

## **DEVELOPMENT OF PROBLEM SOLVING AND FOSTERING OF CREATIVITY IN USSR AND RUSSIA**

Ildar Safuanov, Moscow Technical University of Automobile and  
Road Industry,  
safuanov@yahoo.com

The importance of problem solving in mathematics teaching was always admitted in Russia and Soviet Union. In the beginning of the 20-th century a prominent mathematics educator S. Shohor-Trotsky proposed the “method of expedient tasks” for mathematics teaching. In 70-s, many didactics theoreticians developed “the problem way of instruction” which assumed, of course, the central role of problem solving activities in mathematics teaching. And still, in traditional classroom work the mechanical solving of sample, standard tasks, mainly of computational character, requiring only immediate application of rules just learned predominated. However, on the entrance examinations in higher educational institutions the school graduates had to solve much more difficult tasks. This circumstance lead to the necessity of special preparation with the help of private tutors (coaches). A lot of collections of tasks for the independent solving and training for the entrance examinations have been published. On the other hand, in USSR, since 30-s, when mathematical competitions began to be carried out and the first mathematical circle for school pupils at the Moscow state university was established, great attention was always given to out-of-class activities of pupils in mathematical circles, optional courses and lessons; various mathematical competitions have been cultivated.

In the spring of 1934 in Leningrad the first school mathematical Olympiad in the Soviet Union was carried out. At the same time the first series of mathematical books for school pupils have been issued, mathematical lectures for pupils of senior grades have begun to be delivered in institute of mathematics of Academy of Sciences of USSR in Moscow. The first mathematical Olympiad of Moscow was carried out in 1935 by the Organising Committee consisting of great mathematicians P.S.Alexandrov, A.N.Kolmogorov, S.L.Sobolev and others. After the Olympiad a school mathematical circle at Moscow State University under the guidance of L.A.Lyusternik, L.G.Shnirelman and I.M.Gelfand was established.

The student of Moscow State University David Shklyarsky, gifted mathematician and brilliant teacher, supervised the work of mathematical circles in the university in years 1938-1941.

He invented the new model of work of a circle: the instructor gives a small lecture, containing, as a rule, the complete story about a small mathematical theory. Sometimes the lecture proceeded for two or three sessions. At each session after the lecture the significant part of time was allocated to the reports of the pupils about the tasks solved by them. The part of tasks offered as homework or for solving at the session, illustrated the preceding story of the supervisor; others were not connected to the story, and some became themes of original small research works. Sometimes a difficult theory was divided into a series of tasks consequently offered to the participants. It is natural, that among offered tasks there were also such that only few pupils were able to solve them, and some tasks expected for the solution (at least by one participant of a circle!) for weeks and even months.

In the circles supervised by David Shklyarsky the younger "chiefs", students of first and second year of the university assisting the supervisor in selection and check of tasks have appeared. When the part of a session of a circle was devoted to the solution of tasks, the younger chiefs paced between desk at which the pupils sat, answering questions and monitoring their success, offering those who have solved a task to write their solutions on the blackboard. By the end of year the younger chiefs even more often independently carried out sessions, preparing to become the supervisors of other circles next year.

The advantages of new system of work were checked up by direct experiment. In 1938 Shklyarsky's pupils won all four first prizes at the Moscow Mathematical Olympiad!

Since then the model of work of a circle found by David Shklyarsky has become prevailing in Moscow. The experience of work of David Shklyarsky gave rise to a series "Library of a mathematical circle", created under the direction of one of first members of the circle I.M.Yaglom in 1950-70-s.

Since 60-s, for the pupils all over U.S.S.R. the Correspondence mathematical school has been working at the Moscow State University. The school sends tasks of increased difficulty for independent solving by pupils (the solutions are checked then by the students of the university). The mathematical competitions are being carried out systematically during all the academic year: school and district Olympiads, urban, regional and republican ones and, finally, All-Russia (earlier - all-Union) Olympiads. The All-Russia correspondence Olympiads have been carried out, too. During the last decades, new forms of mathematical competitions have been developed: mathematical fights between teams of classes, schools, cities; tournaments of towns etc. Since the 70-s, mathematical educators in USSR have realised, that it is necessary to

reconsider a role and place of problem solving in the regular school teaching, too, that problems should develop pupils' minds. The necessity of encouragement of heuristic ways of the problem solving, of the pupils' awareness of general methods of problem solving and significance of the solved tasks for their further mathematical activity is admitted. Some authors indicate that it would be useful to teach the pupils to compose their own problems. As a result, new sections containing tasks of the increased difficulty have been included in text-books, especially for primary school. After the "perestroika" (deep changes in economical and social life in the former U.S.S.R) a lot of various educational books has appeared, in particular those proposing "teaching through problems".

Today, there is a well-developed system of preparing pupils to mathematical competitions. The system is based on the model of circle work elaborated by David Shklyarsky. Examples of programs of such activities can be found in books: "Genkin S.A., Itenberg I.V. and Fomin, D.V. The Leningrad mathematical circles" and "V.A.Gusev, A.I. Orlov and A.I. Rozental. Out-of-class activities at grades 6-8".

They include such topics as:

- 1) Induction
- 2) Dirichlet principle
- 3) Rule of extreme
- 4) Invariants
- 5) Symmetry
- 6) Problems on square-lined paper
- 7) Weighing
- 8) Graphs
- 9) Combinatorial theory
- 10) Elements of Number theory
- 11) Geometry

### **References.**

Boltyansky, V.G., Leman, A.A. *Moscow Mathematical Olympiads*. M.: Prosveschenie, 1965.