Journal of Contemporary Educational Research, 2025, Volume 9, Issue 7
http://ojs.bbwpublisher.com/index.php/JCER
ISSN Online: 2208-8474
ISSN Print: 2208-8466

Research on Evaluation Scheme for Quantitative Sense from the Perspective of Core Competencies: Taking the Measurement Unit of the Sixth Unit in the First Volume of the Second Grade of the Beijing Normal University Edition as an Example

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Abstract: The implementation of core competencies clarifies social talent needs and guides math classroom evaluation. Lower-grade primary students, highly malleable, need targeted teacher guidance. Teaching evaluation should meet the talent demands of the times, focusing on core literacy and essential character development. From this perspective, primary math teachers should optimize evaluation, build a diversified system, help students grow in math, find their learning position, and advance confidently.

Keywords: Core competencies; Lower primary school; Quantitative sense; Evaluation scheme

Online publication: July 31, 2025

1. Introduction

Quantitative sense is a new addition to the Graphics and Geometry field in the 2022 Compulsory Education Curriculum Standard. In 2022, the Ministry of Education pointed out that core literacy in the primary school stage is mainly manifested in 11 keywords, such as number sense and quantitative sense [1]. Quantitative sense is a perceptual understanding of the magnitude, weight, amount, speed, thickness, and other quantitative aspects of objects [2], and it is an intuitive perception of the measurable attributes and size of things [3]. From the definition of quantitative sense, we can know that it has the characteristics of subjectivity, fuzziness, and instability. In daily teaching, teachers are often troubled by how to implement the evaluation of quantitative sense. Therefore, this paper tries to design an evaluation scheme for quantitative sense combined with the content of quantitative sense in the second grade, in order to provide ideal support for the new curriculum standard and develop students' core literacy.

2. Problem identification

2.1. Conflicts in current education

The Compulsory Education Mathematics Curriculum Standard (hereinafter referred to as the Curriculum Standard) points out that mathematics classrooms should enable students to "acquire the basic mathematical knowledge and skills that can adapt to daily life and further development," and should also cultivate students' higher-level mathematical literacy, such as "mathematical thinking, mathematical expression, mathematical application, and higher-level humanistic literacy related to mathematics" [1].

Traditional teaching evaluation mainly uses paper-and-pen testing, which often leads us to focus on mathematical knowledge and skills. This will cause daily teaching to more easily ignore students' mathematical thinking and mathematical expression. Although in recent years, more and more teachers have actively explored test questions that can examine students' learning process, it can be clearly seen from the test question types, proposition presentation methods, and answer forms that these changes are far behind the pace of curriculum reform.

2.2. Singularity of evaluation tools

With relevant questions, we found the literature on "evaluation" in CNKI, whose research content is mainly divided into two aspects: evaluation objectives and evaluation functions. Specifically, in the evaluation of mathematical objectives, the evaluation of the mathematical knowledge level mainly focuses on the research of number sense, and the compilation of the number sense scale has been relatively mature [4]. However, there is very little research on the evaluation of quantitative sense, so there is little evaluation tool for quantitative sense that can be borrowed in actual teaching. Without evaluation pointing to human development and core literacy, it is difficult for our education and teaching to undergo substantive changes.

2.3. Uniqueness of evaluation subjects

In traditional evaluation, teachers always play the main role in evaluation, and students' subjective initiative is not fully exerted. Students are in a passive position in the whole activity, which will lead to the insufficient exertion of the incentive nature of evaluation. Because teachers have many objects of concern and limited attention time, one-sided evaluation will make students feel anxious and create unnecessary learning pressure. In extreme cases, it will even make students lose their confidence and interest in learning. Teachers and students will shorten the classroom learning and teaching time, which will increase the unnecessary workload of teachers, and finally increase the pressure on students and teachers.

3. Problem thinking

3.1. Paying attention to the needs of the times

The times need talents with core literacy and necessary character, including math core abilities like abstraction, reasoning, modeling, etc. Core literacy complexity requires comprehensive evaluation methods, such as exams, performance, and self-evaluation. Technical evaluations like computer testing now play a role, replacing traditional "from beginning to end" with combined methods.

3.2. Providing perfect support for the new curriculum standard

The National Medium and Long-Term Education Reform and Development Plan (2010–2020) requires improving compulsory education quality and establishing national standards and a monitoring system. China's education quality monitoring and international evaluations increasingly focus on curriculum standard-based systems [5]. The Curriculum Standard emphasizes multi-dimensional evaluation: "Attention to students' knowledge/skills mastery and emotional attitude development, as well as learning outcomes and process changes" [6]. Primary school math academic evaluation standards offer targeted feedback for teaching. They should concretize Curriculum Standard goals and clarify stage-specific performance standards to support the new curriculum.

3.3. Emphasizing students' core literacy

First, fully understand the connotation and value of primary school math core literacy, the premise for implementing evaluation objectives; second, build a multi-dimensional, operable evaluation system with diverse types; lastly, focus on math activity experience, practical operations, learning processes, thinking generation, feedback, and timeliness [7]. Teachers should monitor students' basic knowledge mastery and key ability assessment. Beyond evaluating math knowledge application, examine operational practice, language expression, and innovative ability.

4. Problem breakthrough

Taking the sixth unit "Measurement" of the first volume of the second grade of the Beijing Normal University Edition mathematics as an example, according to the new curriculum standard and core literacy, sort out the evaluation rubric for students, and establish the evaluation level corresponding to the students' ability level points, in order to provide students with more specific guidance and implementation suggestions.

4.1. Setting of literacy dimensions

The evaluation covers five literacy dimensions: mathematical vision, data analysis, team cooperation, mathematical innovation, and application. Each dimension interrelates to shape students' math core literacy system.

The logic of level stratification is to divide each literacy into four levels according to the law of students' cognitive development and the degree of literacy achievement, from ☆ (1%–70%), ☆☆ (70%–80%), ☆☆☆ (80%–90%) to ☆☆☆☆ (91%–100%), showing the characteristics of from shallow to deep and gradual advancement. The first level is the basic perception layer, focusing on the initial establishment of literacy-related behaviors in teacher-led or simple tasks, such as being able to identify simple measurement objects and tools in mathematical vision; the second level is the independent application layer, where students can independently use literacy knowledge in routine tasks, such as being able to compare and estimate lengths in quantitative sense; the third level is the strategy optimization layer, emphasizing problem insight and method optimization for complex tasks, and being able to deeply process data and attribute causes in data analysis; the fourth level is the innovation and migration layer, requiring students to flexibly migrate in multiple and complex situations to achieve high-level application of literacy, such as comprehensively using knowledge to solve real and complex problems in mathematical application.

4.2. Analysis of the level characteristics of each literacy dimension of quantitative sense

4.2.1. Mathematical vision

Level 1: In the initial stage of mathematical measurement cognition, students can only identify the characteristics of the most basic measurement objects in simple measurement tasks, such as distinguishing intuitive differences such as length and height, and their choice of measurement tools depends on intuitive judgment. They can only use the most conventional and simple tools, reflecting the initial perception of “quantity,” which is the enlightenment state of quantitative sense cultivation.

Level 2: With the advancement of cognition, students can independently deal with routine measurement tasks, be familiar with the standard use of tools such as rulers, and can accurately use tools to obtain measurement results according to task requirements, such as accurately measuring the length of line segments and objects, showing the mastery of measurement operation processes and basic tool functions. Quantitative sense has moved from perception to initial application.

Level 3: Entering the stage of strategic measurement, when facing tasks, students are no longer limited to operations, but can predict potential measurement problems, such as considering the influence of measurement tool accuracy and measurement object deformation, and can also take the initiative to plan solutions, reflecting the thinking about the essence of measurement and complex situations. Quantitative sense is integrated with problem-solving thinking.

Level 4: Reaching the advanced application level, students can flexibly select tools and methods according to task characteristics, and at the same time have an error awareness, can analyze the causes of errors generated by different measurement methods, and understand the relativity of measurement results. Quantitative sense has been sublimated into a deep understanding of the measurement system.

4.2.2. Data analysis

Level 1: As the embryonic stage of data awareness, students can accurately record basic data after simple measurement and other activities, such as the numerical value of measuring the length of an object, and carry out the most intuitive comparison based on the data, such as judging length and amount, initially establishing the connection between data and conclusions.

Level 2: The data processing ability is advanced. Students can simply sort out the data in measurement and other activities, such as classification and sorting, and present them in multiple forms, such as tables and graphs, and can also identify abnormal data and try to process it. The data thinking has developed from single recording to structured processing.

Level 3: Emphasizing in-depth data analysis, students can interpret the sorted data and tap the mathematical relationship behind the data, such as finding the law of object length change and the difference of data in different measurement groups through the comparison of measurement data, realizing the transformation from data to information.

Level 4: Focusing on data communication and migration, students can not only analyze data, but also express their views in the form of reports and displays combined with their own thinking, and use the results of data analysis for communication, reflecting the social application value of data literacy.

4.2.3. Team cooperation

Level 1: The initial form of team collaboration. Students can only confirm their role in the group (such as operator, recorder, etc.)under the clear instructions of the teacher. The completion of the task depends on external guidance, and the initiative and role awareness of collaboration are weak.

Level 2: The stage of independent role positioning. Students can independently determine the division of labor in the group according to the task requirements, clarify the responsibility boundaries, and have basic collaboration ability, and can promote the task together around the task, but the depth and strategy of collaboration are insufficient.

Level 3: The development period of efficient collaboration. Group members can dynamically adjust their roles according to the complexity of the task, give full play to individual advantages, such as in creative tasks, members good at innovation lead the thinking, and careful members control the details, so as to achieve complementary advantages and efficient task completion.

Level 4: The stage of collaborative innovation and empowerment. Facing complex tasks, the team can not only work together, but also find the potential of members in cooperation, inspire the team to solve problems innovatively through experience sharing and thinking collision, and help improve the personal ability of members at the same time, showing the educational value of team collaboration.

4.2.4. Mathematical innovation

Level 1: The bud of innovative thinking. When solving mathematical problems, students master at least one basic method, such as using the making-ten method to calculate addition, and can find problems from a mathematical perspective (such as calculation errors, tedious methods), and try simple exploration, which is the initial awakening of innovative consciousness.

Level 2: The expansion of problem-solving strategies. When encountering difficulties, students no longer rely solely on memory methods, but can take the initiative to mobilize multiple activities such as operation (placing learning tools), verification (reverse calculation), and conjecture (assuming results) to explore. Innovation has developed from a single method to a combination of strategies.

Level 3: Induction and sharing of innovative methods. Students can break through the routine and find unique problem-solving paths, such as simple algorithms and unconventional auxiliary lines for geometric problems, and can also summarize methods and communicate and share with peers, promoting the spread of innovative thinking.

Level 4: Innovative tackling of complex problems. Facing multi-task and complex problems, students can comprehensively use knowledge to generate a variety of solutions, and can also compare and analyze to optimize strategies, showing the systematicity and depth of innovative thinking.

4.2.5. Mathematical application

Level 1: Perception of life mathematics. Students can find simple mathematical elements in reality, such as identifying real objects of "1 meter" and "1 centimeter" in daily life, and establish the initial connection between mathematical concepts and life.

Level 2: Attempt of mathematical explanation. After solving practical problems, students can carry out basic explanations for life phenomena (such as why objects are "long enough" or "not enough") based on mathematical results (such as measured length and calculated quantity), reflecting the initial expression of mathematical application.

Level 3: Innovative application practice. In challenging tasks, students can break through the routine and put forward novel ideas with mathematical thinking, such as designing unique measurement schemes and mathematical game rules, and verify them through operations, realizing the transformation of mathematical application from imitation to innovation.

Level 4: Sublimation of comprehensive application. Students can integrate knowledge in multiple fields to solve complex real problems (such as the mathematical overall planning of campus greening), not only build solutions, but also extract thinking methods, and realize the deep migration of mathematical application.

4.3. Practical value of the evaluation framework

4.3.1. Precision of teaching diagnosis

With the help of this framework, teachers can accurately locate the weak links according to the students' performance at each literacy level. For example, if it is found that students have difficulties in advancing from level 2 to level 3 in data analysis, special activities can be designed focusing on "in-depth data processing and attribution" to optimize teaching with a clear goal.

4.3.2. Gradual cultivation of literacy

The clear level stratification provides a path for teaching planning. Teachers can design ladder-type teaching activities according to the logic of level advancement, from the perception enlightenment of level 1 to the innovative application of level 4, and promote the spiral rise of students' literacy.

4.3.3. Diversification of the evaluation system

The framework integrates self-evaluation, peer evaluation, and teacher evaluation to build a diversified evaluation ecology. Self-evaluation promotes students' self-reflection, peer evaluation cultivates cooperation and critical thinking, and teacher evaluation ensures the professionalism of evaluation, comprehensively measuring the development of literacy and improving the reliability and validity of evaluation.

4.4. Paying attention to students' generality and personality

The relevant evaluation suggestions in the Curriculum Standard also have a multi-dimensional perspective: "It is necessary to pay attention to students' understanding and mastery of knowledge and skills, and also pay attention to the formation and development of their emotions and attitudes; it is necessary to pay attention to the results of students' mathematics learning, and also pay attention to the changes and development in their learning process" [6].

Evaluating primary school students' quantitative sense needs to consider generality and individuality to meet individual differences. Cultivating cm/m quantitative sense is key, so we adopt multi-dimensional evaluation.

General concerns: Measurement accuracy: All students will participate in the measurement task and use the same measuring tools. Unit understanding: Through common classroom discussions and the teaching of subject knowledge, we will ensure that each student understands the basic concepts of centimeters and meters and can clearly distinguish them. Practical application ability: The whole class will participate in solving some practical application problems, such as measuring the lengths of different objects in the classroom.

Personality concerns: Individualized tasks: For students who perform well in measurement, some extended problems are provided to challenge their abilities. For some students who may need additional support, personalized tutoring will be provided to help them improve measurement accuracy. Creative display: Students will have the opportunity to carry out creative displays, such as designing a scale in centimeters and meters or creating an interesting practical problem. Individual feedback and improvement: Provide personalized feedback, emphasizing each student's strengths and improvement. Encourage students to develop personalized learning plans based on feedback to promote their better development in terms of individual differences.

5. Conclusion

In conclusion, through the above evaluation scheme, we aim to ensure that all students master the common foundation while paying attention to and stimulating the personality potential of each student. This helps to form a more comprehensive and differentiated learning environment and promote the comprehensive development of each student in terms of quantitative sense.

Disclosure statement

The authors declare no conflict of interest.

References

[1] Ministry of Education of the People's Republic of China, 2022, Compulsory Education Mathematics Curriculum Standard (2022 Edition), Beijing Normal University Press, Beijing.

[2] Zhang Q, 2012, "Quantitative Sense" Should Not Become a Blind Spot in Mathematics Teaching: Taking the Teaching of "Measurement Units" in the Lower Grades as an Example. Jiangsu Education, 2012(9): 31–33.

[3] Lin W, 2023, Exploration on the Cultivation Strategy of Primary School Mathematics Quantitative Sense from the Perspective of Core Literacy. Mathematics Learning and Research, 2023(11): 89–91.

[4] Wang Q, 2019, A Summary of Domestic Research on Mathematical Evaluation Tools. Education Science Forum, (04): 75–77.

[5] Zhang H, Lu J, 2011, Research and Development of Primary School Mathematics Academic Evaluation Standards. Curriculum, Teaching Material and Method, 31(10): 53–59.

[6] Wu J, 2018, Evaluation Reform to Support Children's Growth-Thoughts and Practices on Primary School Mathematics Performance Evaluation. Primary School Teaching Reference, (26): 5–7.

[7] Li X, 2023, Construction of Evaluation System of Core Literacy in Primary School Mathematics under the Concept of New Curriculum Standard. Curriculum, Teaching Material and Method, 43(04): 112–119 + 126.