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Strategies and Practices for Interdisciplinary Learning of Primary School Mathematics Based on Core Literacy

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ABSTRACT
Interdisciplinary comprehensive practice based on the core literacy of primary school mathematics can effectively break down the barriers between various subjects, enabling primary school students to develop core literacy under diverse backgrounds such as nature, society, and culture, deepen their understanding of mathematics, expand their ability levels, and help them form comprehensive qualities, thereby achieving the fundamental educational goal of fostering virtue and nurturing talent.

KEYWORDS
Primary School; Mathematics Core; Literacy Interdisciplinary

The new curriculum standards for primary school mathematics have provided important instructions on the cultivation of students' core literacy. The core literacy of mathematics has made hierarchical requirements for the ability of abstraction. In the lower educational stages, it focuses on the budding of number sense and symbolic awareness, and establishes mathematical representations through specific objects and images. In the middle school stage, geometric intuition and spatial concepts are strengthened to achieve the transition from the concrete to the semi-abstract. The higher academic stage requires the application of abstract models to solve complex problems and form a structured thinking paradigm. Traditional single-subject teaching has obvious deficiencies in developing students' mathematical literacy. Effective interdisciplinary teaching can improve students' comprehensive thinking level, promote the formation of the overall framework of students' scientific thinking, and enhance students' cultural understanding. Based on this, this paper studies the value of core literacy in primary school mathematics and forms comprehensive teaching countermeasures[1].

1 The Value of Interdisciplinary Teaching in Developing Primary School Students' Core Mathematical Literacy

The theory of multiple intelligences reveals that interdisciplinary teaching can activate students' multi-dimensional intelligence channels and provide a three-dimensional development path for core mathematical literacy. For instance, the integration of the Chinese language subject and the mathematics subject can lead to the intervention of language intelligence, providing semantic support for the expression of mathematical symbols and helping students understand the practical significance of mathematical concepts in Chinese language narratives. In sports activities, the mobilization of students' spatial intelligence is conducive to the cultivation of students' geometric intuitive ability. When mathematical figures are connected with artistic composition and geographical diagrams, students' abstract spatial concepts obtain concrete carriers. In interdisciplinary activities such as scientific experiments and social surveys, the effective integration of interpersonal intelligence helps students break through the limitations of individual thinking and gain a broader space for imagination. Students constantly revise the rationality of mathematical models through collaborative argumentation. This intelligent synergy effect breaks the limitation of traditional mathematics teaching that emphasizes logical and mathematical intelligence, providing a richer growth base for qualities such as mathematical abstraction and scientific thinking[2].

Under the theoretical framework of constructivism, the real problem situations created by interdisciplinary teaching constitute the cognitive scaffolding for the development of core mathematical literacy. When mathematical knowledge is detached from the state of isolated calculation and embedded in complex scenarios such as engineering design and economic decision-making, students will actively adjust their cognition driven by the scenarios. For example, some social practice activities that students participate in need to be measured. Students will elevate some of the processes used in the laboratory to the concept of data, promoting the formation of quantitative decision-making thinking among students. The mathematical representation symbols contained in different practical activities can deepen students' understanding of the mathematics discipline and cultivate students' qualities of interdisciplinary transfer. Students can come into contact with the zone of proximal development of mathematics in practical scenarios, guiding them to enhance their operational thinking skills[3].

2 Analysis of the Problems Existing in Interdisciplinary Teaching of Primary School Mathematics

2.1 Superficial integration of disciplines

At present, in many primary schools, interdisciplinary teaching of mathematics juxtaposes mathematical concepts with elements of other subjects, which only constitutes physical juxtaposes and fails to bring about a chemical react-based cognitive reconstruction. For instance, when geometric figures and the principle of artistic perspective are mechanically pieced together, what students acquire is merely the superposition of visual symbols rather than a qualitative change in their spatial thinking ability. Some schools have created problem situations that are merely used as the stem of math problems, which shows a clear tendency of cognitive dimension reduction. This approach simplifies interdisciplinary challenges into math application problems and actually deprives students of the opportunity to analyze from multiple perspectives. In some schools, the evaluation of interdisciplinary mathematics teaching focuses on the memorization of cross-disciplinary knowledge points while neglecting the cultivation of students' mathematical thinking methods, resulting in the suspension of the goal of quality development. The reason for this is that the school has not yet established a collaborative mechanism at the level of curriculum design, the teaching team lacks a joint lesson preparation mechanism, and the teaching objectives of mathematical logic and other subject paradigms have not reached a consensus.

At the level of teacher development, the teacher training system has long separated the boundaries of disciplines. Mathematics teachers have insufficient mastery of the methodological tools of related disciplines and have fallen into the role predicament of "knowledge transporters" in interdisciplinary teaching. At the institutional guarantee level, the current teaching and research evaluation standards are still dominated by individual subject scores, and cross-disciplinary teaching has become a demonstrative performance, lacking the driving force for continuous improvement. This systematic defect makes surfaceization an inevitable choice for the path with the least resistance. When mathematical modeling and scientific inquiry are simply spliced together, students only acquire superficial knowledge connections and are unable to form comprehensive abilities to solve complex problems. There is also a tendency of goal substitution in the design of teaching activities in some schools. For instance, teachers have alienated the cultivation of core literacy into the memory assessment of interdisciplinary knowledge, which has dissolved the application value of mathematical thinking methods in real situations.

The main reason for this is that subject teachers have a fragmented tendency in understanding the connotation of core literacy. They simply equate interdisciplinary knowledge with the superposition of multi-disciplinary knowledge and fail to grasp the integrated function of mathematical thinking as a methodology. The teaching and research system lacks quality standards for interdisciplinary teaching, which leads teachers to fall into the formalistic trap of "integration for the sake of integration" in practical exploration.

The current assessment mechanism still strengthens the traditional model of subject-based evaluation, forcing interdisciplinary teaching to evolve into a performative practice that caters to the requirements of reform and losing the original intention of cultivating students' lifelong development ability[4].

2.2 There are shortcomings in teachers' ability to integrate across disciplines

Some teachers have a relatively narrow disciplinary perspective and an insufficient understanding of their subjects. As a result, they find it difficult to transcend the fixed thinking patterns of their own subjects to grasp the intrinsic connections of knowledge, leading to interdisciplinary design becoming a mere collage of labels. When mathematics teachers deal with the intersection issues between science and the humanities, they often fall into a fragmented state of instrumental rationality and value rationality.

Some schools' curriculum integration lacks methodological support. Teachers overly rely on ready-made case templates when designing integrated activities and are unable to dynamically adjust teaching strategies according to the characteristics of students' learning conditions. Interdisciplinary integrated teaching inherently places relatively high demands on teachers' cognitive levels and classroom organization abilities. Teachers are prone to fall into organizational predicaments in collaborative teaching. Currently, most subject teacher teams in primary schools lack effective dialogue mechanisms and each adheres to a professional discourse system, making it difficult to form an educational synergy. The main reason for this is that teacher education has long followed the subject-based training model, and teachers have inherent deficiencies in their knowledge structure and lack systematic training in interdisciplinary thinking.

Most school-based teaching and research activities in schools are still carried out by subject groups, and there is a lack of institutionalized communication platforms for teachers' cross-disciplinary cooperation. The current performance appraisal system strengthens the quantitative evaluation of teaching achievements in individual subjects, which suppresses teachers' intrinsic motivation to break through disciplinary boundaries. The absence of such systematic support has led the development of interdisciplinary capabilities into a low-level cycle.

2.3 The interdisciplinary integration evaluation system for teachers is lacking

The mathematics assessment indicators in most primary schools still focus on the mastery of individual subject knowledge as the core, and have not established an observation dimension reflecting the interdisciplinary thinking ability. When teachers attempt to combine mathematical modeling with social science problems, the existing evaluation tools are unable to capture the thinking transitions demonstrated by students in cross-context situations. The lack of a mutual evaluation mechanism among subject teachers has led to the cross-disciplinary teaching effect becoming a simple accumulation of evaluations from various subjects. Summative evaluation dominates, ignoring the professional growth trajectory of teachers throughout the entire cycle of interdisciplinary teaching design, implementation and reflection. The reason for this is that at the level of institutional design, schools have not yet broken through the traditional framework of discipline classification, and cross-disciplinary teaching achievements lack channels for value transformation in professional title evaluation and performance recognition. The failure to establish a quality benchmark for interdisciplinary teaching has led the evaluation activities into a practical predicament of "having no standards to follow". The tradition of exam-oriented education has strengthened the path dependence of subject-based evaluation. The understanding of the effectiveness of interdisciplinary learning by schools and parents still remains at the superficial level of knowledge intersection. The dual effect of insufficient institutional supply and lagging cultural cognition has made the reform of the evaluation system seriously lag behind the innovation of teaching practice.

3 Countermeasures for Interdisciplinary Teaching of Primary School Mathematics under the Background of Core Literacy

3.1 Deepen activity design and explore interdisciplinary mathematical resources

Schools need to establish a system guarantee system for interdisciplinary teaching. The academic affairs department should reconstruct the curriculum management mechanism, break down the traditional barriers of subject class hours, and set up flexible interdisciplinary teaching periods. The teaching and research group needs to formulate cross-disciplinary teaching quality standards, clarify the cultivation gradient of core literacy at each educational stage, and form an observable ability development index system. Establish a regular cross-disciplinary lesson preparation system and promote in-depth dialogues among teachers of different subjects through theme workshops. Set up an interdisciplinary teaching design module to help teachers master integrated teaching methods such as STEAM education and project-based learning. Collect generative resources in interdisciplinary teaching and establish a closed-loop mechanism for teaching improvement. Teachers should take the initiative to broaden their disciplinary horizons and systematically study the basic knowledge framework and thinking methods of adjacent disciplines. Classroom teaching should create real interdisciplinary problem situations and guide students to use mathematical tools to solve complex problems in life and society. Learning evaluation should focus on the thinking process rather than a single outcome, and record the thinking development trajectory of students in interdisciplinary activities through growth portfolios. In terms of home-school collaboration, it is necessary to guide parents to understand the value of interdisciplinary learning and avoid interfering with innovative learning activities through the traditional problem-solving model. Individual students should cultivate the awareness of knowledge transfer and actively discover the intrinsic connections among different disciplinary fields.

3.2 Enhance teachers' interdisciplinary mathematics teaching ability

Teachers need to break through the conventional thinking pattern of traditional mathematics teaching and establish an interdisciplinary cognitive framework. Schools should offer interdisciplinary thinking training courses to help teachers understand the deep connections between mathematics and fields such as science, engineering, and art. The school's teaching and research groups should regularly organize cross-disciplinary theme discussions to reveal the commonalities of thinking among different disciplines through case analysis. Teachers themselves should cultivate the awareness of knowledge integration, actively pay attention to the research achievements of cutting-edge interdisciplinary fields, and incorporate the interdisciplinary perspective into their daily lesson preparation thinking. During the pre-service training stage, normal universities need to set up interdisciplinary teaching design modules to enhance the multi-development ability of mathematical application scenarios. In the on-the-job training session, project-based learning design training is carried out in the form of workshops to guide teachers to master integrated teaching methods such as STEAM education. School-based teaching and research should establish a cross-disciplinary lesson preparation community, and enhance practical abilities through a closed loop of collaborative design, classroom observation, reflection and improvement. Teaching evaluation should add an interdisciplinary integration dimension, with a focus on the development of students' ability to comprehensively apply mathematical tools to solve complex problems. At the school management level, it is necessary to reconstruct the logic of course schedule arrangement and set up flexible interdisciplinary teaching periods.

In terms of resource construction, develop a digital resource library that integrates mathematics with other disciplines and provide transferable teaching case templates. In terms of the assessment mechanism, the achievements of interdisciplinary teaching will be incorporated into the professional title evaluation index system, and a special reward fund will be established. The regional teaching and research network should establish interdisciplinary teaching and research bases to promote the sharing of experiences among schools and professional dialogues.

3.3 Improve the interdisciplinary evaluation mechanism for mathematics

The educational administrative department should formulate an interdisciplinary ability evaluation framework and clarify the key ability dimensions for the integration of mathematics with other disciplines. The school's teaching and research group needs to refine the evaluation index system and incorporate knowledge integration ability, problem-solving strategies, and the quality of innovative thinking into the key points of observation. Shift from result-oriented to process-oriented, with a focus on the thinking development trajectory of students in interdisciplinary learning. The subject teaching team should establish a regular mutual evaluation mechanism and record the implementation effect of interdisciplinary teaching through classroom observation. The student group should participate in the evaluation process and conduct self-assessment through forms such as learning logs and reflection reports. The Parents' committee can design a family observation scale to feedback students' performance in applying mathematical knowledge to life practice. Regional teaching and research institutions need to form expert evaluation teams to carry out joint lesson evaluation activities across schools and disciplines. In terms of technological empowerment, an intelligent evaluation system is developed to conduct visual analysis of students' interdisciplinary thinking processes.

4 Conclusion

In conclusion, interdisciplinary mathematics teaching should, under the guidance of developing core literacy, further create rich experiential mathematics learning activities for primary school students through the guidance of multiple intelligences theory and constructivist theory. Teachers, schools and students all need to enhance their understanding of core literacy, build more systematic experiential teaching activities, guide students to continuously develop their core literacy in mathematics under the existing teaching resources, and increase their interest in mathematics learning.

About the Author

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