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Article

The Design of Performance Assessment Oriented Towards Subject Core Competencies

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Abstract: Under the guidance of subject core competencies, a more scientific and comprehensive evaluation system is required to unleash the educational value of subjects. As a new type of evaluation method that transcends traditional paper-and-pencil tests, performance assessment has been widely used in the assessment of core competencies. Guided by subject core competencies and aligned with the requirements of compulsory education curriculum standards, this paper establishes a performance assessment perspective tailored to the core competency framework of elementary school mathematics. Using "The Meaning and Properties of Fractions" as an example, it constructs a systematic and scientific performance assessment system, encompassing the determination of performance objectives, the design of performance tasks, and the development of performance rubrics. This serves as a reference for the design and implementation of performance assessments in elementary school mathematics that are oriented towards subject core competencies.

Keywords: subject core competencies, performance assessment; elementary school mathematics

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1. Introduction

Performance assessment, as a new form of assessment, transcends traditional paper-and-pencil testing and can truly reflect the educational function and value of a subject. Although frontline teachers currently have the awareness to develop performance assessments and actively explore their implementation, not all assessments driven by real tasks and accompanied by evaluations are scientific and effective performance assessments. This type of assessment, which seems lively but only stays on the surface without touching on the core literacy of the subject, will only increase the burden on teachers. Therefore, how can disciplinary core literacy guide the design of performance assessments? How can performance assessments promote the implementation of disciplinary core literacy? These issues urgently need to be addressed in the current reform of basic education assessment. This paper attempts to construct a performance assessment perspective oriented towards disciplinary core literacy, establish a literacy objective system based on course content and curriculum standards, and present the overall design of performance assessments through examples, providing a reference for the development and implementation of performance assessments in primary school mathematics oriented towards disciplinary core literacy.

2. Performance Assessment Based on Subject Core Competencies

Core literacy mainly refers to the essential character, key abilities, and values that students should possess to adapt to lifelong development and social development [1]. Therefore, classroom teaching and assessment should not only focus on students' academic performance but also on their literacy, cultivating their abilities for future-oriented and lifelong learning. The development of literacy cannot be accomplished overnight, and

one of the key issues in current teaching reform is the implementation of core literacy [2]. Under the guidance of core literacy, each discipline, combining its characteristics, has proposed disciplinary core literacy that better reflects the discipline's educational value. The cultivation and enhancement of disciplinary core literacy cannot be separated from classroom teaching, and its assessment cannot be fully measured by traditional paper-and-pencil tests. Instead, multiple assessment subjects and diverse assessment methods should be adopted to effectively cultivate students' disciplinary core literacy [3].

2.1. The Connotation of Performance Assessment

Performance assessment was formally established and entered into large-scale evaluation in the late 1980s and early 1990s, emerging as a trend to meet the need for developing "higher-order thinking skills" in the "postmodern" era, known as the "new assessment movement" [4]. After being introduced to China around the year 2000, this concept garnered widespread attention from many scholars, who suggested its widespread application in education and teaching. So-called "performance assessment" evaluates students' level of understanding development through their performance process and the "product" of completing complex tasks. These "complex tasks" usually stem from real-life situations and require students to implement them in authentic practice, hence they are also called "authentic performance tasks" [5]. Performance assessment is an evaluation method that relies on careful observation and professional expertise to make judgments, and a complete performance assessment mainly consists of four parts: evaluation purpose, specific performance, exercises or tasks that drive student performance, and a scientific scoring rubric for the performance results, including various forms such as presentations, experiments, and manipulatives [6]. In summary, regardless of the specific form of performance assessment, its core lies in simulating real-life situations as much as possible and comprehensively evaluating students' performance throughout the process of completing complex tasks and their final outcomes based on established scoring rules, with an emphasis on students' understanding and application of knowledge, thus compensating for the traditional objective paper-and-pencil tests' single measurement of declarative knowledge [7].

2.2. An Evaluation Perspective Oriented Towards Subject Core Competencies

Teaching evaluation must reflect the requirements of core disciplinary competencies, because without a corresponding evaluation mechanism that aligns with them, core competencies may merely become a fleeting buzzword, finding it difficult to truly take root. It is evident that cultivating the core competencies of future talents cannot solely rely on paper-and-pencil tests, especially closed-ended multiple-choice questions, which cannot comprehensively evaluate students' competency performance and thus hardly promote the development of their core competencies. Compared with traditional paper-and-pencil tests, performance assessment provides students with opportunities to engage in more challenging real-world tasks, not only measuring the achievement of deep, high-order learning goals focused on core competencies but also carrying educational functions that promote the deepening of curriculum reform, the optimization of classroom teaching, and the facilitation of students' active learning.

In the process of implementing core disciplinary competencies, teachers need to build a bridge between curriculum standards and classroom teaching, skilfully integrating competency goals into teaching content and further refining them into specific teaching objectives that are closely aligned with core disciplinary competencies. At the same time, teachers also need to carefully develop evaluation details and use them as a basis for instructional design, ensuring high consistency among teaching, learning, and evaluation.

With disciplinary core competencies as the cornerstone, not only can the internal logical coherence and high consistency of the subject curriculum standards be ensured, but it also effectively promotes the practical and effective implementation of disciplinary core

competencies [8]. The design of performance assessment oriented towards disciplinary core competencies should be based on the requirements of the curriculum standards, implement disciplinary core competencies in classroom teaching and task implementation, and integrate competency goals into the formulation of evaluation standards, ultimately guiding instructional design and achieving the goal of using assessment to promote teaching and learning [9].

3. From Project Evaluation to a Competency-Based Target System

The cultivation of core competencies ultimately needs to be realized through classroom teaching, so performance assessment should establish a statement framework based on course content, focusing on students' real and specific academic achievement performances. For example, the connotation of mathematics disciplinary core competencies is "three abilities": the ability to observe the real world with a mathematical perspective, to think about the real world with mathematical thinking, and to express the real world with the language of mathematics. So how can we judge whether students can observe the world with a mathematical perspective? What is the level of their observation? What kind of language constitutes "the language of mathematics"? What kind of performance indicates that students have "mastered" it? These require specific descriptions under performance assessment.

Establishing a statement framework based on course content reflects the leading role of disciplinary core competencies in curriculum evaluation. For example, according to the requirements of the new curriculum standards, we can take the three dimensions of mathematics disciplinary core competencies — "the ability to observe the real world with a mathematical perspective", "the ability to think about the real world with mathematical thinking", and "the ability to express the real world with the language of mathematics" — as first-level indicators, refine unit academic requirements, and use them as important bases for instructional design, teaching processes, and teaching evaluation. The connotation of the disciplinary core competency "the ability to observe the real world with a mathematical perspective" can be further divided into four dimensions: "abstraction ability (including number sense, quantity sense, symbol awareness), geometric intuition, spatial concept, and innovative consciousness". Under these, operational descriptions of these competency characteristics are made. Based on these connotations, teachers can combine textbooks to outline the competency goals that students must achieve in each math lesson, while allowing students to understand their achievable levels by referring to the requirements. The verbs describing these goals are also assessment points for teachers, helping them observe the level of students' disciplinary core competencies and assess whether learning outcomes meet the standards.

4. Design of Performance Assessment Based on Competencies

The cultivation of disciplinary core competencies cannot be achieved overnight or through a step-by-step approach, but rather requires gradual advancement and deepening, necessitating the use of systems thinking to construct a path of reform as a whole. The design of performance assessment based on competency standards should be grounded in the guiding role of the competency goal system in teaching evaluation, creating a discipline-specific learning environment, carefully designing authentic situational tasks, precisely planning disciplinary practices, and meticulously arranging evaluation rubrics to achieve integration of teaching, learning, and assessment. Taking the fourth unit "The Meaning and Properties of Fractions" from the fifth-grade lower volume of the People's Education Edition of Elementary School Mathematics as an example, this article designs a performance assessment for the unit from three aspects: performance goals, performance tasks, and performance rubrics.

4.1. Determine Performance Objectives

When conducting competency-based performance assessment in teaching, it is first necessary to clarify the elements and manifestations of the disciplinary core competencies. Then, design performance goals that aim at enhancing these competencies. The goals should not be detached from the learning content but should be set based on the organization of the learning material, students' cognitive levels, and the requirements of the curriculum standards. They should be real, effective, measurable, and reflect the disciplinary core competencies.

Taking "The Meaning and Properties of Fractions" as an example, this unit divides the re-examination of fractions into two main threads: the meaning of fractions and the basic properties of fractions. The meaning of fractions, as the core content of the unit, runs through the entire unit. Only by understanding the essence of the meaning of fractions can one further learn about their properties and operations. Looking at the teaching of fractions throughout the entire elementary school stage, the re-examination of fractions occupies an important position that connects the preceding and the following, representing a significant expansion of students' concept of numbers.

The study of fractions is an important content in elementary school mathematics. Compared with the concepts of integers and decimals, the concept of fractions is more abstract. Therefore, understanding the meaning and properties of fractions plays a crucial role in the development of children's number concept and serves as a powerful vehicle for cultivating their number sense, quantity sense, mathematical thinking, and abstract reasoning abilities .However, due to the multi-dimensional nature of fractions and the diversity of their external representations, such as manipulative operations, graphical representations, verbal explanations, symbolic notations, and real-life situation representations, students' cognitive activities become complex, easily leading to cognitive overload. As a result, fraction teaching has always been recognized as a difficult point in the field of "Number and Algebra". Based on this, the design, implementation, and evaluation of performance tasks aimed at cultivating disciplinary core competencies will promote students' knowledge understanding and competency advancement.

The new curriculum standards stipulate that in the third grade level of compulsory education mathematics, students are required to "experience the process of representing numbers with letters, recognize some characteristics of natural numbers, and understand the meaning of decimals and fractions; be able to perform the four basic operations with decimals and fractions, and explore the consistency of number operations; develop a sense of symbols, computational skills, and reasoning awareness". The core competencies cultivated in this unit mainly include: number sense, quantity sense, computational skills, reasoning awareness, application awareness, etc. Most of these are based on the organization of the content and represent the abilities and competencies that students should attain. They primarily aim to cultivate students' ability to "observe the real world through the lens of mathematics". In the design, implementation, and evaluation of performance tasks, it is also necessary to strengthen the training of students' mathematical thinking and the expression of mathematical language.

4.2. Design Performance Tasks

Authentic performance tasks have unique characteristics compared to other types of assessments. Typically, performance tasks present students with challenging and feasible problems that require them to complete in real-life or simulated real-life situations. Students develop specific products or demonstrate corresponding performances for defined objects (real or simulated). The design of performance tasks needs to be rooted in real-life situations, allowing students to experience the generation and application process of subject knowledge through practical practice, truly embodying the principles of learning by doing, learning by applying, and learning by creating.

The design of performance tasks should, on the one hand, consider the objectives, roles, audience, products, and evaluation criteria in real or simulated real-life situations. On the other hand, it should also clearly and comprehensively elaborate the task elements and rules. The key to designing the various elements of performance tasks lies in reflecting the requirements of disciplinary core competencies. The task objectives should align with the performance goals; the setting of roles, audience, and situations should immerse students in the scenario, pose ill-structured problems, stimulate students' imagination and initiative, and cultivate their innovative consciousness. The task rules should make it clear to students how the task is to be completed and the specific deadlines, such as requiring students to explore through group collaboration, complete the work together during class time, and exchange and present their findings, thereby cultivating their spirit of cooperative inquiry and application awareness. The task products can specify a format or quantity, but they should be open-ended, allowing for personalized learning outcomes.

The improvement of competencies is not about students absorbing more knowledge, but rather about their ability to internalize knowledge and apply it to solve problems after acquiring it. When designing tasks, the first step is to connect the learning materials to students' lives and studies. "A fraction is a 'number'," meaning that a fraction is obtained by first dividing a whole and then counting. The process of "dividing first and then counting" embodies the "quantity" aspect of fractions, while the resulting fraction represents a "ratio". Although the meaning of fractions is relatively abstract, creating specific situations for students in the design of performance tasks can make the quantity visible and the ratio tangible, thereby cultivating students' number sense and quantity sense. Next, analyse the difficulties or questions that students may encounter during the task implementation process, and establish appropriate task scaffolds, such as providing students with examples of works and displaying them in layers, so that students of different abilities can design aesthetically pleasing works at their own level, thereby cultivating their imagination and innovative consciousness. Finally, based on the task content, determine the task rules and outcomes, and fully elaborate the task using infectious language.

4.3. Develop a Performance Rubric

After designing the performance task, it is also necessary to design scoring rubrics that can explain and measure students' implementation process of the task and the presentation of their products, in order to provide feedback to students and promote their self-regulation in learning. The rubric for performance assessment should not only focus on the presentation of the work, but also monitor, evaluate, and provide feedback on the entire process of implementing the performance task. Therefore, performance assessment should be conducted throughout the entire process, and appropriate evaluation tools should be developed and evaluation subjects determined based on the nature and characteristics of the task. Since the design of performance assessment targets the disciplinary core competencies from the outset to the task itself, the dimensions of the evaluation rubric should also be examined based on the core competencies of primary school mathematics [10].

Taking "The Meaning and Properties of Fractions" as an example, before implementing the task, small group discussions are held to clarify the task requirements and implementation plan. The aim is to cultivate students' abilities to analyse and solve problems, as well as to foster a spirit of teamwork and exploration, and develop their imaginative capabilities. During this phase, student self-assessment is used to self-monitor the efficiency and effectiveness of the group discussions. During task implementation, teacher evaluation is employed, where teachers use informal checks such as oral questioning, observation, and dialogue to assess students' understanding of the knowledge and the effectiveness of group cooperation, thereby exercising students' arithmetic skills. After the task is completed, class exchanges and presentations are conducted, with peer evaluations

among groups based on the three competency dimensions of "intuitive imagination", "innovative consciousness", and "mathematical expression". This aims to develop students' innovative consciousness and symbol awareness, enabling them to use mathematical language to express aspects of life.

5. Conclusions

Based on disciplinary core competencies, this paper provides a comprehensive overview of the connotation of performance assessment, the target system aimed at enhancing competencies, and the design of performance assessment. It selects the key unit "The Meaning and Properties of Fractions" from the primary school mathematics curriculum to specifically implement competency-based performance assessment design, systematically constructing the design of performance assessment from the setting of performance objectives to the design of performance tasks, and finally to the development of performance rubrics. This has certain reference value for specific curriculum teaching. This paper also has some limitations, such as failing to establish a paradigm for performance assessment in basic education, only providing a systematic design for a single unit content, and the performance tasks being relatively limited in scope.

The educational and teaching reform guided by disciplinary core competencies calls for new and scientific assessment methods. Performance assessment is not just a concept, but a necessity in the new era of curriculum reform. By integrating the enhancement of competencies into the implementation and evaluation of tasks through performance assessment, students can develop competencies while demonstrating them, making performance assessment a truly educational assessment that promotes the development of disciplinary core competencies.

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