DESIGN SOME GRADE 6 MATH TESTS TO ASSESS THE DEVELOPMENT OF MATHEMATICAL COMPETENCIES

Nguyen Van Anh, Le Thi Van Dung, Tran Anh Phuong, Nguyen Thi Hong*

Hanoi Metropolitan University

Abstract: *In this article, we study the innovations in testing and assessing learning and educational outcomes in the direction of developing students' qualities and competencies according to the 2018 general education program. From that, we design the regular and periodical test in the direction of developing qualities and competencies for 6th grade students according to the new general education program. In each test, we have developed test specifications, matrix of questions, and grading instructions.*

Keywords: *Competencies, periodical test, regular test, developing qualities and competencies, 6th grade students, assessing.*

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(*) Email: nthong@daihocthudo.edu.vn

1. INTRODUCTION

1.1. Modern tendencies in testing and assessment of learning and education result to develop student's quality and competence

1.1.1. Purpose of the assessment

To provide accurate and timely information, to determine the actual situation, learning achievements, and training according to the level of meeting the required requirements of the general education program and the progress of students, to adjust teaching and learning activities to improve the quality of education.

1.1.2. The conception of assessment in the direction of developing student's quality and competence

Evaluating learning outcomes in the direction of developing quality and competence should focus on outputs that are the qualities and competencies of learners, represented in the level and competency to creatively apply knowledge in solving tasks and requirements of diverse and vivid reality. This method attaches importance to assessing the learning process of students, regularly and continuously throughout the teaching process. Competency assessment focuses on the goal of assessing the progress of learners compared to themselves rather than others.

In essence, there is no contradiction between assessment of competence and assessment of knowledge and skills. Competence assessment is a higher development step, not entirely based on the educational program of each subject, where teachers create opportunities for students to solve problems in real-life situations. To do this, students must apply both knowledge and skills learned and self-study, in school and in society, not only in terms of knowledge but also emotionally and ethically.

1.1.3. Principles of testing and assessment in the direction of developing student's quality and competence

Current inspection and evaluation need to follow the following principles: ensuring objectivity, comprehensiveness, systematicity, authenticity, practicality, and efficiency. In particular, ensuring authenticity, authenticity, and efficiency are the most important. Only in this way will it be possible to reflect whether the learner's competency to progress, qualities, and competencies are suitable to the human conditions and needs of the society.

1.1.4. The tendency of completing the assessment

For the test and assessment of students to achieve good results, it is necessary to pay attention to a few points as follows:

- Guide students to develop self-examination and self-assessment skills.

This comes from the trend of student-centered teaching. Train students in learning methods to prepare for lifelong and continuous self-study.

- The examination and assessment of students must following requirements:
- Reproduction of knowledge.
- Practice skills and techniques.
- Developing cognitive competence, especially creative thinking competency.
- Create a real change in students' attitudes and behaviors.
- Train them to detect and solve problems arising in reality.

1.1.5. Competencies that need to be developed

- Aids and tools competency (CC) – being able to make use of and relate to the aids and tools of mathematics

- Communicating competency (GT) – being able to communicate in, with, and about mathematics

- Problem tackling competency (GQVĐ) – formulating and solving mathematical problems

- Modelling competency (MHH) – being able to analyze and build mathematical models concerning other areas

- Mathematical thinking competency (TD) – mastering mathematical modes of thought

2. CONTENT

According to the 2018 high school program, the assessment method has also been changed from a score-based assessment to an assessment based on students' competencies. After that change, teachers, as well as educators, will wonder if the test of students' competency development? How to design such a test? How to build a test that is closest to the assessment requirements? Understanding that, we have researched this issue and given 2 test questions: a regular test and a periodical test for Math 6. We design these 2 tests with the hope to help teachers more easily build a math test by the requirements of the Ministry of Education and Training and also serve to develop the competence of students.

The following two tests (including 1 regular test and 1 periodical test) were designed in the direction of assessing the quality and competency of 6th-grade students. The test samples are complete: test questions, grading instructions, matrix of questions, exam specifications to orient, illustrate in reality for teachers the standards of student assessment in the direction of quality and competence. The scope of knowledge is carried out according to the new 6th-grade textbook program "Cánh diều" to ensure it is consistent with the current curriculum of the Ministry of Education and Training.

2.1. Regular test

Time: 45 minutes

Lesson: Powers with natural exponents

Objective: This test is to provide the competency to apply the properties and laws of exponents and exponents with natural exponents in solving problems; assessment of learning results, competency to memorize knowledge about exponentiation with natural exponents of students.

A. Matrix of exam questions

	Recognization		**Understanding**		**Application**				**Total**
					Low		**High**		
	MC	**Essay**	**MC**	**Essay**	**MC**	**Essay**	**MC**	**Essay**	
1. Some special powers.	- Identify some special powers.								
Number of questions	2								2
Time (minutes)	1								1
Points	1								1
Percentage	10%								10%

Competency element	TD								
2. Properties of exponents.			- Apply properties of powers and special powers.		- Apply properties of exponents - Flexible calculation transformation				
Number of questions **Time (minutes)** **Points** **Percentage**			4 5 2 20%	1 5 2 20%	1 2 0,5 5%	1 7 3 30%			7 19 7,5 75%
Competency element			GQVĐ	GQVĐ	GQVĐ	GQVĐ TD			
3. Laws for large powers.							-Find out the rules for great powers of power -Change regular expressions		
Number of questions **Time (minutes)** **Points** **Percentage**							1 5 0,5 5%	1 15 1 10%	2 20 1,5 15%
Competency element							GQVĐ TD	GQVĐ TD	
Total number of questions **Total time** **Total score** **Percentage**	2 1 1 10%		4 5 2 20%	1 5 2 20%	1 2 0,5 5%	1 7 3 30%	1 5 0,5 5%	1 15 1 10%	11 40 10 100%

B. Test

I. Multiple choice (4 points)

Question 1 : (Recognization) a^0 $(a \neq 0)$ is equal to:

A.1 B. a C.0 D.$\frac{1}{a}$

Question 2 : (Recognization) Find the natural number n > 0, knowing that: $n^{2017} = n$

A.2017 B.2016 C.1 D.2

Question 3: (Low application) Calculate the value of the expression: A=$\frac{3^{10}.11+3^{10}.5}{3^9.2^4}$

A.768 B.3 C.728 D.3^6

Question 4: (Understanding) The result of the calculation $10^5.10^2$ is:

A. 10^3 B. 10^{10} C. 10^8 D.10^7

Question 5: (Understanding) $(2^3)^6$ is equal to:

A. 2^9 B. 2^{18} C. 2^{12} D.2^3

Question 6: (Recognization) $a^m.b^m$ is equal to:

A. $(ab)^m$ B. $(ab)^{mm}$ C. $(ab)^{m+m}$ D.$(a+b)^m$

Question 7: (Understanding) Write the following results as a power: $32^4:8^6$

A. 2^2 B. 4 C. 2^3 D. 8

Question 8: (High application) Find the last digit of 2^{2013}

A. 2 B. 4 C. 6 D. 8

II. Essay (6 points)

Question **1:** (Understanding) (2 points) Find x, know :

a) $(2x+1)^3 = 125$;

b) $3^x + 25 = 26.2^2 + 2.3^0$.

Question **2:** (Low application) (3 points) Do the following calculations in the most logical way:

a) $(2^{17} + 17^2)(9^{15} - 3^{15})(2^4 - 4^2)$;

b) $(8^{2017} - 8^{2015}):(8^{2104}.8)$;

c) $81.(27 + 9^{15}):(3^5 + 3^{32})$.

Question **3:** (High application) (1 point)

$A = 1 + 3 + 3^2 + \cdots + 3^{2006}$

a) Find the last digit of A,

b) Prove that A $= (3^{2007} - 1):2$.

C. Scoring Guide

Multiple choice (4 points)

1	2	3	4	5	6	7	8
A	C	C	D	B	A	A	A

	Question	Answer	The point
Essay (6 points)	**1 (2 points)**	a) 2	**1 point**
		b) 4	**1 point**
	2 (3 points)	a) 0	**1 point**
		b) 63	**1 point**
		c) 9	**1 point**
	3 (1 point)	a) Find the last digit of A: $A = 1 + 3 + 3^2 + \cdots + 3^{2006}$ ⇒ The last digit of A is 3.	**(0.5 points)**
		b) Prove :$A = (3^{2007} - 1) : 2$ $\Rightarrow 3A - A = (3 + 3^2 + 3^3 + \cdots + 3^{2007}) - (1 + 3 + 3^2 + \cdots + 3^{2006})$ $\Rightarrow A = (3^{2007} - 1) : 2$	**(0.5 points)**

2.2. Periodic test

Time: 90 minutes

Aims: The test aims to provide competence and progress of students after a semester; The lesson is divided into 30% multiple-choice and 70% essay, the essay section accounts for the majority of student's thinking and presentation, recognizing the competency to apply math knowledge in combination with other subjects and use mathematical tools to solve problems as well as real-world problems; diagnose strengths and weaknesses of learners to promptly adjust teaching objectives and teaching methods accordingly.

The periodic test includes knowledge of 3 chapters: chapter 1: natural numbers, chapter 2: integers, and chapter 3: intuitive geometry. In these 3 chapters, we focus the most on chapter 2. Because chapter 1 is the part of knowledge that students have learned, familiarized, and applied a lot in previous classes, hence in the test they put the questions in recognization, low application form to help students to remind knowledge and a high application question which improves students' thinking ability. In terms of chapter 2, this is a new piece of knowledge compared to students, thus we put questions from understanding to low application to help students become more fluent when working with this knowledge. Especially when calculating with negative integers, students still make many mistakes. Therefore, adding more questions to this knowledge section also helps teachers to realize outstanding problems and creates opportunities for students to practice with this knowledge. As for chapter 3, this chapter mainly helps students to review their knowledge of the formula for calculating the perimeter and area of plane geometry and provides more properties of those shapes. Hence in general, the children are familiar with this knowledge, therefore we only put 2 questions in this section, including 1 understanding question: help review the properties of specific shapes and 1 question about the real life problem. The practical application helps them develop problem solving capacity and apply the knowledge they have learned to specific situations in life.

A. Matrix of test questions

Level / Topic (Content, chapter)	Recognization		Understanding		Applications				Total
					Low		High		
	MC	Essay	MC	Essay	MC	Essay	MC	Essay	
Chapter 1: Natural numbers	-Write a set - Identify prime numbers		- Apply divisibility properties and definition of prime numbers to analyze a natural number - Apply divisible sign		- Apply divisible sign - Find GCD, analyze natural numbers		Apply exponentiation to natural exponents		
Number of questions **Time (minutes)** **Score** **Ratio %**	2 (Q1,2) 1 10%					1 (Q11) 1.5 15%		1 (Q13) 0.5 5%	4 3 30%
Competency Element	TD		GQVĐ	GQVĐ	GQVĐ	GQVĐ		GQVĐ TD	
Chapter 2: Integers	Use negative integers to represent				Apply the rule of brackets, the theory of negative integers, operations with integers to calculate				
Number of questions **Time (minutes)** **Score** **Ratio %**	1 (Q4) 0.5 5%		3 (Q5,6,7) 1.5 15%	1 (Q9) 1 10%	1 (Q8) 0.5 5%	1 (Q10) 2 20%			7 5.5 55%
Competency Element	MHH TD					GQVĐ			
Chapter 3: Intuitive geometry			Determine the symmetry axes of some plane geometry		Calculate area, the perimeter of some plane geometry				
Number of questions **Time (minutes)** **Score** **Ratio %**			1 (Q3) 0.5 5%			1 (Q12 1 10%			2 1.5 15%
Competency Element			GT CC			TD GQVĐ			
Total number of questions	3		4	1	1	3		1	13
Total time	1.5		2	1	0.5	4.5		0.5	10
Total score									
Ratio %	15%		20%	10%	5%	45%		5%	100%

B. Test

I. Multiple choice: (4 points)

Question 1: (Recognization) A is a set that concludes the natural numbers not equal to 0 and less than 8 can be written:

A. A =$\{x|\ x \in \mathbb{N}^*|\ x < 8\}$

B. A =$\{x|\ x \in \mathbb{N}\ |\ x < 8\}$

C. A =$\{x|\ x \in \mathbb{N}\ |\ x \leq 8\}$

D. A =$\{x|\ x \in \mathbb{N}^*|\ x \leq 8\}$

Question 2: (Recognization) How many prime numbers are less than 18?

A. 8 B. 7 C. 6 D. 9

Question 3: (Understanding) Which of the following clauses is **wrong**?

A. The rectangle with different side lengths has 2 symmetry axes.

B. The hexagon with equal sides has 3 symmetry axes.

C. The rhombus an with angle not equal to 90° has 2 symmetry axes.

D. The isosceles triangle has 1 symmetry axis.

Question 4: (Recognization) Which of the following is the integer indicating the year of the event "The first Olympics took place in 776 BC"?

A. – 1776 B. 776 C. -776 D. 1776

Question 5: (Understanding) If $x - c = a - (a + c + b)$, then x is equal to:

A. $x = -b$ B. $x = a - b + c$

C. $x = a + b - c$ D. $x = -a$

Question 6: (Understanding) Choose the correct equality:

A. $-24 + 4 = 21$ B. $54 + (-6) = 48$

C. $4.3 + (-5) = 6$ D. $-9 + 32 = 16$

Question 7: (Understanding) In the discussion, An, Binh, and Chi made the following statements:

An: “The sum of two positive integers is always a positive integer”

Binh: “The sum of two negative integers is always a negative integer”

Chi: “The sum of two integers with same sign always has the same sign as those two integers”

Which statement is correct, which one is incorrect?

A. An, Binh are correct, Chi is wrong. B. An is correct, Binh and Chi are wrong.

C. All of them are correct. D. All of them are wrong.

Question 8: (Low application) Let $x \in \mathbb{Z}$ and $(-154 + x) \vdots 3$ then:

A. x divided by 3, remainder 1

B. x is divisible by 3

C. x divided by 3, remainder 2

D. inconclusive is divisible by 3 of x

II. Essay: (6 points)

Question 9: (Understanding) (1 point) Find x, know:

a. $-17 - (-2 + x) = 3$

b. $(-2x + 2).(-4x - 2^3) = 0$

c. $-7.(5 - x) - 2.(x - 10) = 15$

d. $x - 15 = -20 - 4x$

Question 10: (Low application) (2 points) Quick calculate (if can):

a) $24.82 + 24.18 - 100$ b) $[131 - (13 - 4)^2] - 2^4.5$

c) $12 + 3.[39 - (5 - 2)^2]$ d) $2018^0 - \{15^2 : [175 + (2^3.5^2 - 6.25)]\}$

Question 11: (Low application) (1.5 points) A military unit of 576 men and 360 women. Come to the Central region to help people overcome the consequences of floods. They intend to divide into many groups to serve many communes, in which the distribution of men and women equally among the groups. How many groups can be divided at most? At that time, each group has how many men and how many women.

Question 12: (Low application) (1 point) The floor of a factory is rectangular. They want to cover the floor of that factory with bricks. Assume a brick has a length and width of 9m and 5m. The price of each brick is 35,000 VND. Know the width of the factory is 75m. The width is half of its length.

a) Calculate the floor area of the factory.

b) How much money does it take to cover the floor of the factory?

Question 13: (High application) (0.5 points)

Let A = 2021^3 and B= $2020.2021.2022$

Do not specifically calculate the value of A and B. Compare A and B.

C. Scoring guide

Multiple choice (4 points)

1	2	3	4	5	6	7	8
A	B	B	C	A	B	C	C

	Sentence	Answer	Point
Essay (7 points)	**Question 9 (1 point)**	a) $x \in \{-18\}$	0.25 points
		b) $x \in \{-2; 1\}$	0.25 points
		c) $x \in \{6\}$	0.25 points
		d) $x \in \{-1\}$	0.25 points
	Question 10 (2 points)	a) 2300	0.5 points
		b) -30	0.5 points
		c) 102	0.5 points
		d) 0	0.5 points
	Question 11 (1.5 points)	Find $\text{GCD}(576, 360)$ is equal to 72. Find the number of men in each group is 8. Find the number of women in each group is 5.	0.5 points 0.5 points 0.5 points
	Question 12 (2 points)	2. The length of the factory floor is 150 m. The floor area of the factory is 11250 m^2.	0.25 points 0.5 points
		3. The area of one brick is 45 m^2. The number of bricks needed to cover the floor is 250 tablets. The amount to spend to cover the floor is 8750000 dong.	0.25 points 0.5 points 0.5 points
	Question 13 (0.5 points)	Find: A =2021^3 B =$2021^3 - 2021$ ⇒A > B	0.5 points

4. CONCLUSION

In this article, we have built two test questions to assess the student's ability in the direction of developing the quality of learners' competence for grade 6 students according to the 2018 general education program, of which one is: one is the regular test (45 minutes) and the other is the periodic test (90 minutes).

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THIẾT KẾ MỘT SỐ ĐỀ KIỂM TRA ĐÁNH GIÁ MÔN TOÁN LỚP 6 THEO HƯỚNG PHÁT TRIỂN PHẨM CHẤT, NĂNG LỰC

Tóm tắt: *Trong bài báo này chúng tôi nghiên cứu những đổi mới trong kiểm tra đánh giá kết quả học tập, giáo dục theo hướng phát triển phẩm chất, năng lực của HS theo chương trình giáo dục phổ thông 2018. Từ đó chúng tôi thiết kế các đề kiểm tra thường xuyên và định kỳ theo hướng phát triển phẩm chất, năng lực cho học sinh lớp 6 theo chương trình giáo dục phổ thông mới. Trong mỗi đề kiểm tra chúng tôi có xây dựng đặc tả đề kiểm tra, ma trận đề, và hướng dẫn chấm cho từng đề.*

Từ khoá: *Năng lực; bài kiểm tra định kỳ; bài kiểm tra thường xuyên; phát triển năng lực; phát triển phẩm chất, học sinh lớp 6; đánh giá.*