements of mathematics such as symmetry and proportion, as well as applying mathematical knowledge to artistic creation and other activities, students can feel the unique charm of mathematics and enhance their imagination and creativity in the process of artistic creation. Interdisciplinary teaching of mathematics and sports is also an effective way to cultivate students' comprehensive literacy. Incorporating mathematical elements into sports activities, such as using mathematical knowledge to analyze sports trajectories and calculate sports performance, can not only enhance students' physical fitness, but also improve their ability to use mathematical knowledge to solve practical problems.

Interdisciplinary teaching of elementary school mathematics creates a richer and more diverse learning experience for students by integrating the knowledge and methods of different disciplines. This mode of teaching not only helps to improve students' mathematical literacy, but also comprehensively develops their observation, imagination, expression, as well as practical and innovative abilities, thus laying a solid foundation for students' future all-round development.

## 2.2. Enhancing students' sense of innovation

The implementation of interdisciplinary teaching in elementary school mathematics education significantly opens up broader thinking boundaries for students and constructs a diversified platform for innovation. This mode of teaching encourages students to combine their mathematical knowledge with other disciplines, thus exploring new ways of thinking and problem solving in the cross-fertilized field of knowledge. [2]

In the intersection of mathematics and science, students can deepen their understanding of mathematical concepts such as proportions and statistics through experimental data collection and analysis, and at the same time cultivate a scientific spirit and a sense of innovation in this exploration process. For example, when studying the relationship between plant growth and factors such as sunlight and water, students not only use their mathematical knowledge to record and analyze data, but also stimulate their enthusiasm for exploring the unknown in scientific experimental design, and this kind of interdisciplinary practical activity helps students to form an innovative way of thinking. The combination of math and art provides another creative learning space for students. Incorporating mathematical elements, such as geometric shapes and symmetry, into artistic creations not only enhances the aesthetics of the artwork, but also allows students to experience the unique charm of mathematics in the creative process. This interdisciplinary learning experience helps stimulate students' innovative thinking and develop their individuality and creativity in artistic expression. Interdisciplinary teaching also allows students to discover the application value of mathematics in sports through the combination of mathematics and sports. For example, the use of mathematical knowledge in sports activities to calculate the trajectory and speed of movement not only improves students' motor skills, but also allows them to feel the practicality of mathematics in actual operation, thus stimulating more innovative ideas and practices.

The application of interdisciplinary teaching in elementary school mathematics effectively promotes the enhancement of students' sense of innovation. Through the mutual penetration and integration of knowledge from different disciplines, students are able to look at problems from a broader perspective, generating new angles of thinking and solutions, and this innovative ability is undoubtedly of great significance to the overall development and future growth of students.

## 2.3. Enhance students' ability to solve practical problems

Interdisciplinary teaching emphasizes the integration and application of knowledge, especially in elementary school mathematics education, this mode of teaching shows its unique value. Through the organic integration of mathematics and other disciplines, students can not only deepen their understanding of mathematical knowledge, but also apply this knowledge in practical situations, thus enhancing their ability to solve practical problems.

In the integration of math and science teaching, students often need to apply their knowledge of proportions to solve measurement problems in science experiments. For example, when conducting chemistry experiments, students need to accurately mix reagents according to the reaction ratio of chemical substances, which requires students to master the basic concepts of proportions as well as their ability to apply mathematical knowledge to practice. Through such interdisciplinary learning, students not only consolidate their mathematical knowledge, but also improve their operational accuracy and problem-solving ability in science experiments. In the combination of mathematics and sports, statistical knowledge is widely used. Students can gain a deeper understanding of the principles and methods of statistics by collecting and analyzing data from sports competitions, such as athletes' scores and the ratio of winning and losing matches. This interdisciplinary learning activity not only enhances students' data processing ability, but also cultivates their data analysis

thinking, enabling them to view and evaluate various phenomena in sports competitions more scientifically. Interdisciplinary teaching also helps students develop a comprehensive knowledge system and an integrated way of thinking. When solving complex problems, students need to synthesize the knowledge and methods of multiple disciplines, which requires them to have the ability to integrate knowledge across disciplines. Through interdisciplinary teaching in elementary school mathematics, students can gradually learn how to establish connections between different disciplines and how to combine mathematical knowledge with knowledge from other disciplines so as to solve various practical problems more effectively.

Interdisciplinary teaching of elementary school mathematics has a significant role in enhancing students' ability to solve practical problems. This teaching mode can not only help students better master mathematical knowledge, but also cultivate their interdisciplinary thinking and practical ability, laying a solid foundation for their future learning and development. Therefore, interdisciplinary teaching should be vigorously promoted and implemented in elementary school mathematics education to better meet the needs of students' comprehensive development. [3]

## 3. The theoretical basis of interdisciplinary teaching of elementary mathematics

### 3.1. Constructivist Learning Theory

Constructivist learning theory provides an important theoretical foundation and practical guidance for interdisciplinary teaching of elementary mathematics. The theory emphasizes the initiative of students in the learning process, and considers that learning is a process in which individual students actively construct new knowledge through interaction with the external environment based on their existing knowledge and experience. The application of this theory is particularly important in interdisciplinary teaching.

Constructivist learning theory emphasizes the autonomy of student learning. In interdisciplinary teaching, students are no longer passive receptacles of knowledge, but become the main body of active exploration of knowledge. Students need to actively participate in interdisciplinary learning activities under the guidance of teachers, and gain a deeper understanding of the nature and application value of mathematical knowledge through independent learning and cooperative inquiry. This kind of independent learning helps to stimulate students' interest and motivation in learning and improve their learning effectiveness.

Constructivist learning theory also focuses on the contextualization of learning. It believes that knowledge learning can not be separated from the specific context, and interdisciplinary teaching is to provide students with a rich variety of learning context. In the interdisciplinary teaching of elementary school mathematics, teachers can create real problem situations to guide students to use mathematical knowledge to solve practical problems in other subjects. This contextual learning approach not only helps students better understand and apply mathematical knowledge, but also develops their problem-solving ability and practical ability.

Constructivist learning theory provides strong theoretical support and practical guidance for interdisciplinary teaching of elementary mathematics. By utilizing this theory, teachers can better guide students in interdisciplinary learning and promote their overall development. At the same time, students can also continue to improve their comprehensive literacy and practical ability in interdisciplinary learning, laying a solid foundation for their future learning and life.

### 3.2. Multiple Intelligences Theory

Multiple Intelligences Theory, proposed by American psychologist Howard Gardner, subverts the traditional concept of intelligence, pointing out that human intelligence is not a single

logical-mathematical intelligence, but covers a wide range of domains, including, but not limited to, language, mathematical-logical, spatial, musical, bodily-motor, interpersonal, and self-knowledge. This theory brought a new perspective to the field of education, making educators begin to focus on the diversified development of students rather than just a single academic achievement.

The application of the theory of multiple intelligences is particularly important in the interdisciplinary teaching of elementary mathematics. Mathematics, as an abstract subject, is often regarded as a purely logical and computational field. However, under the guidance of the multiple intelligences theory, we can see the close connection between mathematics and other fields of intelligence. For example, solving a complex mathematical problem may not only require mathematical-logical intelligence, but may also involve spatial intelligence (e.g., spatial imagination in geometric problems), linguistic intelligence (understanding the topic and interpreting the answer), and so on.

Interdisciplinary teaching provides students with opportunities to develop multiple intelligences. Teachers can stimulate students' various intelligences by designing creative and inspiring teaching activities. For example, incorporating mathematical concepts into science experiments and asking students to use their mathematical knowledge to analyze the experimental data not only exercises students' mathematical logic intelligence, but also develops their scientific inquiry ability. Another example is to let students express mathematical concepts, such as symmetry and proportion, through painting or sculpture in art classes, which not only deepens students' understanding of mathematical concepts, but also cultivates their spatial intelligence and creativity.

Interdisciplinary teaching also requires teachers to use diverse assessment methods. Traditional paper-and-pencil tests often only assess students' mathematical-logical intelligence, while neglecting the development of other intelligences. Therefore, teachers need to design more diversified assessment methods, such as observing students' performance in group activities, recording students' creative processes, evaluating students' oral reports, etc., in order to comprehensively assess the development of students' multiple intelligences.

In general, the theory of multiple intelligences provides strong theoretical support and practical guidance for interdisciplinary teaching of elementary mathematics. Through interdisciplinary teaching, teachers can cultivate students' multiple intelligences more comprehensively and meet their individual development needs, thus laying a solid foundation for their future learning and life.

## 4. Problems in interdisciplinary teaching of elementary school mathematics

### 4.1. Lack of clarity in the objectives of interdisciplinary teaching

In the interdisciplinary teaching of elementary mathematics, the clarity of teaching objectives is crucial to the effective development of teaching activities. However, at present, some teachers tend to neglect this in the process of practice, resulting in unsatisfactory teaching results. Teachers' lack of clear goal-oriented interdisciplinary teaching tends to confuse students. When students are involved in interdisciplinary activities, if they do not know the purpose and significance of the activities, they may feel confused and unable to devote themselves fully to them. In this case, students' motivation and initiative in learning will be affected to a certain extent. Unclear teaching objectives will also affect teachers' organization and guidance of teaching activities. Without clear objectives as reference, teachers may be too casual in designing teaching activities or even deviate from the teaching theme. In addition, in the process of teaching, it is also difficult for teachers to make timely adjustments according to the actual situation of students to ensure the effectiveness of teaching activities.

### 4.2. Lack of integration of interdisciplinary content

In the interdisciplinary teaching of elementary school mathematics, due to the lack of systematic thinking, some teachers tend to be fragmented, repetitive or lacking in intrinsic connection when choosing teaching contents. This not only affects the teaching effect, but also may lead to students' confusion and resistance to interdisciplinary learning. In the interdisciplinary teaching of elementary school mathematics, if the content lacks integration, it will produce many disadvantages. On the one hand, the mathematics discipline and other disciplines work separately and cannot realize the integration of knowledge. For example, when explaining geometric shapes, if it is not combined with the graphic aesthetics of the art discipline, students' understanding of shapes will be limited to abstract mathematical concepts, and it is difficult to feel its beauty and practicality in real life. On the other hand, the lack of integration will lead to a single teaching method and make it difficult to stimulate students' interest in learning. For example, simply using mathematical teaching methods to explain mathematical problems related to natural sciences will make students feel boring and unable to motivate them to explore actively. At the same time, the lack of integration is also not conducive to the development of students' comprehensive thinking ability, and it is difficult for them to think and solve complex problems from multiple disciplinary perspectives, which limits the overall development of students and the enhancement of their innovation ability. [4]

### 4.3. Single approach to interdisciplinary teaching

In the interdisciplinary teaching of elementary school mathematics, the singularity of teaching methods is indeed a problem that needs to be solved urgently. Although the traditional didactic teaching method can systematically impart mathematical knowledge, it often neglects the students' subjective status in learning and their individual needs. This kind of "fill-in-the-blank" teaching is not only difficult to stimulate students' interest in learning, but also may inhibit their innovative thinking and desire for inquiry. In order to improve this situation, teachers need to actively explore and practice diversified interdisciplinary teaching methods. For example, project-based learning can be used to allow students to focus on a specific interdisciplinary theme and carry out inquiry and practical activities. In this process, students are not only able to apply their mathematical knowledge to solve practical problems, but also enhance their comprehensive literacy in cooperation and communication. In addition, contextual teaching method is also a good choice. By creating vivid and interesting interdisciplinary contexts, teachers can guide students to take the initiative to discover, analyze and solve problems, so as to cultivate their independent learning ability and innovative thinking.

### 4.4. Unreasonable evaluation of interdisciplinary teaching and learning

In the interdisciplinary teaching of elementary school mathematics, the unreasonable problem of evaluation methods needs to be solved urgently. Although the traditional paper-and-pencil test is easy to operate, it often only examines students' mastery of knowledge points, but cannot comprehensively evaluate students' key literacy skills such as thinking ability, innovation ability and practical ability. This kind of evaluation and assessment is unreasonable and will bring about adverse effects. If students' learning outcomes are measured only by traditional mathematics examination results, the development of students in other aspects of interdisciplinary learning will be neglected. For example, students' experimental design skills, observation and analytical skills, etc. cannot be reflected in teaching integrated with science subjects. Unreasonable assessment methods may also mislead the teaching and learning directions of teachers and students, making

them focus too much on the mastery of mathematical knowledge and neglect the development of interdisciplinary skills. In addition, it may reduce students' motivation to participate in interdisciplinary learning as their efforts and diverse talents cannot be fairly recognized. A reasonable assessment method should take into account a number of dimensions, such as students' performance in different disciplines, their ability to work together, and their innovative thinking, in order to comprehensively and accurately reflect students' growth and progress in interdisciplinary teaching and learning.

## 5. Optimization Path of Interdisciplinary Mathematics in Elementary School Based on Core Literacy

### 5.1. Clarify the goals of interdisciplinary teaching and learning

In the process of clarifying the interdisciplinary teaching objectives of elementary school mathematics, teachers need to deeply understand the connotation of core literacy and closely integrate it with the specific content of mathematics teaching. In terms of knowledge objectives, teachers should clarify the mathematical knowledge points that students need to master in interdisciplinary learning, such as number and algebra, graphics and geometry, statistics and probability, etc., and focus on the organic integration of knowledge with other disciplines. As for the ability goal, teachers should focus on cultivating students' thinking ability, innovation ability and practical ability, so that students can use mathematical knowledge to solve practical problems and improve their comprehensive application ability in interdisciplinary learning. As for the literacy goal, teachers should pay attention to the cultivation of students' emotional attitudes and values, enhance students' mathematical literacy and humanistic literacy through interdisciplinary teaching, and form a well-rounded personality quality.

In order to achieve these objectives, teachers need to further refine the teaching objectives into specific and actionable requirements. For example, in terms of knowledge and understanding, they can set the level of understanding and specific application ability that students need to achieve; in terms of process and skills, they can make clear the thinking process and operational skills that students need to demonstrate when solving problems; and in terms of affective attitudes, they can stipulate the positive attitudes and spirit of cooperation that students should demonstrate in interdisciplinary learning. These specific requirements will help teachers to provide more targeted guidance and assessment in the teaching process to ensure the effectiveness of interdisciplinary teaching.

Teachers should also give due consideration to students' individual differences and learning needs when setting interdisciplinary teaching objectives. In view of the characteristics and interests of different students, teachers can set teaching objectives at different levels and provide personalized learning support to meet the diversified development needs of students. This will help stimulate students' learning interest and motivation and promote their better performance in interdisciplinary learning.

### 5.2. Integrate teaching resources and optimize teaching content

In the process of optimizing the interdisciplinary teaching content of elementary school mathematics, the integration of teaching resources is particularly important. This requires teachers not only to deeply understand the intrinsic connections between mathematics and other subjects, but also to be able to skillfully integrate these connections into teaching activities. [5] Teachers can enrich the content of mathematics teaching by introducing knowledge and materials from other subjects. For example, when explaining graphs and geometry, graphic design elements in the art

curriculum can be combined to allow students to understand more intuitively the characteristics and beauty of geometric shapes by observing and drawing various shapes. When explaining proportions and scales, the knowledge of map drawing can be introduced, so that students can feel the application of scales in map making through practical operation.

Teachers can also apply mathematical knowledge to problem solving in other subject areas. For example, in science courses, students can use statistics and data analysis methods in mathematics to deal with experimental data, so as to enhance their practical application of mathematical knowledge. In physical education courses, teachers can help students understand the possibility of winning or losing in a game through the knowledge of probability in mathematics, so as to enhance students' interest in and understanding of mathematical knowledge. Teachers can also use modern information technology means to integrate teaching resources. For example, the use of multimedia courseware, network teaching platform and other resources, the organic integration of mathematics and knowledge of other disciplines, presented to students in a more vivid and graphic way. This can not only enhance students' interest in learning, but also improve the teaching effect.

### 5.3. Innovative interdisciplinary teaching methods

When exploring the optimization strategy of interdisciplinary teaching of elementary mathematics, the innovation of teaching methods is particularly important. Traditional teaching methods are often teacher-centered, focusing on the one-way transmission of knowledge and ignoring the subjectivity and practicality of students. Therefore, we need to break this inherent teaching mode and introduce more flexible and diverse interdisciplinary teaching methods that emphasize student participation.

Project-based learning is a student-centered inquiry-based learning approach that is well suited for interdisciplinary teaching. In project-based learning, teachers can design a challenging and meaningful project according to the content and objectives of the teaching, and let students carry out in-depth learning and research around the project. For example, a "Little City Planner" project can be designed to allow students to use mathematical knowledge and scientific principles to plan the layout of the city and calculate the population density. Through such project-based learning, students can not only comprehensively apply multidisciplinary knowledge to solve practical problems, but also practice teamwork, communication and coordination and other comprehensive skills. [6]

Contextualized teaching is also an effective interdisciplinary teaching method. It emphasizes teaching in real or simulated situations to stimulate students' learning interest and emotional experience. In the interdisciplinary teaching of elementary school mathematics, teachers can combine the students' life and cognitive characteristics to create a lively and interesting situation, and guide students to find problems, ask questions and try to solve problems in the situation. For example, in teaching the knowledge of proportion, a situation of "making magic potion" can be created, so that students can find out the optimal proportion of different ingredients through experiments and calculations. This kind of contextual teaching not only enables students to understand mathematical knowledge more intuitively, but also cultivates students' practical ability and innovative thinking.

Apart from project-based learning and contextualized teaching, teachers can also flexibly adopt other teaching methods for interdisciplinary teaching according to students' intelligence characteristics and learning styles. For example, for students with strong visual-spatial intelligence, the diagramming method can be used to assist mathematics teaching; for students with strong verbal intelligence, mathematical expression can be cultivated through mathematical stories or mathematical diaries. Through the organic combination of multiple teaching methods, students' core

literacy and comprehensive abilities can be more comprehensively enhanced.

Regardless of what teaching methods are used for interdisciplinary teaching, teachers should pay attention to the individual differences and cognitive laws of students, respect the students' status as the main body of learning, and give full play to the subjective initiative and creativity of students. At the same time, teachers should also continue to reflect on and summarize their teaching experience, timely adjustment and optimization of teaching methods to ensure the effectiveness and relevance of interdisciplinary teaching. Only in this way can we truly realize the goal of interdisciplinary teaching of elementary school mathematics, and cultivate new era talents who have both a solid foundation in mathematics and a broad interdisciplinary vision and innovation ability.

### 5.4. Establishment of a diversified evaluation system

The establishment of a diversified assessment system is crucial to the comprehensive and accurate assessment of students' interdisciplinary learning effectiveness. Such an evaluation system not only helps teachers to gain a deeper understanding of students' learning status, but also provides students with more targeted feedback and guidance, thus stimulating their learning motivation and enhancing their learning effectiveness.

In the process of building a diversified evaluation system, teachers need to focus on the diversity and complementarity of evaluation methods. Although the traditional paper-and-pencil test can objectively measure students' knowledge mastery, it is difficult to comprehensively reflect the development of students' practical ability, innovative thinking and emotional attitude. Therefore, teachers need to combine other assessment methods, such as observation records, work displays and oral reports, to evaluate students' learning outcomes more comprehensively. Establishing a diversified evaluation system is an important part of optimizing interdisciplinary teaching of elementary mathematics. By adopting a combination of multiple assessment methods, teachers can gain a more comprehensive understanding of students' learning status and provide them with more targeted feedback and guidance, thus stimulating their learning motivation and enhancing the effectiveness and quality of interdisciplinary teaching.

## 6. Conclusions

The optimization strategy of interdisciplinary teaching of elementary school mathematics based on core literacy is of great significance. Therefore, teachers should study in depth the correlation points between different disciplines and mathematics, integrate the resources of language, science, art and other disciplines, and build a rich learning context for students. In addition, teachers should design interdisciplinary practical activities, so that students can use multidisciplinary knowledge to solve mathematical problems in hands-on operation, and cultivate comprehensive thinking ability and innovative consciousness. At the same time, students are encouraged to explore independently and are guided to think about mathematical phenomena from different disciplinary perspectives. Through interdisciplinary teaching, we can not only enhance students' core mathematical literacy, but also promote their all-round development and lay a solid foundation for their future learning and life.

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