Structure and Maintenance of a Mathematical Creative Lesson as a Mean of Pupils' Meta-Subject Results Achievement

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ABSTRACT

The purpose of the research is to study and change the structure of a mathematical lesson to improve quality of pupils' mathematical training and design mechanisms of inclusion the systems of open type tasks in educational process considering specifics of pupils' creative personality development. The leading method is modeling of a mathematical creative lesson. The structure of it contains such stages, as motivation, psychological relief, intellectual warm-up and resume, besides traditional substantial sections. More than 700 pupils from 5-9 grades of comprehensive school took part in the experiment, which has been carrying out for the last three years. The result of the research is the author's idea of using separate open type tasks, and the system of open type tasks, which consider psychological, physiological, motivational and cognitive features of pupils, promote development of their creative component for meta-subject results achievement. The practical use of the structure of a mathematical creative lesson and the systems of open type tasks shows pupils creative results and progress in mathematical training, expressed by best marks on the subject and at mathematical competitions of various levels. It proves the quality improvement of mathematical education among pupils trained by the offered technique.

Keywords: mathematics, secondary school, mathematical creative lesson, open type tasks. problem training.

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State of the literature

- The transition to the new generation of educational standards brings up within the context of methodological scholarship the issues of schoolchildren' creative development and their achievement of meta-subject results. However, the existing body of research on the theory and methodology of teaching mathematics have not yet determined which methods and approaches are the most effective.
- Despite the fact that the issues related to the structure and organization of a contemporary mathematics lesson are often addressed in theoretical and methodological mathematical literature, there is a lack of research focused on the effective organization of student creative development within the boundaries of the traditional methodology.
- The body of methodological mathematical literature hardly has anything related to the use of open and partly open type of problems. The importance of these problem types and their potential cannot be denied but the systems of effective teaching with the use of these problems have not been developed.

Contribution of this paper to the literature

- In this study we suggest that the structure of a mathematics lesson need to be changed so that to add to the traditional parts of a lesson such parts as 'motivation', 'psychological relief', 'intellectual warm-up' and 'summary' in order to enhance a lesson with the elements that help schoolchildren achieve meta-subject results.
- The special role is given to the open and partly open types of problems in the organization of a creativity-orientated lesson so that to engage students in universal learning activities (setting goals, planning, constructing arguments, analyzing, generalizing, comparing, control and self-control) and thus helping them achieve meta-subject results.
- Apart from mathematical problems and open problems in the course of creative classroom work a variety of brain-teasers and puzzles can be used to facilitate the development of students' logical, abstract and creative thinking while at the same time taking into account motivational and cognitive characteristics which are usually excluded from consideration in teaching based on the traditional methodology.

INTRODUCTION

Social and economic development of society inevitably attracts modernization of the education system. The aspiration to improve the sphere of educational services, quality of school graduates' knowledge, their successful advance in further professional activity led to formation of modern methodological and administrative approaches. That finally promoted introduction of new generation educational standards in the Russian Federation, which have already had the legal status. They contain both the subject and personal, and the meta-subject results of the trained (Federal state standards of the general education, 2012).

Today intellectual development is not enough. A person has to be able to act in a non-standard situation, quickly and productively join unfamiliar kinds of activity, predict result,

carry on constructive dialogue (Leikin & Pitta-Pantazi, 2013). Only in this case he would succeed. The need to format such kind of pupils' activity, which would allow him to realize himself in environment using the internal potential, both intellectual, and creative, became aggravated. All this is the expected effect put in pupils' mastering of meta-subject abilities (Galyan, 2014).

However, this direction of pedagogical activity has many difficulties. For example, Russia has been taking part in the PISA international measurement of knowledge quality for many years (Program for International Student Assessment). The results of the 2012 research are deplorable: the Russian pupils are extremely badly able to apply knowledge in life situations. Russia takes only the 31-39 place in mathematical literacy, 38-42 place in readering literacy and 34-38 place in natural-science literacy (The international program for an assessment of educational achievements of pupils, 2012). Low productivity of the Russian pupils is often explained by singularity, not typicalness of the tasks offered to them. Pupils have not enough abilities, which Federal state educational standards call as the meta-subject.

Time demands to rethink the saved-up pedagogical experience. The need to form the personality with high intellectual potential developed by creativity, high extent of meta-subject abilities is the basis of innovative activity of a teacher. And it is obvious and stated in the federal and regional documents. Now each teacher faces the questions: "How to form meta-subject results?", "What are the criteria of their assessment?". There is no ready mechanism at the level of federal or regional programs, everything remains to teacher's decision. It turns out that a teacher has to resolve the contradiction between the result accurately defined in federal educational standards and lack of a detailed technique for formation and assessment of pupil's universal educational actions, in particular the one promoting achievement of meta-subject results.

Prerequisites and theoretical base of research

The need to solve the tasks set above and understand the described contradiction brought to the need of educational process modification.

Analyzing literature and resorting to own pedagogical experience, we came to opinion that change of structure and maintenance of a lesson to strengthen its developing effect can become one of the directions of educational process modernization providing mastering meta-subject abilities by pupils.

Besides The concept of development of mathematical education in the Russian Federation (The concept of development of mathematical education in the Russian Federation, 2013) accepted in 2013 calls for educational process modernization to achieve purposes of effective development of pupils. Among its tasks are: a) modernization of the contents of training programs of mathematical education at all levels; b) improvement of quality of mathematics teachers work, creation and realization of own approaches and

author's programs; c) provision conditions for development of the trained, having high motivation and showing abilities.

The changes happening in society and current trends in education introduce amendments in concrete realization of the directions designated above (Akkaya, 2016). Our research is based on the following concepts and ideas: intellectual and creative potential of a person (Bakulevskaya, 2001); G. S. Altshuller theories of inventive problem solving in its pedagogical interpretation called TRIZ pedagogics (Gin, 2015); NFTM-TRIZ theories of continuous formation of creative thinking (Zinovkina, 2008); theories of application of open type tasks in training (Gin & Barkan, 2014); systems of creative tasks on the basis of open type tasks (Utyomov, 2012); training to search ideas and independent drawing up tasks (Shuba, 1995).

MATERIALS AND METHODS

Research methods

The research used the following methods: analysis of psychologic-pedagogical and mathematical-methodological literature, analysis and synthesis of experience of teachers working at a temporary creative collective (problem group) and own experience on carrying out mathematical lessons on the given structure with the use of open type tasks, analysis of educational activity products, method of mental experiment, forecasting, systematization and generalization of facts and concepts, modelling, method of expert evaluations, analysis of educational activity results, development of educational-methodological materials, pedagogical experiment.

Experimental base of research

The experiment was carried out by skilled teaching with the use of structure of mathematical creative lesson and systems of open type tasks for pupils of secondary school in classes of the teachers working in temporary creative collective (problem group) on the basis of Institute of education development in the Kirov region. Skilled teaching is carried out since 2014 in six basic educational organizations of Kirov and five general education organizations of the Kirov region (more than 300 pupils annually).

The authors also developed and conducted remote advanced training courses "The technique of development of pupils' creative thinking and creative abilities in the conditions of implementation of the Federal state educational standards and the professional standard of a teacher" (108 hours) and "Development of pupils' universal educational actions in the conditions of implementation of the Federal state educational standards and the professional standard of a teacher" (74 hours). Since 2012 more than 600 teachers of the Russian Federation and the neighboring countries received training on the platform of the Interregional center of innovative techniques in education (Kirov).

Investigation phases

The research was conducted in three stages.

The first stage analyses the current state of the problem in theory and practice of teaching mathematical disciplines at secondary school. Studying and analysis of psychology-pedagogical and mathematics-methodological literature on the problem, observance and analysis of teachers' experience in order to study opportunities to change the structure of a mathematical lesson and inclusion in it both separate open type tasks, and their systems for effective formation of pupil's creative personality for meta-subject results achievement and improvement of mathematical training quality.

The second stage developed methodological approaches to introduction the model of mathematical creative lesson with inclusion of open type tasks at realization the strategy to form pupil's creative personality and conditions for meta-subject results achievement. Selection of the maintenance of open type tasks for various stages of mathematical creative lesson was made. Discussion of the model has been carrying out by the problem group – mathematics teachers of 11 educational organizations of Kirov and the Kirov region working in temporary creative collective –, feedback with listeners of distant courses and reports at conferences and seminars of various levels. That leads to consecutive improvement of the offered organizational model and technique of its implementation in mathematical education of pupils.

The third stage goes in parallel with the second one. The author and other mathematics teachers of temporary creative collective carry out skilled teaching and approbation of mathematical creative lesson model by the offered technique. The course is conducted since 2014 in the 5-9 grades at 11 educational organizations of Kirov and the Kirov region (more than 300 people annually).

RESULTS

Structure of a mathematical creative lesson

First, it should be noted that achievement of meta-subject results imposes certain requirements to a modern lesson. Therefore, the new structure of a lesson has to correspond to them:

– lesson has to be developing;

– lesson has to have the beginning motivating for work and the termination fixing results of this work;

– subject, purpose and problems of a lesson are formulated and realized by pupils;

– a teacher has to stir up pupils' activity, organize problem and search situations;

– there are minimum reproduction and maximum creativity and co-authorship at a lesson;

– lesson has to train child for various life situations (Karagöz-Akar, 2016).

Educational process has to be based on an activity approach, which purpose is to develop pupil's personality during active perception of a training material. It means that the main task of a teacher is to create the conditions provoking children's action (Fundamental basis of the maintenance of general education, 2011).

Creating the model of developing lesson, we used the structure of a creative lesson offered in the system of continuous formation of creative thinking and development of creative abilities of learners with active use of M. M. Zinovkina theory of inventive problem solving (NFTM-TRIZ) as the basis. The theory considers the requirements to a lesson stated above. The structure of a lesson of creativity methodology significantly differs from a traditional lesson. It includes the blocks realizing the lesson purposes adequate to the purposes of the developing education in general (Utemov, Zinovkina & Gorev, 2013).

NFTM-TRIZ system offers the structure of a twinned creative lesson. The grade-lesson system in educational organizations, absence twinned lessons of mathematics at secondary school and specifics of mathematical education resulted us to modernize the structure of a creative lesson. The experience showed that the option of a mathematical creative lesson constructed according to the scheme (**figure 1**) is the most effective for formation of universal educational actions in general and, first of all, meta-subject ones.

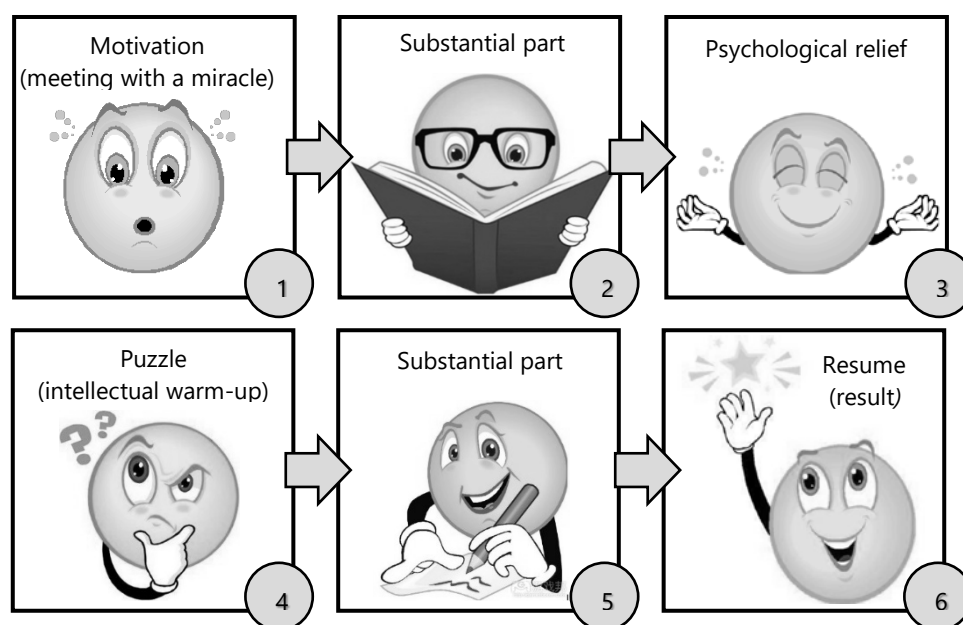Let's make explanations to its main stages.

Figure 1. Structure of a mathematical creative lesson

Motivation is specially selected system of interesting facts capable to surprise pupils. This block provides pupil's motivation to lessons and develops his curiosity. Act of surprise or so-called "effect of a miracle" is the best way to involve pupils in intellectual work for information overloads compensation and search activity awakening.

Substantial block unites program material on a subject (mathematics) and the system of tasks aimed to develop divergent, logical thinking, pupils' creative abilities, abilities to sharp and live perception, abstract and difficult thinking, speech, mathematical and technical literacy.

Psychological and physiological researches showed the close connection between intense intellectual and emotional loading and tension of skeletal muscles, vegetative shifts. Decrease in mental intensity against muscular relaxation is shown in the form of "liberation" in communication, behavior, activity and manifestation of feelings. Therefore, the obligatory block of a lesson is *psychological relief*. It is realized through exercises on harmonization of cerebral hemispheres development, auto-training, system of movable-emotional games, staging, etc. The relaxation is due to positive emotions that is a good emotional relief for a child.

The next block is a system of *puzzles* with increasing complexity. They are embodied in real objects and have the original idea. It is a peculiar training of a pupil on overcoming thinking inertia, development of sharpness and creation of positive emotions after a puzzle solution, emergence of confidence in own creative possibilities. The solution of a puzzle demands from nonconventional turn of pupil's thought. There is a development of paradoxical, creative thinking, overcoming of thinking stereotypes, development of creative imagination, including spatial imagination. The system of puzzles awakens observation and curiosity, interest of a child to research and intellectual activities.

Resume provides feedback with pupils at a lesson and provides quality and emotional estimation of a lesson by pupils.

Such structure of a lesson allows both to form subject knowledge and abilities, and to provide pupils' achievement of personal and meta-subject results in joint creative activity.

Open type tasks in mathematical training of pupils at secondary school

The most important element of the structure of educational mathematical activity is the educational task (Gorev, 2012), solving which a pupil carries out certain actions and operations. In the context of the chosen lesson model, we suggest to use open type tasks (Utemov, 2012) to form universal educational actions and, first of all, meta-subject ones and develop creative qualities of a pupil. If the chosen technology is the base of a lesson scenario, than filling of its contents by open type tasks is the arrangement: it helps pupils to understand the studied essence; gives beauty to a lesson, intensifies thought processes.

Unlike the closed type tasks typical for school textbook of mathematics, open type tasks assume the "indistinct" condition having uncertainty degree, various (often non-algorithmic) methods of decision, set of various versions of the answer (Gorev & Utemov, 2011). Open type tasks provide possibility to apply standard knowledge in non-standard situations. Solving such tasks, pupil can show ability of logical and abstract thinking, i.e. ability to classify, generalize and draw analogies, to predict result and generate ideas (Antonijević, 2016; Tabach & Friedlander, 2013).

Despite the complexity to estimate such tasks, there is a possibility to assess them according to four items of a two-mark scale (**Table 1**).

Table 1. Criteria for open type tasks assessment

Marks	Effectiveness (if the required in the task was achieved?)	Optimality (whether such a decision justified or not?)	Originality (if the decision is new or previously known?)	Status (if the solution is detailed, or at the level of ideas?)
2	The proposed solution will give clear understanding how to achieve results	The solution has a particular method providing quite capacious, clear and beautiful optimal result	Solution is original, and is found with less than 5% of the respondents	Solution is reasoned clearly and correctly and all actions are justified
1	All in all, the solution process is clear and it is possible to achieve the results, but some moments of solution are not thought out or explained vaguely	The solution is optimal but some aspects of the solution process can be greatly simplified	The solution is rarely found in the answers: from 5 to 10% of the respondents	The decision is on the level of ideas that might be brought to reasonable justification and completion
0	According to the solution it is not clear how to achieve the desired result	The solution process is too cumbersome; the use of many techniques are unjustifiable	The solution is standard and provided by more than 10% of respondents	The solution process is not represented or is vague

Use of these criteria to assess systems of open type tasks allows to give effective quantitative estimation of a level of meta-subject results achievement (Gorev & Utemov, 2014; Gorev, P. M. & Yachina, N. P. & Nurgaliyeva, A. K., 2015).

Open type tasks and change of their degree of openness allow to solve some contradictions inherent to traditional training (**Table 2**), i. e. to come to new educational results.

Conviction in the fact that open type tasks promote pupils' involvement in universal educational activity (goal-setting, planning, argument, analysis, synthesis, comparison, control and self-checking), logically attracts a question: "Is it possible to construct all training process using only open type tasks? Obviously, it is not. A child has to solve both types of tasks: open and close. It is important to combine these two types of tasks in a certain most

effective sequence. Therefore, it is possible to consider different strategies in use of both types of tasks at mathematical lessons.

Table 2. The contradictions of traditional training solved by open type tasks

Elements of a task	Types of openness of tasks	The solved contradiction
Purpose	Ambiguity of a purpose ("indistinct task", "tasks formulated on the decision course")	The pupil gets the object of a school task in advance. Meeting life problems, we spend a lot of time for defining, which purpose to reach (manifestation of the most advanced stage of freedom and activity of a person)
Condition	Ambiguity of a condition ("tasks with excess or incomplete condition", "wrong names")	There are no such tasks at lessons, as textbook authors or teacher select conditions necessary and sufficient for task solution. In life, conditions, in which the problem has to be solved, remain uncertain in many respects
Way of solution	Ambiguity of a solution way ("creative task" in case if the solution way is unknown and should be invented)	First, we study a way to solve a certain type of tasks at the lessons, and then we offer tasks for its working off. In life, nobody tells us to necessary way to solve the arising problem. There is a choice problem between various possible decisions
Answer	Ambiguity of an answer (openness of a task in narrow sense)	Training material gives unambiguity of the correct answer presented at the end of the textbook. Life gives us the chance of various ways of results for solution of the arising problems

1) to fulfill separate skills by means of the closed type tasks and to learn to use these skills in life by means of the open;

2) to enter material by means of open type tasks and fulfill separate skills by means of close type tasks; it is the problem training.

The greatest efficiency in the mixed strategy is to use open type tasks both at the beginning, and at the end of training (Bahar & Maker, 2015).

Open type tasks at various stages of a mathematical creative lesson

The following pedagogical methods can be used at *motivation stage* of mathematical creative mono-lesson: display of mathematical focus; surprise from the reported fact; "nonmathematical" beginning of a lesson; pupil's surprise from the arisen contradiction, which should not be; surprise from material, which should be studied. There are some examples.

1. *Topic "Criteria for divisibility"*. There are some big numbers on a board. A teacher without making any calculations says that the concrete number is divided on 2, on 5, on 9 etc. Pupils can check it using calculators. A teacher asks a question: "How does he (a teacher) learned it? What is focus essence?" Often pupils answer that numbers were specially picked up; calculations were made before a lesson. Further, an experiment is offered: a pupil writes any big number on a board. A teacher says that it is (is not) divided on 2, 3, 5, 9. Pupils check

it using calculators. The experiment repeats several times, pupils are convinced in the "focus" effect and they are ready to know it.

2. *Topic "Sphere, ball".* A teacher holds an orange with obviously thick peel. The possible questions are:

– Where did I get an orange?

– How do oranges appear in shops? (Where do oranges grow?)

– How does a buyer choose oranges? (by size, color, smell, visually estimates peel thickness, etc.)

– Buying an orange, how much do we pay for a peel?

– The volume of an orange peel is approximately equal to the volume of juicy part of a fruit, i.e. nearly a half of price we pay for a peel.

– How do you think does this orange have a thick peel?

– Buying an orange with a thick peel, you generally get a peel and pay the most part of cost for it.

After that it is possible to clean orange, to squeeze (crumple) a peel and to see approximate equality of volumes of a fruit and a peel.

On the motivation block, pupils are involved in universal educational activity, where formation of the following universal educational actions is possible:

– the regulatory: goal-setting, forecasting, planning, self-control, assessment;

– the informative: conscious and creation of speech statement, creation of logical chain of reasonings, participation in statement and formulation of a problem, modeling;

– the communicative: ability to express the thoughts according to communication conditions, planning of educational cooperation with teacher and pupils;

– the personal: pupils establishment connections between the purpose of educational activity and its motive.

The following receptions of pedagogical equipment can be used at the *substantial block* of a mathematical creative lesson: tasks with counterexample; lack of a question to data; use of excess data in formulation; tasks, for which it is necessary "to get" numerical data; change of space dimension for task solution; pupils' independent invention of "new" solution not presented in the textbook. The following examples of open type tasks can be used in the substantial block.

1. *Classification of objects.* What signs can divide the following numbers into groups: –5; 14,6; 90; 0; –1; 1,3; 726; –180; 3?

2. *A task without a question.* Artem's parents are people with very interesting professions. The mother is the flight attendant, and the father is the train driver. The mother stays at home once in four days, and the father – once in seven days. It turned out that both of them work on September 1.

The general methods of scientific creativity, "TRIZ" methods of contradiction resolution can be used in the structure of a creative lesson for studying of program material: "on the contrary" method, the principle of dynamism, the principle of transition to another dimension, the principle of "intermediary", etc. For example, the game "Yes — no" can be held at a lesson.

Thus, the substantial block of a mathematical creative lesson is possible to form such universal educational actions as:

– the regulatory: self-control, correction, control;

– the informative: search and allocation of necessary information, structuring knowledge, reflection of ways and conditions of action, independent creation of algorithms to solve creative problems, analysis, synthesis, leading under concept, modeling;

– the communicative: statement of a questions (initiative cooperation in search and collection of information); identification of a problem, search and assessment of alternative ways of contradiction resolution, decision-making and its realization;

– the personal: estimation of the acquired contents, proceeding from social and personal values, providing personal moral choice.

An example of a mathematical creative lesson with the use of open type tasks at all its stages

Let's give an example of mathematical creative lesson with the system of open type tasks. The teacher O. V. Rychkova presented the lesson "Criteria for divisibility" for six grade pupils at the competition "The Russian Teacher of Year – 2015".

Motivation

After a greeting, pupils are offered to see the slide movie.

– The movie is very short, but there are such important words:

"… *In an infinite set of natural numbers, just as among the Universe stars, there are separate numbers and their whole "constellations" of surprising beauty, numbers with unusual properties and peculiar, inherent harmony. You just need to be able to see these numbers, to notice their properties. Peer at a natural number sequence – and you will find a lot of surprising and exotic, amusing and serious, unexpected and funny. He sees someone who looks. After all, people in the summer and starry night ... won't notice the North Star shining, if they don't send their eyes to the sky …*"

– What is interesting in this world of numbers? How can they surprise us? For example, they can surprise us by focuses. I will show you one of them.

Focus. To write down any three-digit number on a sheet of paper, to attribute to this number the same number on the right, to divide this number on 7, to divide this result on 11, to divide result on 13. If all calculations were executed correctly, the three-digit number which was written originally will turn out. Why? (Hypotheses of pupils.)

Together we solve the focus (frontal work).

– 1001 – what interesting number. This number even has a name. The whole world calls it Shakherezada's number. And why is it called so? (Hypotheses of pupils.)

– The magic does not necessarily mean sleight of hand. We can use mathematics with its logical mechanisms, including the topic "Divisibility of Numbers".

Further we formulate the lesson purposes.

– You finish studying the topic "Divisibility of Numbers"; you have got acquainted with new concepts, algorithms. If the subject has been studied, why do we have today's lesson? (Answers of pupils.)

As the act of surprise the teacher used the video fragment and mathematical focus. The other surprising moment is opportunity to use calculator at a lesson of mathematics, because purpose of this stage is not to form calculating abilities. All this leads joint activity of the teacher and pupils to statement and acceptance of a topic and the lesson purposes.

Substantial block

Feature of a lesson, its key idea is inclusion of open type tasks in its maintenance. They promote of pupils involvement in universal educational activity. The lesson draws the attention to mastering the general methods of scientific creativity: classification with unset criteria, creation of counterexample, brainstorming.

Task "Classification of Numbers". Into what groups it is possible to break numbers: 25, 146, 90, 5, 12, 17, 26, 180, 3, 11111? (Pupils offer different options.)

– How did you see numbers, which can be (cannot be) divided on any number, without carrying out division operation? (Used criteria for divisibility.)

Task "Find a Couple". Each pupil has a card, there is the formulation of one criteria for divisibility on a half of which. It is necessary to find halves of each sign and to formulate it.

Task "Think Up the Number". To think up the number, which:

– is not divided on 3;

– is divided 5, is not divided on 10;

– is divided 9, is not divided on 3 (there is no such number).

– Why could not you think up such number?

Task "Pick Up a Number". Put numbers instead of asterisks in the number * 4 *, so that the received number can be divided on both 3, and 10.

We show all possible options: it is possible to have three numbers: 240, 540, 840.

– There is a special class among numbers. Here are some first numbers from this class: 2, 3, 5, 7, 11, 13, 17. What are the numbers? (Prime numbers.)

– These numbers are very important for mathematicians, but it is still not clear how they are distributed on a numerical row. In 1859, the German mathematician Georg Riemann offered the way of their search. Mathematician subjected to check this method on one and a half trillion similar numbers, but nobody can prove that the further check will be successful. Riemann hypothesis is widely used at calculation of security systems of data transmission, therefore its proof makes big practical sense. The one, who will prove Riemann hypothesis, Clay institute promises to pay one million dollars.

– If there are prime numbers, there are … (composite numbers).

Task. Is it possible to break all natural numbers on prime and compound? Does the classification capture all natural numbers?

– There is number 1, which does not belong neither to prime, nor to compound numbers.

– We sounded one problem of modern science – an absence of proof for Riemann hypothesis, – and now I will tell you the fairy tale.

The fairy tale with tasks

– On September 28, the number 28 decided to invite all its dividers, which are smaller, then it. The first came 1, than 2, than … What other numbers came to number 28? (1; 2; 4; 7; 14)

– When all the guests gathered, number 28 saw that there are not so many numbers. It was afflicted and offered each guest to invite its dividers. How many new guests will come? (Nobody will come). Why?

– What a holiday without round dance. The sign "plus" united all the guests of number 28 united and a miracle happened! What was the sum? (28).

– 1 told that any number, which is equal to the sum of the smaller dividers, is called… (perfect).

– Number 28 was pleased and asked what the other perfect numbers are. (6; 28; 496).

– September 29 came and number 29 decided to invite its smaller dividers. The first came 1. Who else came to the number 29? (Nobody.)

– What can we say about number 29? What kind is it? (Prime)

–October had the same custom.

– Only one number had not have guests. What number is it? (1).

–How many times did 1 visited other numbers? (30). What numbers had the only one guest? (2; 3; 5; 7; 11; 13; 17; 19; 23; 29; 31). What was the guest? (1)

Psychological relief

Psychological relief is realized through game competition, "Yes – no" game and "Who is more?" game.

Game competition on rows. Each row has the task on the board, pupils come to board in turn and sign an answer. The team, which first completed the task, wins. A prize to the won team is a card with a number (any).

LCD (25, 3) =

LCD (10, 4) =

LCD (25, 3) =

LCD (7, 30) =

"Yes – no" game. The teacher imagines a three-digit number. The one, who first guess it, wins. It is possible to ask only "yes – no" questions. The winner gets a card with a number.

Task "Who is more?" There is a set of numbers on a slide: 29, 6, 76, 39, 45, 7, 10, 101, 85, 400. Look at the slide and assume, what task will be given?

After that, the slide is closed. The task is to reproduce the numbers from memory. The one, who remembers more numbers, wins. The winners get a card with a number.

Puzzle

The block use the puzzle "An irrepressible square" (Gorev & Utemov, 2015).

Task. The puzzle consists of five parts. Take four of them, except a small square, and make a square of them. And now try to make a square of all five parts.
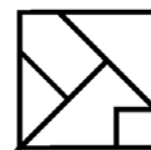
The offered puzzle is an open type task: the formulation contains a contradiction: how is it possible to make a square adding a new element?

Substantial block

The lesson purpose is repeat the topic and prepare for examination. The main aim of a lesson is to form children's understanding of studying the topic. Therefore, the didactic material is different real life situations.

– Where can we use knowledge of the topic "Divisibility of Numbers", except mathematical lessons?

– Ability to calculate LCD and LCM of numbers can help people of different professions.

Tasks

The supply manager Raisa Ivanovna gave an assignment to the technology teacher Andrey Petrovich to buy the shortest boards, which can be sawn on equal parts for 30 cm and 40 cm. Board of what length will Andrey Petrovich buy?

Artem's parents are people with very interesting professions. The mother is the flight attendant, and the father is the train driver. The mother stays at home once in four days, and the father – once in seven days. It turned out that both of them work on September 1. It is possible to call this text a task? (No.) Formulate a question that this text could be considered as a task. We choose from the offered questions: "When will Artem see the parents together?", and solve a task.

Yesterday 660 white, 165 red and 173 yellow roses were delivered to a flower shop. The whole day the seller tried to make the greatest number of identical bouquets of red and white roses, not remain any superfluous. But as long as nothing goes .The sixth-grader daughter came to the shop and quickly solved the problem, having reported, how many bouquets is possible to make and how many flowers will be in each of them. How did the daughter argued?

Game "What? Where? When?" (one round). At the same time 3 teams of experts play (on raws). Question: "The most important and valuable I store in the safe with coded lock. A lock code is the seven-digit number consisting of the twos and the threes. There are more threes and the number can be divided on both 3, and 4. Dear experts, in one minute call a code of the lock of my safe". The winner team gets a card with number.

Resume

Development of quality assessment skills and self-assessment of personal and collective activities, check of objectives achievement are provided in this part of a lesson. At this stage, children received a product of their activity (a number with description). The reflexive moments are included in different stages of a lesson and consist in teacher's understanding the degree of success and sensibleness of tasks performance.

All three teams of pupils, using every card with numbers earned during a lesson, make a number from them number and describe properties of this number in terms of the topic "Divisibility of Numbers".

DISCUSSIONS

The issues related to the structure and contents of a modern mathematics lesson are often studied and developed in methodological scholarship. For example, Volovich (1995), Pichurin (1987), Grudenov (1990), Zilberberg (2012), Manvelov (2005), Makhmutov (1985), Levitas (1989), Ivanova (2010) have made considerable contributions into the development of these issues.

We see strengthening of the developing effect of mathematical lesson and realization of possibility to develop pupils' meta-subject results in development of pupil's creative personality. Before the new educational standards in domestic pedagogical and methodological science there have already been the directions, which developed the subject of creative personality: the developing training (Davydov, 1986; Zankov, 1999; Elkonin, 1989); problem training (Matyushkin, 2003; Makhmutov, 1975); creative pedagogics (Altshuller, 2004); education of intellectual creative personality (Sukhomlinsky, 1987); development of pupils' creative personality when training separate disciplines of a school course (Ammosova, 2000; Gavrilova, 2010). Besides, methodologists Balk (1969), Gusev (2003), Episheva and Krupich (1990), D. Polya (1991), Shvartsburd (1964), et. al. noted the need of creative activity formation when training mathematics at high school and school additional mathematical education.

The analysis of psychological-pedagogical and mathematical-methodical literature, experience of mathematics teachers shows that formation of pupil's creative personality when training mathematics a has huge value. Development of creative activity as one of types of educational mathematical activity promotes formation of pupils' thinking, abilities to find new solutions of various tasks, ability to be guided in the changing educational situation, think and work productively and non-standard, show activity, consciousness and initiative in educational work. That is direct reflection of meta-subject results of training.

However, the researches on the theory and technique of training mathematics haven't considered the methodical concepts realizing approaches to familiarizing pupils with experience of creative activity and achievement of high meta-subject results through entering the elements originating in creativity pedagogics into the structure of mathematical lesson, that directly has to conduct to development of creativity of pupils.

According to Episheva and Krupich (1990), specific feature of intelligence is, first of all, the generalized informative ability to create and solve problems. Tasks in educational process are used as means of giving, fixing and check of mastering material. The majority of tasks in traditional textbooks are standard, solved on known algorithms. While it is much more effective to train pupils to search variable decisions, to choose the best results by means

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of open type tasks – the tasks assuming diversity of decisions, answers, researches, images, forecasts, etc., i.e. the tasks giving opportunity for creativity.

Thereby the offered methodological approaches on modification of mathematical lesson structure and addition of its contents both separate open type tasks, and their systems, is the new direction in development pupil's personality at the possibility to achieve high meta-subject results of training.

CONCLUSION

Analyzing various points of view on a problem of creative person formation by means of mathematics to achieve good training results at the meta-subject level, we developed and introduced the structure of a mathematical creative lesson in educational practice and use of open type tasks. The carried-out approbation of the possible contents to improve quality of pupils' mathematical training allowed to build methodological approaches of inclusion of open type tasks in various stages of a mathematical creative lesson considering specifics of development of pupil's creative personality. The result of the research carried and skilled teaching with application of the structure of a mathematical creative lesson and use of the systems of open type tasks with mathematical contents formed the methodological approaches and the key ideas about using open type tasks at various stages of a mathematical lesson. Practical use of the structure of a mathematical creative lesson and the systems of open type tasks allows to specify achievements of pupils' creative results and progress.

The chosen structure of the developing creative lesson of mathematics and inclusion of open type tasks in its maintenance allow to organize meta-subject activity (the activity outside the subject directed on training in the generalized modes of work with any subject concept and connected with life situations). The meta-subject activity is basing of a meta-subject approach (transfer of modes of work with knowledge to pupils) to achieve meta-subject results (generalized ways of activity mastered by pupils both within educational process, and in real life situations).

Use of open type tasks at a lesson and beyond it allows to improve results of mastering program material. Monitoring of educational activity results of pupils shows positive dynamics.

Open type tasks increase the educational potential of a lesson. They are the mean of formation of pupil's qualities: they force to estimate the contents, proceeding from the social and personal values providing personal moral choice. Pupils use mathematical apparatus for implementation of socially significant projects, showing readiness to apply the acquired knowledge and ways of activity in real life to the solution of practical tasks. Using methods of scientific creativity, pupils try to look at future of society as at an open type task.

Today the activity assessment in quantitative expression is considered convincing, but not everything can be measured by numbers. Meta-subject results are the results directed on prospect of successful independent life of our children. Besides, at the solution of educational and non-learning tasks pupils show thinking creativity, initiative, resourcefulness, activity, ability to emotional perception of mathematical tasks and reasoning, take responsibility for a choice of decision and answer. It means that open type tasks can be mean for personal results achievement.

If to speak about the means of formation of pupils' universal educational actions, we should note that the proposed methodological solutions have to be universal too. Any teacher can use open type tasks. It confirms the importance of using the general methods of creative thinking development. The future of our school is creative teachers.

RECOMMENDATIONS

The materials of the article can be useful to the mathematics teachers seeking to raise the level of pupils' development from positions of achievement creative and meta-subject results during mastering mathematical material.

We see the perspective direction to improve the offered model of a mathematical creative lesson by adding it with aspects connected with broad introduction of distance training technologies: distance maintenance of pupils' activities during the educational period and expansion of model on some educational institutions with realization of network interaction of teachers and developers of programs.

Use of open type tasks at lessons has to be followed by extracurricular activities. To strengthening the developing effect the general methods of creative thinking development should be use, as the ideal finite result, synectics method, method of brain storm, method of transition to another dimension, "on the contrary" method, etc., which came from TRIZ. These methods help to overcome psychological inertia, i. e. predisposition to a concrete mentality during tasks solution, ignoring alternative opportunities, except the initial one. After-hour lessons can be used for solving inter-subject open type tasks.

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