

Construction and Practice of a Localized Mathematics Homework Design Model for Rural Primary Schools

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This paper addresses the problem that mathematics homework in rural primary schools is disconnected from students' life reality, experience reality, and mathematical reality. Based on the theory of localized education, it constructs a "three-dimensional support—four-link closed-loop—multi-party collaboration" design model. After five years of action research, relying on rural resources in Liupanshui, local elements are transformed into homework materials to promote the development of teachers and students, providing a paradigm for homework-based education.

Keywords: localization, mathematics homework design

Problem Statement

Appropriate mathematics homework can help students consolidate and internalize knowledge, and more importantly, promote them to transform mathematical knowledge into literacy. However, current mathematics homework design, especially in rural primary schools, is disconnected from students' life reality, neglects experience reality, and fails to attach importance to mathematical reality. This makes it difficult for students to connect knowledge with their own reality, hindering the achievement of the educational goal of transforming knowledge into literacy.

At the policy level, the Notice on Strengthening the Management of Homework in Compulsory Education Schools requires teachers to improve their ability to independently design homework and select content accurately (General Office of the Ministry of Education, 2021); the "Double Reduction" policy emphasizes optimizing homework design to give full play to its educational function (General Office of the Communist Party of China Central Committee, 2021); the Mathematics Curriculum Standard (2022 Edition) clearly stipulates designing diverse exercises to meet the differentiated needs of students (Ministry of Education of the People's Republic of China, 2022).

Practical dilemmas are specifically manifested in three aspects: first, disconnection from students' real life reality. For example, textbook questions such as "The area enclosed by a 400-meter track is approximately 1 hectare" and "A bag of rice weighs 5 kilograms" are inconsistent with rural students' living environments and experiences, easily leading to incorrect sense of quantity. Second, neglect of experience reality. For instance, homework on "Position and Direction" uses "tourist maps" of places students have never visited, or teaches "the

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composition and decomposition of 10 objects” only through animation demonstrations without letting students experience “counting small sticks”, making it difficult for students to form mathematical abstraction. Third, lack of attention to mathematical reality. When designing homework, students’ existing knowledge and skills, thinking styles, etc., are not considered. For example, two-digit multiplication homework is assigned without confirming whether students have mastered one-digit multiplication.

Core Concepts

Localization

Localization consists of “local” and “ization”, referring to a dynamic process of transforming external or local resources based on local specific realities. It emphasizes integrating resource transformation with local culture and development realities. It is a specific process or state where teachers “root themselves in local realities”, focus on students’ “participatory experience”, rely on local resources, use localized knowledge, and carry out teaching activities in combination with rural social characteristics (Zhu, 2022). Through effective guidance from teachers, the localization of local and external educational resources is realized, which in turn integrates local resources into specific homework design practices, promoting students’ local development and the cultivation of their literacy and abilities.

Localized Mathematics Homework Design

Keyword clustering analysis of mathematics homework research using VOSviewer software shows that “exercise design” was a major focus before the surge in homework design research. Recent research hotspots related to mathematics homework design mainly include “Double Reduction”, “core literacy”, and “unit homework”, as well as homework design strategies, effectiveness, stratified homework, and reducing burden while improving quality.

Localized mathematics homework design is a process of localized design and practice of students’ mathematics homework by teachers, parents, and local villages and communities, based on students’ mathematical reality, relying on their real life reality, and considering teachers’ educational and teaching capabilities. It emphasizes that education should return to students’ life fields, daily life scenarios, and real realities. Its main purpose is to make up for the inconsistency between some homework in textbooks and teaching aids and students’ life reality, reduce students’ homework burden, develop their mathematical literacy, and give full play to the educational function of homework.

Practical Exploration

Investigation on the Current Situation of Localized Mathematics Homework Design in Rural Primary Schools

A questionnaire survey and semi-structured interviews were conducted among teachers from small-scale rural primary schools (with fewer than 200 students) in Liupanshui. The results show that 99% of the 336 surveyed teachers believe mathematics homework is important, 53% often design homework, and 1 teacher never does so. Most teachers spend 20-30 minutes designing homework, with textbooks and teaching aids as the main sources. The primary basis for homework design is students’ mastery of knowledge, and the main purpose is to enable students to understand what they have learned, followed by cultivating their mathematical literacy. The main factors affecting homework design are teachers’ professional competence, followed by time arrangement and design awareness. Among the six types of local resources, teachers consider school resources the most

important for homework design, followed by family resources, while institutional cultural and natural resources are the least valued.

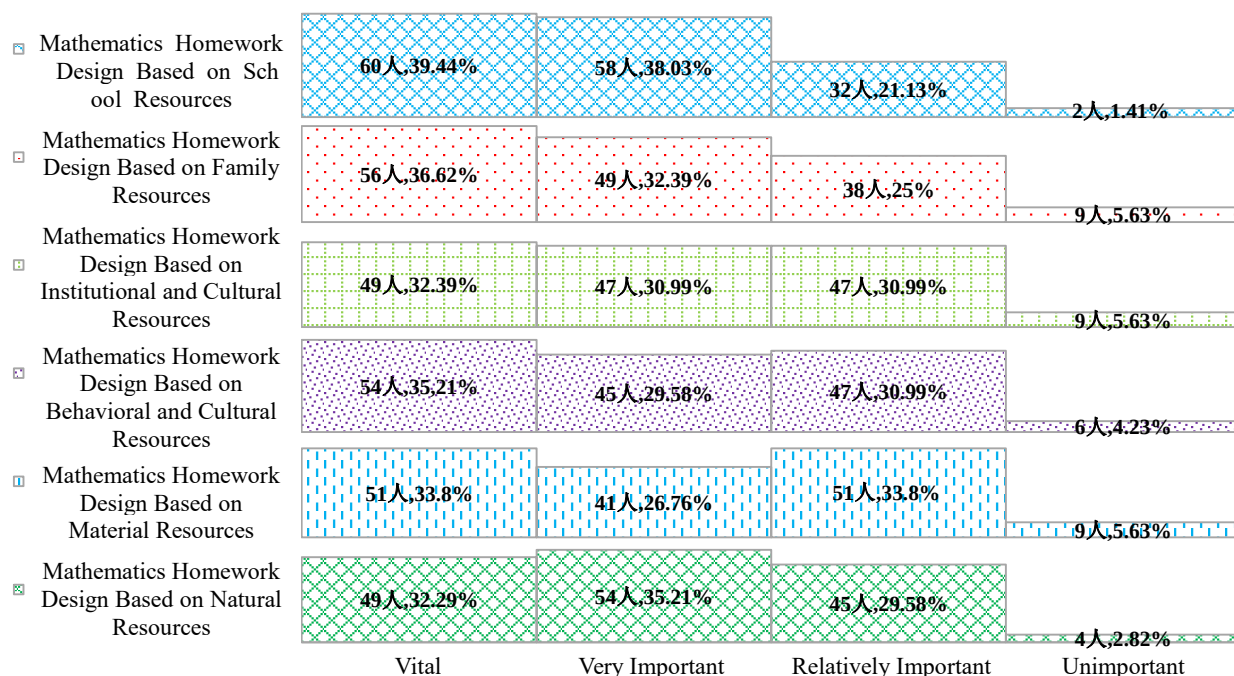


Figure 1. Teachers' perceptions of the importance of using local resources for mathematics homework design.

Case Condensation of Localized Mathematics Homework Design in Rural Primary Schools

Since the first localized mathematics homework was designed in 2019, after five years of research and practice, more than 50 localized mathematics homework design cases have been developed and practiced in selected rural primary schools in Liupanshui, focusing on 11 core literacy performances in primary school mathematics. Here are some case excerpts:

Case 1: Mathematics Homework on Understanding Kilometers. Teachers identify a target point 1 kilometer away from the school and lead students to visit it. Students record their steps and time independently, calculate their step length, and estimate the time required to travel to the city (about 35 kilometers). This allows students to personally perceive the distance of 1 kilometer while reviewing knowledge such as unit conversion, multiplication, and division, helping them form a correct sense of quantity.

Case 2: Estimating the Volume of Fruits from Platanus Trees on Campus. The fruits of Platanus trees are light and float on water, making the textbook's water displacement method inapplicable. Teachers and students discuss and practice three solutions: 1. Use the water displacement method with thin bamboo sticks to press the fruits underwater; 2. Wrap the fruits with soil (instead of plasticine) into regular shapes and calculate the volume difference before and after wrapping; 3. Use salt instead of water to measure the volume difference when fruits are immersed.

Model Construction

Based on the theory of localized education, combined with the resource endowments of rural primary schools and students' development needs, a "three-dimensional support—four-link closed-loop—multi-party

collaboration” localized mathematics homework design model has been constructed after five years of action research, realizing the educational logic of “resource transformation—experience deepening—literacy internalization”, as shown in Figure 2.

The core logic of the model is: taking students’ reality as the foundation, local resources as the carrier, and literacy development as the goal, connecting textbook knowledge, local scenarios, and students’ experience, transforming homework from text-based exercises to life practice, and from passive completion to active inquiry.

The model consists of three core dimensions: 1. Basic support: dual reality anchoring (extracting mathematical elements from rural resources on the life side, and grasping students’ knowledge and abilities through questionnaires on the mathematical side); 2. Implementation operation: four-link closed loop (forming a team to explore and transform resources into materials, compiling stratified/project-based homework according to five principles, organizing on-site practice, and conducting multi-dimensional feedback and optimization); 3. Guarantee and collaboration: multi-party joint efforts (led by teaching and research groups, equipped with a “concept—technology—condition” management system and case database).

It also includes a four-stage operation closed loop (needs analysis, resource transformation, implementation and experience, evaluation and optimization) and three key support mechanisms (establishing resource lists, designing stratified homework, and improving teachers’ abilities).

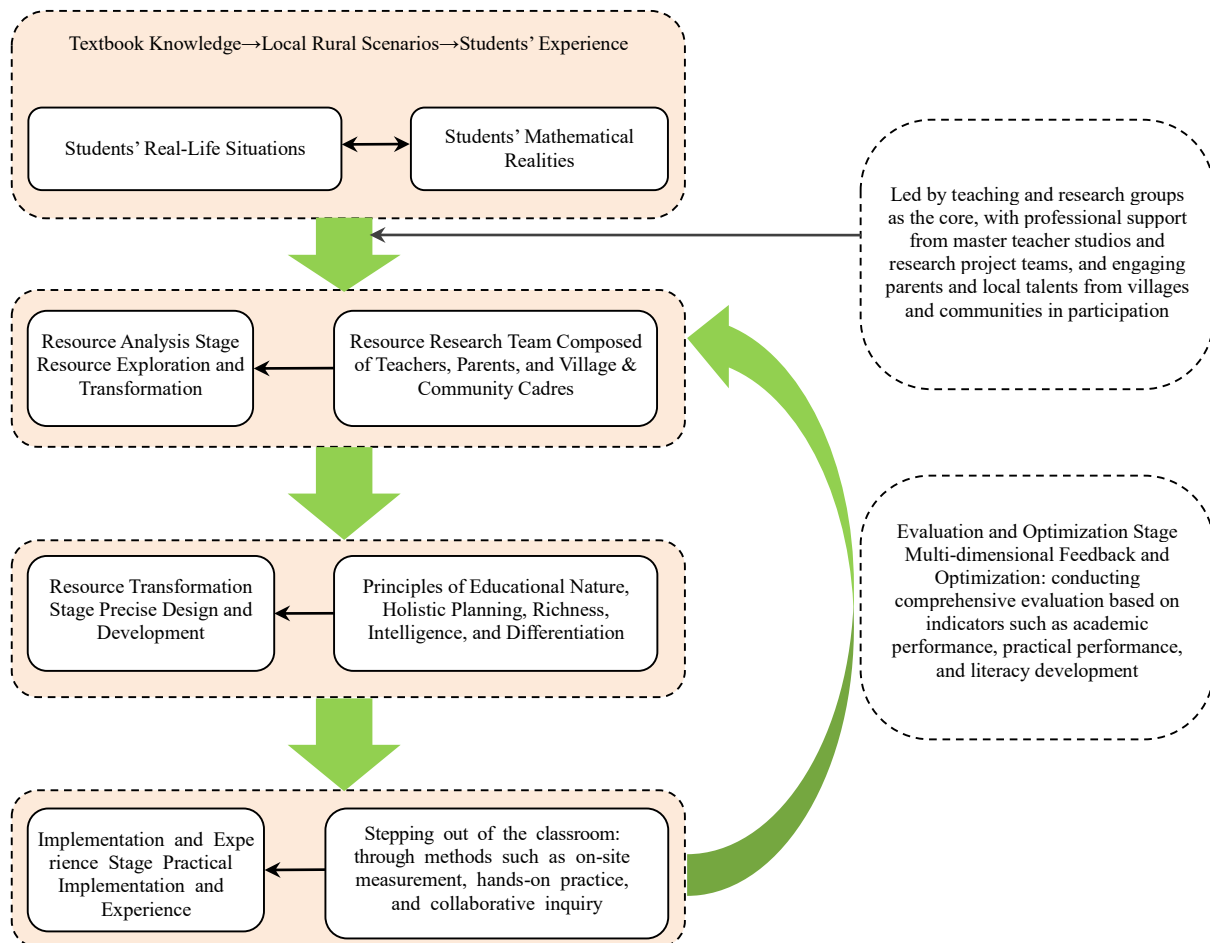


Figure 2. Localized mathematics homework design model for rural primary schools.

Effect Reflection and Discussion

Localized mathematics homework in rural primary schools allows students to step out of the classroom, connect knowledge with experience in playgrounds and life scenarios, and realize the transformation of knowledge into literacy.

Positive Effects

Improving interest and quality in education: Homework designed based on local resources reduces students' burden and enhances their learning interest. Students participate in practices such as measurement and agricultural product statistics. Since 2021, the academic performance of the class taught by the project leader has risen from 238th (7th from the bottom) to 79th in the district, and the performance of classes taught by other teachers has also improved significantly.

Promoting teachers' development: The practice research prevents rural teachers from "lying flat" by keeping them engaged, activates promotion channels, and enhances their self-identity.

Strengthening academic influence: Integrating "localization" with homework design has yielded achievements, including 1 completed municipal-level project, 1 ongoing provincial-level project, and 1 first prize in district-level teaching achievements.

Challenges and Reflections

The challenge of declining student and teacher numbers in rural primary schools: Urbanization has led to a shortage of students and the loss of excellent teachers in most rural primary schools, forming a "vicious circle". Issues such as attracting excellent teachers for rural education reform, ensuring all-round education with insufficient professional teachers, and implementing localized curriculum development require further research.

The challenge of artificial intelligence (AI): Despite abundant rural resources, few teachers are dedicated to homework design. In the AI era, exploring how to use AI for precise homework assignment, empower quality monitoring and evaluation, and implement differentiated homework design needs further exploration.

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