

## WHAT CAN WE LEARN FROM THE SOVIET WAY OF TEACHING MATHEMATICS?

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Examples of problems from Russian textbooks and exams.

1. (4<sup>th</sup> grade) A boat traveling upstream covered the distance of 113.4 kilometers in 9 hours. How long would it take the boat to return if the speed of the current is 1.8 kilometers per hour?
2. (5<sup>th</sup> grade) Fresh fruit which contained 90% water was picked and dried. The dried fruit contained only 20% water and the amount of dried fruit was 100 kilograms. How much fresh fruit was picked?
3. (high school graduation exam) Solve the equation:  $(x^2 - 1)(x^2 - 9x + 20) \log_2 (x^2 - 8) = 0$
4. (high school graduation exam) Find all values of **a** such that solution of the system is a point in the second quadrant. 
$$\begin{cases} x - y = \mathbf{a} \\ 2x + 3y = 1 \end{cases}$$
5. (College of Physics of Moscow State University entry exam in 1995). BE is a bisector in the isosceles triangle BCD (BC=CD). Find BE if CE=c and DE=d.
6. (College of Chemistry of Moscow State University entry exam in 1995). A tank contained pure alcohol. 1/3 of alcohol was poured out and replaced by water. Then 1/3 of the mixture was poured out and replaced by water. This procedure was repeated k times (including the first replacement of alcohol with water). What is the minimal value of k such that amount of alcohol becomes less than 10%?

What can we learn from the Soviet way of teaching mathematics?

- Help our students to learn to answer the question **WHY?** (*not HOW?*)
- Use more word problems as they require our students to think.
- Use mental math exercises.
- Require our students to think critically.
- Use correct notation and proper mathematical language and require the same from your students.
- Try to make math interesting and exciting.

You can find more information about math education in Russia here:

1. Articles by Andre Toom listed below can be found on his home page <http://www.de.ufpe.br/~toom/>

1. A. Toom. A Rich, Free Nation Must Have Creative Learning. (Letter to editor.) The Central New Jersey Home News, 1990, June 18, p. A6.
  2. A. Toom. Decentralize Aid. (Letter to the editor.) New York Times, 1991, January 10, p. A24.
  3. A. Toom. A Russian Teacher in America. Journal of Mathematical Behavior, 1993, v. 12, n. 2, pp. 117-139.
  4. A. Toom's interview for Palo Alto Review, San Antonio, Texas, fall 1993, pp. 38-43.
  5. A. Toom. From Russia with Math. UME Trends, v. 6, n. 2, May 1994, pp. 10-11.
  6. A. Toom. Review of the book "Colorado Math Olympiad: The First 10 Years and Further Explorations" by Alexander Soifer. Crux Mathematicorum (Canada), 21, June 1995, pp. 198-201.
  7. A. Toom. Review of the book "Mathematical Circles (Russian Experience)" by Dmitry Fomin, Sergey Genkin, and Ilia Itenberg, AMS, 1996. The American Mathematical Monthly, May 1997, pp. 474-477.
  8. A. Toom. How I Teach Word Problems. Primus, v. VII, n. 3, September 1997, pp. 264-270.
  9. A. Toom. Review of the book "A Mathematical Mosaic: Patterns & Problem Solving" by Ravi Vakil. American Math. Monthly, May 1997, pp. 474-477.
  10. A. Toom. Word problems: Applications vs. Mental Manipulatives. For the Learning of Mathematics, v. 19 (1), March 1999, pp. 36-38.
  11. A. Toom. Between Childhood and Mathematics: Word Problems in Mathematical Education. Humanistic Math Network Journal, #20, July 1999, pp. 25-32,44.
  12. A. Toom. From the life of units. Kvant Selecta: Combinatorics, I. Ed. by S. Tabachnikov. Mathematics World, v.17, 2002.
  13. A. Toom. Arithmetical Word Problems in Russia. Published in a slightly different version as "Ryska skolproblem" in "Svenska Matematikersamfundet Medlemsutskicket, Sweden, October 1, 2005, pp. 8-11
  14. A. Toom. Wars in American Mathematical Education. Unpublished.
2. Igor Sharygin Mathematical Education and Society. *The Teaching of Mathematics*, 2002, Vol.2, pp.71-80.

3. V.I. Arnold On Teaching Mathematics <http://pauli.uni-muenster.de/~munsteg/arnold.html>

4. Alexander Karp 'Universal Responsiveness' or 'Splendid Isolation?' Episodes From the History of Mathematics Education in Russia. *Paedagogica Historica Vol.42, Nos.4&5*, August 2006, pp.615-628.