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The Application and Optimization of Unit Integration Teaching in Primary School Mathematics Based on Big Ideas

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Abstract: "Big ideas" serve as a pivotal concept that occupies a central position in mathematics, connecting various knowledge points within the mathematics curriculum. The unit integration teaching of primary school mathematics based on big ideas leverages the structural framework of the discipline, facilitating students to actively construct knowledge through deeper understanding. Interviews revealed that while most front-line primary school mathematics teachers recognize the value of unit teaching under the big ideas framework and understand its basic process, challenges remain in determining unit teaching objectives, selecting appropriate teaching content, and formulating effective evaluation methods. Therefore, from the perspectives of teachers, schools, and educational research departments, specific strategies have been proposed to optimize the integration of primary school mathematics units based on big ideas.

1. Introduction

The proposal of core competencies reflects the deepening of curriculum reform, specifies the direction and purpose of curriculum reform, and has a guiding and leading role. In order to achieve the teaching goals oriented towards core competencies, the curriculum standards require Chinese teachers not only to have a comprehensive understanding of the internal connections between teaching content, but also to deeply understand and grasp the close link between the main teaching content and the corresponding development of core competencies. More and more scholars and frontline teachers are now aware that unit integration teaching design can help students truly understand the essence of mathematical concepts and is an important way to implement subject core competencies. At present, research on unit integration teaching in primary mathematics is still in the exploration stage. Understanding the current implementation status and difficulties faced by frontline primary mathematics teachers in unit integration teaching, and proposing corresponding countermeasures based on the big ideas can help improve their ability to integrate units and teaching effect.

2. Literature Review

In the domain of curriculum and instruction, it was the American curriculum development experts

Wiggins and McTighe who earlier proposed and applied the concept of "big idea". They contended that the "big idea" serves as the fundamental material for students' comprehension [1]. It helps us meaningfully connect fragmented knowledge to aggregate and form larger concepts, principles, or methods, thereby facilitating flexible application in various new situations both within and outside the discipline. Charles opined that big ideas can be classified into two types: one is the big idea at the content level, namely the concepts, themes, theories, experiences, etc. at the core of the discipline. The other is the big idea at the methodological level, namely the methods and means of addressing various problems by applying theories and experiences[2]. Scholar Lang Xiaomou suggested that big ideas can be divided into disciplinary core concepts (within the discipline), common concepts (across disciplines), and concepts regarding science itself[3]. In the case of the mathematics discipline, the big idea is the key concept that occupies a central position in mathematics and links the knowledge points in the mathematics curriculum. It can embody the instructional ideology of the mathematics curriculum and contribute to the transfer of knowledge.

As an advocate of the New Education Movement, DeCourcy put forward the concept of teaching integration. This concept, as the prototype of unit integration teaching, had a strong impact on the lesson-based teaching that was organized based on the compilation of lesson materials at that time. Professor Zhong Qiquan pointed out in "Modern Curriculum Theory" that "unit teaching" integrates students' thoughts and experiences to form a whole[4]. Mathematics unit integration teaching, from the perspective of improving students' core mathematical literacy, integrates and reorganizes the teaching material content into teaching units that can highlight the main line of mathematical content and the relevance of knowledge. It is a dynamic process of carrying out teaching and continuously cycling for improvement . Lv Shihu and others summarized the instructional design of mathematics units into the following five steps: determining the unit content, analyzing teaching elements, formulating unit teaching objectives, designing the teaching process, and evaluating, reflecting, and modifying[5]. Zhu Junhua and Liu Jinyang, from the perspective of big ideas, have explored the unit-based integration teaching in primary school mathematics. They believe that the unit-based integration teaching under the guidance of big ideas is conducive to the development of an overall view and enables students to truly understand the essence of mathematical concepts. [6]

It can be concluded from the above that unit integration teaching, as an important means to promote the curriculum reform based on literacy, is both an opportunity and a challenge for teachers. How primary school mathematics teachers conduct unit integration teaching, what kind of suitability exists between big ideas and unit integration teaching of primary school mathematics, and how to boost primary school mathematics teachers to carry out unit integration teaching based on big ideas still await further exploration in the academic circle.

3. The Implementation Status and Existing Problems of Integrated Teaching of Mathematics Units in Primary Schools

On the basis of a comprehensive analysis of the research on unit integration teaching by relevant scholars, the current implementation status of unit integration teaching in primary school mathematics is investigated through the interview method, and the real situation and existing problems of primary school mathematics teachers in terms of their cognition, design, implementation, etc. of unit integration teaching are deeply explored.

3.1 Lack of In-depth Understanding of Integrated Teaching Objectives for Units

Although the majority of the interviewed teachers have demonstrated an awareness of the specific connotations of big ideas and unit integration teaching and their significant value within the educational system, this cognitive basis provides a precondition for them to attempt more systematic

and integrated teaching strategies in actual teaching. Nevertheless, teachers still exhibit deficiencies in understanding and clearly defining the connotations of big ideas and unit goals. This cognitive ambiguity directly influences the depth and breadth during their teaching design and implementation processes. Specifically, when formulating teaching plans, the interviewed teachers tend to focus more on the specific goals of individual class periods, namely the class period goals, rather than taking a more macroscopic unit perspective to comprehensively plan the goal system of the entire teaching unit. In the setting of unit teaching goals, teachers generally tend to rely on the preset unit goals provided in the teacher reference books, rather than constructing them based on an individualized understanding of the actual learning needs of students, in-depth analysis of the course content, and comprehension of big ideas. Although this dependence simplifies the teaching preparation process to a certain extent, it may also restrict the targeting and flexibility of teaching goals. Due to the absence of a strong and consistent big idea as a guiding and directive force throughout all class periods, the structural integration of disciplinary knowledge still appears insufficient.

3.2 Weak Integration of Unit Integration Teaching Content

Among the group of surveyed teachers, although the majority of primary school mathematics teachers possess a certain level of self-awareness and comprehension regarding the fundamental operational steps of unit integration teaching, and have, to a certain extent, accepted and attempted to incorporate this teaching model into their daily instruction, they still lack contemplation on the integrativeness of teaching content when conducting actual unit integration teaching. Firstly, there exists a deviation in teachers' understanding of the core concept of "unit" in unit teaching. The majority of teachers tend to equate "unit" with the "explicit units" clearly demarcated in the teaching materials, that is, units explicitly defined by the textbook compilers based on the logical structure of the knowledge system or the requirements of the teaching progress; they overlook the "implicit units" that naturally converge from knowledge points with internal connections. These implicit units may span multiple explicit units, even across different grades or grade levels, and they naturally form based on the deep interconnections among knowledge and the cognitive development path of students. Due to the lack of identification and utilization of implicit units, teachers often have difficulty capturing the deep interrelationships among knowledge, thereby restricting the depth and breadth of unit integration teaching. Secondly, teachers lack the capacity for creative utilization of teaching materials. They are mostly confined to designing unit teaching within the original framework of the teaching materials, lacking attempts at integrating teaching content across different grade levels and integrating cross-disciplinary and cross-grade knowledge.

3.3 The Simplicity of Evaluation Models in Unit Integration Teaching

In the aspect of evaluation, some teachers have begun to experimentally adjust the traditional paper-and-pencil test model in unit teaching, striving to make its content composition more diversified and contextualized. They have shifted from the previous recall tests of single knowledge points and designed application problems, case analysis questions, and other types of questions that are closer to real-life situations and problem-solving requirements. While testing students' mastery of basic knowledge, they also assess their problem-solving ability, critical thinking, and knowledge transfer ability. Nevertheless, although the aforementioned attempts demonstrate the advancement and development of teachers' educational evaluation concepts, on the whole, the evaluation model for unit integration teaching remains relatively simplistic. Specifically, paper-and-pencil tests, as the traditional evaluation method, are still widely and frequently employed; while formative evaluation methods such as performance evaluation and portfolio evaluation, which can reflect students' learning process and individualized development more comprehensively, are seldom applied in actual unit-

level integrated teaching. Regarding the evaluation objects, the main focus is on evaluating the depth and breadth of students' mastery of disciplinary knowledge, while less attention is paid to evaluating non-cognitive factors such as students' intrinsic motivation for learning, interest, persistence, and attitudes when facing challenges, making it difficult to comprehensively reflect the true effectiveness of education and the multi-dimensional needs of students' development.

3.4 Insufficient Reflection Awareness and Capability in Unit Integration Teaching

Teaching reflection is not only a crucial aspect for enhancing the quality of teaching but also a significant impetus for facilitating teachers' professional growth and promoting educational reform. After the conclusion of unit integration teaching, the majority of teachers will reflect upon and adjust their unit teaching designs and implementations in accordance with the teaching practice. Nevertheless, their reflection and adjustment activities are mostly confined to modifying the teaching process of class periods and specific teaching contents, with less reconsideration of the overall framework, logical coherence, and cross-period knowledge transfer of the unit teaching design. Most unit integration teaching designs are typically conducted for open classes. During this process, collective lesson planning and team reflection, as important means to promote the optimization of teaching designs, assist teachers in examining teaching practice from multiple perspectives, identifying existing problems and deficiencies, and thereby obtaining more targeted improvement strategies. However, conducting teaching reflection and adjustment based on individual teachers is relatively more challenging. In daily teaching practice, due to the lack of continuous practical guidance and theoretical leadership from professional teams or educational experts, teachers often encounter difficulties in conducting in-depth and systematic refinements of teaching designs after classes. This current situation restricts the further enhancement of teachers' teaching reflection capabilities, causing the optimization of teaching designs to often remain superficial and fail to address core issues and profound teaching principles.

4. A Feasibility Analysis on Integrated Teaching of Primary Mathematics Based on Big Ideas

4.1 Integrating Teaching Objectives of Mathematics Units as a Whole

The big ideas play a significant integrating role in both students' learning of disciplinary knowledge and the development of various core qualities. Regarding the learning of disciplinary knowledge, the longitudinal big ideas assist in clarifying the disciplinary knowledge system, and the transverse grand concepts help establish connections among different disciplines, which is crucial for further clarifying the unit objectives. The development of students' knowledge and the depth of their cognition during the learning process are also gradually deepened. Meanwhile, the big ideas enable the unit objectives to focus on the sequential and staged development of the students themselves, making the teaching objectives of the integrated mathematics units more holistic.

4.2 Structuring Teaching Contents of Mathematics Unit Integration

The big ideas converge to reflect the essence of a discipline, possessing common attributes such as relative stability, consensus, and dominance, and can achieve meaningful constructions of discrete or trivial different themes and knowledge. Thus, the unit teaching content centered on and dominated by disciplinary big ideas is like a knowledge network framework with extensive significance and clear hierarchies. Running through teaching with big ideas from beginning to end is conducive to students' establishment of connections among knowledge within the discipline, across different disciplines, and with the real world, as well as the construction of models and the promotion of

students' transferability.

4.3 Diversifying Teaching Evaluation of Mathematics Unit Integration

The evaluation of integrated teaching under the framework of big ideas is comprehensive evaluation. In big idea teaching, not only do teachers design corresponding evaluation and assessment plans, but students are also taught to evaluate themselves and their peers. Based on the students' active and proactive collection of learning materials, they provide feedback (peer evaluation) to each other, monitor the achievement of learning goals (self-evaluation), adjust their learning methods, reflect on the progress of learning, and establish their own learning goals. Under the guidance of big ideas, teachers are no longer limited by the predetermined unit goals, and pay increasing attention to students' emergent performance, enabling qualitative evaluation and quantitative evaluation to be effectively combined.

5. Strategies for Optimizing Primary Mathematics Unit Integration Based on Big Ideas

5.1 From the Teacher's Perspective

Strengthen the awareness of big ideas and establish a holistic teaching concept. Through interviews and surveys, it was found that some teachers, due to being accustomed to the traditional lesson-based teaching design mode, lacked the awareness of holistic teaching. The formation of students' core disciplinary competencies is a long and systematic process. The fragmented lesson-based teaching design overly emphasizes the learning of individual knowledge points, disconnects the relationships between knowledge, and neglects the systematic nature of mathematical knowledge, which is not conducive to students' autonomous construction of knowledge. Therefore, teachers need to first strengthen their awareness of big ideas, grasp the overall teaching content, develop the habit of unit planning, and consciously apply it to classroom teaching. Educators should shift from teaching the textbook to using the textbook to teach, explore the mathematical thinking methods and educational value in the textbook, and move from merely teaching to educating.

Focus on big ideas and formulate unit teaching objectives. The primary school mathematics unit integration teaching design based on big ideas will center around big ideas. Starting from the connotation of unit knowledge, the core objective of the unit is designed, and then sub-objectives are derived from the core objective. The sub-objectives in each dimension are interrelated, and teachers cannot implement each sub-objective separately. At the same time, teachers also need to exert their subjective initiative in teaching, formulate corresponding unit teaching objectives based on the integrated unit teaching content, rather than merely relying on the teacher's reference book. The establishment of unit teaching objectives needs to meet the learning requirements of unit knowledge and skills, core competencies, the process and methods of ability development, emotional attitudes, and values.

Sort out big ideas and analyse teaching elements and content. Screening big ideas from textbook content requires analysing and mining the underlying big ideas from specific content from the perspective of the entire mathematics discipline. When helping students form cognitive structures, teachers should pay attention to the connection of teaching content between and within units, emphasizing the core mathematical knowledge, higher-level concepts, and underlying thinking methods under the guidance of big ideas. For instance, when teaching the unit "The Meaning of Fractions," teachers should interpret the textbook in accordance with the curriculum standards and explore the core concepts of fractions. One is "a kind of number," representing a result that can participate in arithmetic operations; the other is "a number in the form of a ratio," that is, the ratio relationship between the local and the whole, and between elements in collections.

Based on big ideas, optimize the teaching process. Since the importance and difficulty of each knowledge point in the mathematics knowledge system at the primary school stage are different, teachers should reflect differences in the arrangement of class hours for unit teaching content. In conducting unit teaching design, teachers can make appropriate adjustments and integrations to the unit teaching content based on big ideas, and re-consider the teaching sequence and class hour arrangement. On the basis of a comprehensive grasp of the teaching content, students' learning situation, unit objectives, and unit class hour objectives, optimize the teaching process and rationally arrange the teaching time according to students' existing knowledge systems and cognitive laws.

Based on the big idea, implement teaching evaluation. The unit teaching evaluation based on the big idea is a continuous and comprehensive assessment that integrates feedback throughout the entire process of learning big ideas. It is necessary to assist students in clarifying the unit teaching goals at the outset of the unit teaching. Distinct from the previous single, final, and extrinsic evaluations, it is multi-faceted, continuous, and intrinsic, involving students' self-evaluation and reflection, aiming to facilitate students' learning activities and generate positive emotional experiences. Evaluation scales such as the "Student Classroom Dynamic Evaluation Scale" can be designed, incorporating evaluations by teachers, self-evaluations by students, and mutual evaluations among classmates, enabling students to have a more comprehensive and profound understanding of their learning situations.

5.2 From the School's Perspective

Organize relevant training on unit integration teaching and offer teachers opportunities for collaborative learning. Schools should attach great importance to the training of teachers' subject-specific professional knowledge, prioritize the update and expansion of subject knowledge in promoting teachers' professional development, and strive to enhance teachers' proficiency in subject-specific knowledge. Schools can regularly organize collaborative exchange meetings among internal teachers to jointly share their experiences and difficulties in unit integration teaching. Alternatively, they can hold thematic lectures on unit integration teaching irregularly, inviting experienced frontline teachers, experts, or educational researchers from various cities and districts to the school to share and exchange experiences with teachers and address the difficulties they encounter in implementing unit integration teaching. Moreover, schools can organize teachers to pursue further studies outside the school, participate in provincial, municipal, or national teaching and research activities, and then share their experiences in the form of reporting lessons upon their return.

Refine the evaluation and management efforts to guarantee the implementation of the unit integration teaching. Strengthening the implementation of collaborative work and emphasizing the evaluation, motivation, and supervision of teachers is a crucial guarantee for implementing unit teaching design. After organizing unit integration teaching training or lesson demonstrations for teachers, it is necessary to promptly organize the evaluation or assessment of training and teaching research achievements and promptly provide feedback on the evaluation results to teachers. Exerting the diagnostic and incentive functions of evaluation can assist teachers in better perfecting their unit teaching designs. Besides, schools can also consider the implementation of teachers' unit integration teaching designs as an important component in evaluating teachers and determining performance-based salaries. Moreover, schools should offer material and spiritual rewards to teachers with outstanding teaching achievements, thereby effectively boosting teachers' enthusiasm for teaching and research. Simultaneously, it is essential to enhance the management of school teaching and research groups, actively organize teachers to conduct collective unit lesson planning, and regularly inspect their teaching research achievements to ensure that unit integration teaching design becomes a regular teaching practice.

5.3 From the Perspective of the Teaching and Research Department

Attach great importance to the implementation of unit integration teaching and motivate teachers' teaching enthusiasm. The teaching and research department should actively exert a leading role and provide direction and planning for frontline teachers to conduct unit integration teaching design. Educational administrators should enhance teachers' attention and emphasis on unit integration teaching, assist teachers in truly understanding and accepting the concept of unit teaching design, and implement unit integration teaching in a targeted manner based on the theme of research and training activities. Meanwhile, attention should also be paid to the rationality of the intensity and time arrangement of teaching and research tasks, avoiding imposing additional burdens on teachers beyond their daily teaching tasks and even generating resistance, enabling teachers to actively participate in unit teaching design as researchers.

Play a leading role and provide unit integration templates for teachers. The teaching and research department can provide unit plans for each academic stage and school year or offer corresponding examples of unit integration teaching design to provide guidance for frontline teachers in conducting unit integration teaching. At the same time, it can also organize key teachers from various schools to conduct collective lesson preparation for unit integration teaching, helping teachers familiarize themselves with the methods and specific implementation processes of unit integration teaching design and then feedback their experiences to other teachers in their own schools.

Actively carry out relevant teaching and research activities on unit integration teaching and organize teachers for exchanges and discussions. The teaching and research department needs to make reasonable plans for unit teaching design and actively implement research. For the difficulties and doubts encountered by frontline teachers in the implementation of unit integration teaching, methods such as special lectures, online discussions, or WeChat posts can be utilized to provide centralized answers. Educational institutions should, through various teaching and research activities, provide teachers with the opportunity to learn relevant teaching strategies for unit integration teaching design, enabling teachers to actively carry out unit teaching design to enhance classroom teaching effectiveness based on a true understanding of the connotation, concepts, and specific operation steps.

6. Conclusions

On the basis of a comprehensive analysis of the studies on unit integration teaching conducted by related scholars, the current implementation status of unit integration teaching by primary school mathematics teachers was deeply understood through the interview method. The study reveals that the majority of primary school mathematics teachers in China acknowledge the value of unit integration teaching under the big idea and are familiar with the basic procedures. To a certain extent, they have accepted and attempted to incorporate this teaching mode into their daily instruction. Nevertheless, teachers still have an insufficient in-depth understanding of the teaching objectives of unit integration, the integration of teaching content is relatively weak, the evaluation model for unit integration teaching is simplistic, and the awareness and ability for reflection on unit integration teaching need to be enhanced. The unit integration teaching in primary school mathematics based on the big idea can make teaching objectives integrated, teaching content structured, and teaching evaluation diversified, which is beneficial for cultivating students' mathematical thinking ability and facilitating their all-round development. The enhancement of the quality of unit integration teaching requires teachers to intensify their own awareness and upgrade their professional teaching proficiency; schools to organize training and guidance and refine relevant management mechanisms; teaching and research departments to actively lead and provide blueprints for unit integration. Only when teachers sincerely recognize the teaching value and possess the ability to carry out the corresponding teaching design can the effect of unit integration teaching be truly realized.

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