ACTIVE TEACHING USING THE SYSTEMS OF MATHEMATICAL PROBLEMS WITH THE ENVIRONMENTAL CONTENTS AND HAVING THE CROSS-DISCIPLINARY LINKS FOR PUPILS IN PRIMARY SCHOOL (PART I)

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Summary: When composing the system of mathematical problems with the environmental content, we use a scheme that we have developed: "transferring the oretical knowledge on environmental issues from other (not from mathematics) subject solving the set mathematical problem after writing down the solution of this problem, putting such pre-formulated questions for pupils, which strengthen the pupils' environmental knowledge".

We have written more than 1200 mathematical problems with the environmental contents having the developmental and cross-disciplinary links for active teaching of pupils of all classes in primary school, on single-digit and multi-digit numbers, a puzzle and logical problems, the problems of multiplication and division of numbers by several times, the problems on motion, the entertaining mathematical problems with the environmental content, the problems of finding the percentage, finding the sum of two products, combinatorial problems, the problems on birds, fish, animals, plants, insects, the problems associated with the country's nature reserves, including their flora, fauna and so on. We brought and examined a small part of these problems and made relevant methodological conclusions.

Our pedagogical experiments have demonstrated that the inclusion of the system of mathematical problems with the environmental contents having the developmental and cross-disciplinary links, makes the lower grade pupils teaching active, interesting and versatile, the need for all teaching disciplines is clearly seen. The scientific view and skills of pupils are expanding, there is no need for additional time and it facilitates in-depth and thorough mastering of all disciplines in primary school.

Key words: environment, mathematical problems, primary school, teaching process.

The teaching process should be based on active learning. One of the most acceptable effective models of active learning with primary school pupils is associated with a realization of the cross-disciplinary links. The teacher can realize the cross-disciplinary links through different approaches, but it is necessary to follow the scientific principle, which means that the theoretical knowledge transferred to pupils, or any specific data given in a mathematical problem situation should reflect the real science-based information, because pupils easily remember numerical data, and if information provided to them from other sources does not tally with data that are already known to them, this is a matter of disappointment to them.

Teaching in the early grades is an active process, and it is effective when the teacher is able to involve all pupils in the teaching process. When is this achieved? As soon as a theme for the classroom is interesting for pupils, when pupils have already certain knowledge about this theme, which they are trying to demonstrate to the class. Such themes may be different in the high grades, while in the early grades, the teacher does not have much of a choice, since the scope of pupils' knowledge in the early grades is not wide and in-depth. One of such themes that the teacher can involve in the teaching process includes the issues of environmental education that are of high relevance in their essence and may well be used to establish the cross-disciplinary links. We believe that it is necessary to pay more attention to environmental education of pupils in schools from the first year of primary school education, because environmental problems are global in nature, and all mankind is involved in their solution.

From a scientific perspective, the goal of environmental education is achieved when the following problems are resolved in conjunction:

- Educational problems – which means gaining knowledge by pupils on environmental problems and knowledge of ways to address them;

- Disciplinary poblems – building up pupils' capacity to lead healthy lives and act with environmental commitment;
- Developmental problems – disseminating of pupils' intellectual and practical knowledge, studying the flora and the fauna, their critical assessment, development and implementation of environmental activities together with the teacher.

Explanation and study of teaching materials of the environmental content is mostly happening during the classes in natural history, fine and applied arts, mathematics, and the mother tongue, where, in an accessible to pupils format, there are considered the links between animate and inanimate nature, as well as between different components of animate nature (plants, animals, etc.), nature and human beings. After that, the pupils are familiarized with the outside world and they establish the environmental links that help them to establish the logical links there.

We consider it appropriate to use environmental tours in teaching practice in primary school, the purpose and function of which consist in practical implementation of environmental issues with the content of natural history and other teaching courses, checking them, which is reflected in watching plants and animals, observing the production processes, which were desrcibed in teaching materials, visiting historical sites, which were discussed in teaching materials, checking the data given in the mathematical problems situations of environmental nature, which deal with the height and age of trees and plants, and so on. Such types of environmental study tours attract the interest of pupils, they go to nature and visit enterprise or factory, get acquainted with some manufacturing processes, make measurements, which help them to develop their practical skills. Sometimes, especially in the lower grades, it is also advisable to organize the simulation study tours. During the environmental study tours, pupils have the opportunity to measure and check some data that they will use later in solving mathematical problems with the environmental content.

We consider it methodically appropriate to include the mathematical problems with the environmental content in the teaching process of mathematics, particularly during teaching those themes, which deal with mathematical problems with the relevant content. The teaching process implemented in this manner does not require dedicating additional time, while the developmental effect of pupils is high, because by including the problems with such content, the teaching process brings them together into a comprehensive system, which contributes to active teaching, the creation of new knowledge and modern teaching methods, on the basis of which the relevant recommendations are being worked out. We also consider it appropriate to discuss the mathematical problems with the environmental content at extracurricular, facultative and mathematics subject circle lessons.

When composing the system of mathematical problems with the environmental content, we use a scheme that we have developed: *"transferring the oretical knowledge on environmental issues from other (not from mathematics) subject$\rightarrow$ solving the set mathematical problem $\rightarrow$ after writing down the solution of this problem, putting such pre-formulated questions for pupils, which strengthen the pupils' environmental knowledge"*.

Textbooks of mathematics for lower secondary classes in Georgia are virtually absent from the mathematical problems with the environmental content having the developmental and cross-disciplinary lnks, so they are mostly written by the teachers, for which the teachers first have to compile a database that will contain existing scientific information on environmental issues related to flora, fauna and so on. For example, data related to a lifespan of some species of trees, height of trees, environmental importance of forests, the environmental role of birds and insects in nature, the length of rivers, the distances between different settlements, the distances from the Earth to the moon and from the Earth to the sun, national parks and reserves existing in the country and so on. It is recommended to write down the collected data as a table format, which will then help pupils to write different types of mathematical problems with the environmental contents.

We have written the mathematical problems with the environmental contents for all classes of primary schools, solving such problems requires operations with single-digit and multi-digit numbers, also we have composed a puzzle and logical problems, the problems of multiplication and division of numbers by several

times, the problems of motion, the entertaining mathematical problems with the environmental content, the problems of finding the percentage or the sum of two products, combinatorial problems, the problems on birds and animals, plants, insects, the problems associated with the country's nature reserves, including their flora, fauna and so on. Let us bring some of them.

Mathematical problems with the environmental contents

1. After recycling one centner of wastepaper, we obtain the same amount of paper as after cutting and processing of 8 adult pine trees. Pupils have collected 3000 kilograms of wastepaper. How many adult pine trees have been saved by pupils?

2. In the world, the atmosphere is polluted with 58 million tons of gas by enterprises, and with 36 million tons of gas by road transport throughout the year. How many millions of tons of gas in total pollute the atmosphere during the year?

3. 30,000 tons of contaminated substances are flowing into the water reservoirs of Georgia throughout the year. How many thousands of tons of contaminated substances will get into the reservoirs within 5 years?

4. Annually, 57 million tons of household rubbish is accumulated in the world. How many household rubbish will be accumulated in the world within 3 years?

5. Every day, 1 species of plants and 1 species of animals die out throughout the world. How many species of plants and animals will become extinct within 10 years?

6. The Red List contains: 202 species of insects, 80 species of birds and 94 species of mammals. How many species are on the verge of extinction?

7. In one minute, 2 hectares of forests are cut down in the world. How many hectares of forests are cut down by people for an hour?

8. The total length of all types of roads in Georgia is 120 thousand kilometers. The length of the Earth's equator is 40 thousand kilometers. How much longer is the length of all types of roads in Georgia in comparison with the length of the equator?

9. Water dripping from the damaged tap fills the glass in 6 minutes. How many glasses of water will come out from the damaged tap within 1 hour? within 24 hours?

10. There are 8500 species of birds on the Earth. About 650 of them live in Georgia. How many species do not live in Georgia?

11. The length of the lake frog is 15 centimeters, while the length of the toad is 8 centimeters above the lake frog's length. How many centimeters is the length of the toad?

12. The frog eats 7 insects every day. How many insects will be eaten by frog in a week? in a month?

13. The mole eats 24 worms every day. How many worms will be eaten in 3 weeks? in 3 months?

14. The oak lived 1000 years, the fir-tree - 500 years. How many more years did the oak live compared with the fir-tree?

15. The lime tree lives 700 years in the woods, and 70 years in urban area. How many times more the lime tree lives in the woods than in urban area?

16. Green grasshopper eats 147 worms, 41 mosquitoes, 266 flies per season. How many insects are eaten by green grasshopper during the season?

17. How many flowers will fade if each of the 25 pupils on the field picks 5 flowers on the meadow?

18. One large enterprise emits 200 tons of soot into the atmosphere per year. If we install there the cleansing filters, then the amount of soot emitted into the atmosphere by this enterprise will be reduced by 20 times. How many tons of soot will be emitted by the enterprise after installing the cleansing filters? Which enterprises in our city (region) are polluting the environment?

19. One adult tree breathes out as much oxygen, as required for one person for one day. In urban area, due to high degree of environmental pollution, the oxygen release has been reduced by 10 times. How many adult trees are needed in order to provide with oxygen a city with a population of 1 million people?

20. One vehicle can pollute the atmosphere with 20 kilograms of poisonous gas within 24 hours. How many kilograms of poisonous gas are emitted by 8 vehicles in 10 days?

21. According to the calculations of scientists, 2000 years are required for the creation of a 5-centimeter thick layer of earth in nature. How many years will it take to create naturally a 12-centimeter thick layer of earth?

22. Processing of 1 ton of tatters results in producing 600 meters of fabric. How many meters can be produced by processing 25 tons tatters?

23. The great tit can eat about 120 roundworms every day, the total weight of which is 34 grams. What is the weight of roundworms that can be eaten by the great tit in summer (June, July, August) and early autumn (September)? (As a matter of inquiry for pupils: the great tit is able to eat food equivalent to its own weight).

24. There are thousands of birds in the territory of the Ajameti Reserve. The male and female blackbirds bring daily 60 cutworms, while twice as many cutworms are brought by the male and female finches, and three times more are brought by the male and female woodpeckers than finches to feed their young. How many times more cutworms are brought by the male and female woodpeckers to feed their young compared to the male and female blackbirds?

(Find the data about the nature reserve near your residence, what kind of forest areas are in the reserve, which animals and birds are common for the territory of the reserve, what is the area of the reserve, when the reserve was founded, etc).

25. During the year, the owl kills 1000 field mice. How many kilograms of wheat they save for the farmers, if one field mouse destroys 1 kg of wheat per year?

26. In the early twentieth century, the domba-bisons were on the verge of extinction. In 1964, several adult domba-bisons were brought into the Caucasus Reserve. How much did the number of domba-bisons has increased by 2019, if 10 little domba-bisons were were born every year?

27. The ants are most industrious creatures in the forest. On average, the ants bring two dozen insects into their nests per minute. How many insects the ants bring into their nests in 1 hour?

28. For normalcy for fishes in the aquarium, no less than 3 liters of water is required. How many fish can we buy in a zoological store to place them in aquarium with a capacity of 50 liters?

29. The polar night in the Far North lasts 150 days, while in the tundra, it lasts from 1 December to 28 February. How many days longer is the polar night in the Far North compared to the tundra?

30. There are 120 volcanoes in New Zealand, of which 29 are active. How many extinct volcanoes are in New Zealand?

31. The height of the Elbrus summit is 5642 meters, which is 609 meters above the height of the Kazbegi summit. Calculate the height of the Kazbegi summit.

32. Bamboo is growing by 30 cm per day. How many centimeters will its height increase in 12 hours?

33. Everyone on Earth consumes paper every year, the production of which requires 3 coniferous trees. How many coniferous is required for meeting your family's demand for paper?

34. About a tenth of 250,000 species of plants existing on Earth are on the verge of extinction. How many species are facing the threat of extinction on Earth?

35. In a single season, from May to September, one elm-tree absorbs 120 kg of contaminated poisonous gas from the air. The elm-tree lives 400 years. How many kilograms of poisonous gas absorbs the elm-tree during its lifespan?

36. The oak shrubbery releases 830 kg of oxygen per year, while the same pine-tree shrubbery releases 540 kg of oxygen. How much more oxygen is released by the oak shrubbery compared to the pine-tree shrubbery?