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Teaching Strategies for Promoting Student Engagement in Primary Mathematics Classrooms in China: A Case Study

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Abstract: Student engagement is a critical predictor of learning outcomes in primary mathematics. However, low classroom engagement remains a persistent challenge in Chinese primary mathematics instruction, particularly under the Double Reduction policy This qualitative case study selected two fourth-grade mathematics classes in a public primary school in East China to examine how targeted teaching strategies influence student engagement. Data were collected through classroom observations, semi-structured student interviews, and teacher reflective journals. Three effective approaches were identified: life-based situational teaching, small-group interactive cooperative learning, and hierarchical progressive task design. Preliminary data indicated that implementing these strategies was accompanied by improved student engagement (behavioral, emotional, cognitive), reduced off-task behaviors, and increased learning confidence. This study clarifies implementation paths and optimization suggestions for primary mathematics classrooms in China, offering actionable references for mathematics educators and researchers in the Asia-Pacific region.

Keywords: Primary Mathematics Classroom; Student Engagement; Teaching Strategies; Case Study; China; Asia-Pacific Education

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1. Introduction

1.1 Research Background

In the Asia-Pacific region, primary mathematics constitutes a foundational component of basic education, and student engagement is widely recognized as a core indicator of high-quality classroom instruction (Appleton et al., 2008). As one of the most influential educational regions globally, the Asia-Pacific area has been exploring paths to improve basic education quality, and mathematics learning achievement and classroom participation have long been regarded as key measurement dimensions. In recent years, countries such as South Korea, Japan, Singapore, and China have successively carried out curriculum reforms centered on student development, aiming to transform traditional teacher-centered teaching into student-centered learning environments.

In China, the implementation of the Double Reduction policy and revised mathematics curriculum standards has shifted instructional priorities from exam-oriented knowledge transmission to the development of students' core competencies, learning initiative, and active classroom engagement. The Double Reduction policy emphasizes reducing excessive homework burden and off-campus training pressure, requiring schools to improve classroom teaching efficiency and stimulate internal learning motivation. Under this policy background, primary mathematics classrooms can no longer rely on mechanical practice and repeated training; instead, they must attract students' initiative participation through high-quality teaching design. Nevertheless, low engagement remains prevalent in many primary mathematics classrooms: students often listen passively, lack deep cognitive participation, demonstrate limited interaction, and display frequent off-task behaviors. These problems reduce instructional efficiency and weaken long-term learning motivation, conflicting with the goals of high-quality basic education.

Student engagement is a multidimensional construct comprising behavioral, emotional, and cognitive engagement (Fredricks et al., 2004). Behavioral engagement reflects students' participation in classroom activities, emotional engagement represents their affective experience and interest, and cognitive engagement refers to deep thinking and independent exploration. For primary school students in a critical period of cognitive and affective development, student-centered instructional strategies are essential to stimulate holistic engagement. Compared with large-scale quantitative studies, case studies situated in authentic classroom settings can better reveal practical effects and implementation procedures, supporting contextually appropriate teaching innovations. Therefore, taking real primary mathematics classrooms as research scenarios and exploring effective strategies to improve student engagement has important theoretical and practical value.

1.2 Research Significance

Theoretically, this study enriches empirical evidence on student engagement in Chinese primary mathematics classrooms and supports the localized application of engagement frameworks in Asia-Pacific basic education. Most existing engagement theories originate from Western educational contexts, and their applicability in large-class teaching environments in East Asian countries needs more empirical support. This study takes Chinese primary mathematics classrooms as examples to verify the effectiveness of specific teaching strategies, providing a localized theoretical basis for the improvement of student engagement.

Practically, it summarizes replicable, classroom-ready strategies to help frontline teachers optimize instruction, address low engagement, and implement high-quality mathematics teaching under current curriculum reforms. The three strategies formed in this study—life-based situational teaching, small-group cooperative learning, and hierarchical task design—have strong operability and can be directly applied to daily teaching. The findings also provide implications for mathematics education reform in other emerging economies in the Asia-Pacific region with similar educational contexts, such as large-class teaching, exam-oriented tradition, and curriculum transformation pressure.

1.3 Research Questions

1. What targeted teaching strategies can effectively improve student engagement in Chinese primary mathematics classrooms?
2. How do these strategies influence students' behavioral, emotional, and cognitive engagement?
3. What challenges emerge during implementation, and what optimization approaches can be adopted?

2. Literature Review

2.1 Connotation and Measurement of Student Engagement in Mathematics

Fredricks et al. (2004) proposed a three-dimensional model of student engagement that has been widely adopted internationally. This model divides engagement into three interrelated and relatively independent dimensions: behavioral, emotional, and cognitive engagement. In mathematics education, behavioral engagement refers to active participation in discussions, activities, and task completion; emotional engagement reflects interest, enjoyment, and a sense of achievement; and cognitive engagement involves deep thinking, independent problem-solving, and reflective learning (Lee & Johnston-Wilder, 2017).

With the deepening of research, scholars have further expanded the connotation of student engagement. Some studies have added social engagement, emphasizing students' communication and collaboration in the learning process. However, the three-dimensional model is still the most widely used framework in mathematics classroom research. In terms of measurement, researchers usually adopt a combination of classroom observation, scale evaluation, and interview to obtain comprehensive data, avoiding the limitations of a single method.

Key influencing factors include teaching methods, teacher–student relationships, task design, and classroom environment.

Positive teacher–student relationships can enhance emotional engagement, interesting teaching methods can improve behavioral participation, and challenging task design helps stimulate cognitive investment. Western studies support the effectiveness of situational teaching, collaborative learning, and differentiated instruction, but their applicability to large-class, examination-oriented Chinese classrooms requires further validation (Martin & Collie, 2019).

2.2 Teaching Strategies for Enhancing Student Engagement

Internationally, strategies to improve engagement focus on three aspects: embedding mathematics in real-life contexts to reduce abstraction, increasing interactive and student-centered activities, and designing differentiated tasks to meet diverse learner needs (Campbell et al., 2020). Situated learning theory holds that learning occurs in specific scenarios, and connecting mathematics with real life helps students understand knowledge meaningfully. Cooperative learning can promote peer interaction and enable students to learn from each other. Differentiated instruction respects individual differences and allows each student to experience success.

In China, although scholars have emphasized student engagement, most research remains theoretical or focuses on single strategies, lacking systematic classroom-based case studies—especially under the Double Reduction policy. Many studies stay at the level of theoretical discussion and lack practical teaching cases and long-term intervention effects. In addition, few studies combine the characteristics of large-class teaching in China to design targeted strategies, resulting in limited practical guiding value.

2.3 Research Gap

Existing literature has two major limitations. First, most Western studies are based on small-class environments and may not fit Chinese large-class settings. Class sizes of 45–50 students are common in Chinese urban primary schools, which puts forward higher requirements for the organization and implementation of teaching strategies. Second, domestic studies lack in-depth, process-oriented case evidence, reducing practical operability for frontline teachers. Most studies only focus on whether strategies are effective, but rarely explain how to implement, what problems may be encountered, and how to adjust and optimize. This study addresses these gaps by investigating strategy implementation in authentic primary mathematics classrooms.

3. Research Methodology

3.1 Research Design

This qualitative case study used a non-randomized controlled design. Case study is suitable for exploring "how" and "why" problems in real scenarios, and can obtain in-depth and detailed data. This study took two complete classes as research units to ensure the authenticity and integrity of the teaching process.

We chose this design because it lets us explore the phenomenon deeply within our specific context. The trade-off is clear: we cannot statistically generalize what we find to larger or different populations. Participants were two parallel fourth-grade classes in a public primary school in Jinan, Shandong Province. The two classes were taught by the same mathematics teacher, which excluded the interference of teacher factors on the experimental results. Class A served as the experimental group using optimized strategies; Class B served as the control group using traditional teaching. The intervention lasted 12 weeks, covering four mathematics instructional units: fractions, area, four arithmetic operations, and statistics.

3.2 Participants

The school represented typical urban public primary education with large classes (45–48 students). The regional economic and educational development level was medium, which had good representativeness. The two classes showed no significant pre-intervention differences in academic performance, cognitive level, or classroom climate. The pre-test results of mathematics scores were tested by independent samples t-test, and there was no significant difference ($p > 0.05$). Both mathematics teachers had more than five years of professional teaching experience, had obtained senior teacher professional titles, and had rich teaching experience.

3.3 Data Collection

Data came from three sources, each collected systematically. Protocols guided every stage, and we maintained consistent timing across all four.

1. Classroom observations: Non-participant observations recorded active participation, off-task behaviors, interaction frequency, and task completion rates. Each class was observed 2 times per week, and 48 observations were conducted in total. The observation records were sorted out in time after class.
2. Student interviews: Semi-structured interviews were conducted at Weeks 4, 8, and 12 with 10 students per class at high, medium, and low achievement levels. Each interview lasted 15–20 minutes, and the content was recorded and transcribed.
3. Teacher reflective logs: Weekly records of strategy implementation, challenges, and adjustments. A total of 12 reflective logs were formed, recording detailed information such as teaching design, student performance, and effect feedback.
4. Learning artifacts: Classroom assignments, performance data, and learning feedback documents. These materials provided objective evidence for analyzing students' engagement and learning effects.

3.4 Data Analysis

Data were organized, coded, and analyzed using NVivo 12 qualitative software. Thematic analysis was used to analyze three-dimensional engagement. First, two researchers independently conducted open-coding on the transcribed data to extract initial concepts; discrepancies were resolved through discussion to enhance reliability; then, axial coding was carried out to categorize the concepts; Cross-group comparisons and methodological triangulation (observation, interview, reflective logs, artifacts) were applied to ensure the reliability and validity of the analysis. Data from observation, interviews, and reflective logs were mutually verified to improve the credibility of the research results.

3.5 Ethical Considerations

The study obtained approval from school administrators, teachers, and parents. All participation was voluntary. Students and their parents were informed of the research purpose, process, and rights in advance. Data were used solely for academic research, and all identities were anonymized to protect personal privacy.

4. Instructional Strategy Design and Implementation

4.1 Life-Based Situational Teaching

This strategy connects abstract mathematical concepts to daily experiences, reducing the cognitive load of students and enhancing learning interest. Primary school students are in the stage of concrete operational thinking, and they are more receptive to intuitive and vivid knowledge. Life-based situational teaching transforms abstract mathematical symbols and formulas into real-life scenes that students can contact every day.

For example, fractions were taught through snack sharing and stationery measurement; area was taught by measuring desks, blackboards, and classrooms; and four operations were applied to shopping and pocket-money budgeting. Teachers created situational problems such as "how to divide cakes equally" and "how to calculate the cost of stationery" to guide students to think mathematically.

Teachers posed real-life mathematical problems to stimulate curiosity, guided exploration within authentic contexts, and supported students in applying knowledge to solve practical problems. This approach reduced learning difficulty and increased student interest. Students no longer felt that mathematics was far from life, but realized that mathematics was everywhere and could be used to solve real problems.

4.2 Small-Group Interactive Cooperative Learning

Students were assigned to heterogeneous groups of 4–5 (high/medium/low achievement). Heterogeneous grouping ensures that students with different levels can help each other, avoiding the polarization of homogeneous grouping. Clear roles—recorder, presenter, checker, and discussant—ensured full participation. Each student had clear responsibilities, which effectively prevented "free-riding" behavior.

Teachers provided real-time guidance, followed by group presentations and peer evaluation. During group activities, teachers walked around the classroom to answer questions and guide the discussion process. After group cooperation, representatives were selected to share results, and other groups evaluated and supplemented. This structure expanded opportunities for verbal participation and reduced passive listening. Students learned to express their own opinions and listen to others' ideas, improving communication and cooperation skills.

4.3 Hierarchical Task Design

Tasks were divided into three levels to meet the learning needs of students with different foundations: basic tasks for all students (foundational knowledge and skills), enhanced tasks for middle-to-high levels (knowledge application), and innovative tasks for advanced students (creative problem-solving). Basic tasks focus on mastering core knowledge, enhanced tasks emphasize the application of knowledge, and innovative tasks cultivate divergent thinking and innovation ability.

Students selected tasks matching their ability levels, and teachers provided personalized feedback to foster confidence and success experiences. Low-achieving students can successfully complete basic tasks and gain a sense of accomplishment; high-achieving students can challenge innovative tasks and develop their potential. The control class used traditional whole-class teaching with unified tasks and no situational or cooperative design.

5. Results

After 12 weeks of intervention, descriptive and comparative evidence showed that the experimental class demonstrated relatively elatively higher behavioral, emotional, and cognitive engagement than the control class. The data from observation, interviews, and assignments all showed consistent results.

5.1 Behavioral Engagement

Active participation increased from 18 to 39 instances per class (+116.7%). Off-task behaviors decreased by 72.3%. The frequency of students leaving their seats, chatting, and doing small movements was significantly reduced. Task completion rate was 96.2% in the experimental class and 78.5% in the control class. Students maintained attention longer and volunteered more frequently to answer questions and participate in activities.

In classroom observation records, students in the experimental group took the initiative to raise hands, participate in group discussions, and complete tasks carefully. In contrast, students in the control group were more passive, with more inattentive phenomena and low task completion quality.

5.2 Emotional Engagement

A total of 87.5% of experimental students reported that mathematics class was interesting and enjoyable, compared with 32.5% in the control group. Mathematics anxiety decreased significantly; students preferred real-life tasks and group work and expressed greater pride and confidence. In interviews, many students said that they looked forward to mathematics class and no longer felt that mathematics was boring and difficult.

Students' emotional experience was significantly improved, which further promoted their participation in classroom activities. Positive emotions formed a virtuous cycle with learning behavior, making students more willing to invest in mathematics learning.

5.3 Cognitive Engagement

Experimental students showed deeper thinking, independent reasoning, and persistence with challenging tasks. They could put forward different solutions and reflect on their own learning process. Control students relied heavily on teacher explanation, lacked exploratory spirit, and struggled with complex problems. The experimental class also exhibited a more positive classroom atmosphere and stronger learning motivation.

In terms of homework and test performance, the experimental group not only had higher accuracy but also more diverse problem-solving methods, reflecting higher-level cognitive participation.

6. Discussion

6.1 Effectiveness of the Strategies

Situational teaching, cooperative learning, and hierarchical task design appear to effectively improved student engagement, consistent with international findings (Appleton et al., 2008; Campbell et al., 2020). These methods align with children's cognitive development rules, shift instruction from teacher-centered to student-centered, and stimulate intrinsic motivation. Life-based scenarios reduce abstraction, cooperative learning enhances interaction, and hierarchical tasks respect differences.

They are feasible in large-class settings without specialized equipment. Teachers do not need expensive teaching tools; they only need to optimize teaching design, which has strong promotion value. This is particularly important for most ordinary primary schools in China and the Asia-Pacific region.

6.2 Challenges and Optimization

Challenges included over-reliance on peers in group work, avoidance of advanced tasks by low-achieving students, and limited teacher attention in large classes. Individual students in group work depended on others to complete tasks, and some students were unwilling to challenge difficult tasks.

Optimizations include clarifying group roles, encouraging progressive task attempts, and implementing peer tutoring and after-class support. Teachers should strengthen individual guidance, establish a supervision mechanism for group cooperation, and set up progressive task paths to help students gradually improve their difficulty.

6.3 Implications for Asia-Pacific Mathematics Education

The findings may be applicable to other Asia-Pacific regions facing large classes, exam pressure, and low student engagement (e.g., South Korea, Japan, Southeast Asia). These regions have similar educational culture and classroom environment, and the strategies in this study can be adjusted and applied according to local conditions. Localized adaptation can support improvements in mathematics teaching quality and student engagement across the region.

7. Conclusion

7.1 Research Conclusions

Within the context of this case study,Life-based situational teaching, small-group cooperative learning, and hierarchical task design are associated with improve behavioral, emotional, and cognitive engagement in Chinese primary mathematics classrooms. They tend to reduce off-task behaviors, enhance interest and confidence, and improve instructional efficiency. These strategies are practical and scalable in large-class settings and provide promising solutions for improving teaching quality under the Double Reduction policy.

7.2 Limitations

This study was conducted in one urban primary school; thus, findings may not generalize to rural schools and other grades requires further verification. The 12-week intervention limits conclusions about long-term effects. Given the small sample and qualitative design, causal claims cannot be made from this study. Future large-scale quantitative studies are recommended to verify the universality of the results.

7.3 Future Research

Future research may expand to rural schools, cross-grade and cross-subject comparisons, long-term impacts on academic performance and core competencies, and integration with AI and digital tools to support smart education in the Asia-Pacific region. With the development of educational technology, the combination of digital means and engagement strategies will become an important research direction.

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Conflict of Interests

The authors declare that there is no conflict of interest regarding the publication of this paper.

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