

Problem Corner:

Thinking Skills and Technology

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Introduction

It is common sense that mathematics learning outcomes cannot be and should not be measured only by testing or examination alone; this is where exploration with technological tools could become life-long learning experiences. Due to college entrance examinations or similar tests, in many countries, information and communication technology (ICT) in daily mathematics teaching is not well implemented. Teachers need to rush to cover pre-determined content in a certain period of time or face a teach-to-the test scenario. If technological tools are used in a classroom, they are used in a minimum way at best. The following scenarios occur quite often in China:

- 1) Many mathematics teachers present an answer to a problem too quickly before allowing students to grasp the key concept behind the problem.
- 2) Teachers emphasize the strategy of dividing questions into different categories during their usual problem-solving training sessions and concentrate on telling students how to match methods with problems and reminding them to be beware of artificial ‘traps’ for some types of questions.

As a result, these strategies indeed become additional rules or formulae for students to memorize, and it is no wonder that we keep many students who already lack understanding of some basic mathematical concepts away from doing well in an examination. We note that calculators are not allowed in examinations in most parts of China; the daily use of technological tools has not been regarded as way of improving students’ marks on examinations. Teachers believe that the only effective way for students to improve their test scores is through repetitive practice on hundreds or thousands of mathematics problems. There is no wonder that many students lose interest in mathematics learning very quickly.

Many education systems, especially in East Asia, resemble the Chinese examination-oriented one, where the college entrance examination can almost determine one’s future. So every student strives to learn mathematics well to achieve a better grade. Why can’t an education system seriously and honestly think about how students can learn and comprehend basic mathematics concepts thoroughly with the help of ICT tools prior to an examination instead of worrying about whether any ICT tools can be allowed in an examination? According to past experience, the role of technology, especially Dynamic Geometry Systems and Computer

Algebra Systems, has been widely recognized as helping students to enhance their understanding of mathematical concepts. *Thus, it is natural to ask if technology also has a positive impact on students' examination performance or problem solving skills.*

In this section, we will gradually publish some mathematics questions (three problems per issue of eJMT), and the solutions will be provided in the subsequent issue of eJMT. We start with problems from previous college entrance examinations in China, but contributions of problems and solutions, from middle to high school level, from other countries or regions around the world are welcome. *We wish students and teachers to contribute mathematics problems and provide us examples of how dynamic analytic thinking skills can be inspired and enhanced with the help of technological tools.* To contribute to this section, please send your problems with solutions to Chuan-Bo Zuo at chbzuoyahoo.com.cn. If problems and solutions are published by eJMT, acknowledgement will be made on publication.

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Question 1 (2007, Jiangsu, China) Let $f(x) = \log_2[2x^2 + (m + 3)x + 2m]$. It is known that $f(x) \in (-\infty, \infty)$. Find the range of the parameter m . Extend your results to solving similar problems.

Question 2 (2009, Beijing, China) Let the point P be on the line $l : y = x - 1$, and let A and B be the two points of intersection of the parabola $y = x^2$ and a straight line passing through P . We call P an \mathcal{A} -point if $|PA| = |AB|$. Which one of the following statements is correct?

- A. All of the points on the line $l : y = x - 1$ are \mathcal{A} -points.
- B. Only finitely many points on line $l : y = x - 1$ can be called \mathcal{A} -points.
- C. Not all of the points on line $l : y = x - 1$ are \mathcal{A} -points.
- D. Infinitely many points, but not all of the points, on line $l : y = x - 1$ can be called \mathcal{A} -points.

Question 3 (2006, Hubei China) Consider the following four statements about the equation $(x^2 - 1)^2 - |x^2 - 1| + k = 0$ with variable x and constant k .

- (i) There is a real number k that makes the equation have two different real roots.
- (ii) There is a real number k that makes the equation have four different real roots.
- (iii) There is a real number k that makes the equation have five different real roots.
- (iv) There is a real number k that makes the equation have eight different real roots.

How many of these statements are false?

- A. 0
- B. 1
- C. 2
- D. 3

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