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# Development of Meta-subject Competencies of the 7-9 Grades Basic School Students through the Implementation of Interdisciplinary Mathematical Courses

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**ABSTRACT**
The article is aimed at describing one of the possible interdisciplinary courses for students of the 7-9 classes of the basic school connecting mathematics with natural sciences and the study of such courses role in the formation and development of meta-subject competencies of students. The leading method for this is the modeling of interdisciplinary courses, the main tools for the development of meta-subject competence in which are the interdisciplinary character of the content, including open and partially open type tasks in the course structure and the organization of project activities of schoolchildren in the field of studying mathematics and related disciplines. As a result of the research conducted by the authors they worked out several author's interdisciplinary courses, among them a special place is taken by the course "Mathematics in Natural sciences" for the classes of the natural-science profile. It is suggested in it to consider mathematical questions when applying them to the material of related disciplines both through the study of theoretical material and in the process of solving problems, including the open type, and involving schoolchildren in the project of interdisciplinary activity. Practical use of the interdisciplinary courses allows to see the achievements of meta-subject results by schoolchildren and the successes of students both in mathematical preparation, expressed by high marks on the subject, and related disciplines, which indicates the improvement of mathematical education quality of students who received training using the proposed methodology.
**Keywords:** mathematical educatio, intersubject relations, meta-subject approach, project activity, creative development.


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**State of the literature**

- There are changes in the system of general education connected with the introduction of new educational standards, which changes its paradigm: the transition from the formation of a knowledge system to the development of the pupil's personality is being done at the subject and meta-subject level by means not only of the subject, but also of the use of interdisciplinary courses. And this is poorly reflected in methodical research on mathematical education at present.
- We can find very few researches in the literature on the theory and methodology of teaching mathematics and natural sciences devoted to the introduction of courses of interdisciplinary content, in the complementary mathematical education of schoolchildren in particular. Practically there are no researches on the possibility to include open-type tasks and project activity of students in them.
- The overwhelming majority of studies on additional mathematical education are directed to work with mathematically gifted schoolchildren. That practically excludes the question of mass development of students by means of additional mathematical education especially those whose profiling is not directly related to mathematics.

**Contribution of this paper to the literature**

- A mathematical course of interdisciplinary content "Mathematics in Natural Science" is proposed for the basic school Students of the 7th - 9th grades in additional mathematical education based on the material revealing the interrelationship between mathematics and natural sciences. It is demonstrated here how the results obtained in mathematics, served as a source of new ideas and results in individual sections of the natural sciences.
- For the first time both individual open-type tasks and their systems are introduced to the course. By solving them a student is involved in universal educational activity (goal-setting, planning, argumentation, analysis, synthesis, comparison, control and self-control) and consequently achieves meta-subject results.
- In addition to mathematical problems and open-type tasks project technologies aimed at achieving the result of inter-subject activities are widely used that was practically excluded earlier in the traditional method of teaching mathematics.

## INTRODUCTION

The Concept of the Mathematical Education Development in the Russian Federation which came into action means some priority directions of its improvement (the Concept of mathematical education development in Russian Federation, 2013). First, it requires the development of logical thinking of schoolchildren, abilities to Interaction and communication in the classroom and in extra-curricular activities in mathematics, which determines the success of the student, his opportunities for socialization and integration in society. Secondly, mathematical knowledge should not be divorced from reality, students should be able to apply them both in scientific researches including areas not directly related to mathematics and in practical life. Thirdly, it is necessary to pay special attention to the formation of creativity, the ability to find problems' solutions in non-standard conditions. A

school graduate should be able to design and solve necessary practical and creative tasks of an open type.

Proceeding from the above mentioned the modernization of education not only focuses on the profile orientation of the school, broad integration and differentiation but also determines the great importance of continuous additional education, which can more Effectively and fully ensure the formation of a versatile personality capable of creative approach to the solution of problems arising at the interface of disciplines (Eilks, 2015, Gorev, 2011).

It is possible to mention a number of activities that implement additional mathematical education both once-only and systematic: study-groups and electives, special courses and seminars, competitions and olympiads, mathematical camps and so on (Gorev, 2013). All this makes an invaluable contribution to the formation of both the personality and intellect of the student at the levels of subject and meta-subject achivements. The continuous line of such activities makes this work the most effective, which is confirmed by the results of our long experience (Gorev, 2014). At the present stage of education there is a need to create conditions contributing to the development of the meta-subject competencies of students. That is the students become aware of the need to acquire knowledge, mastering the ways of using them, and influencing the formation of independent thought activity skills that would allow them to achieve success in life using their internal potential, both intellectual and creative. It is not enough for this to form only strong subject knowledge and skills; the personal development of students, on Inter-subject level in particular is required (Gorev, 2015). The question of the need to develop skills in solving applied mathematical tasks with a natural, technical or economic content arises before a teacher of Mathematics more and more often. However, certain difficulties arise here which must be solved systemically (Kim & Cho, 2015). On the one hand, a huge amount of subject material defined by the standards does not give any time for attraction of interdisciplinary relations directly during the lessons of mathematics. The teacher has a strict and clear calendar-thematic plan which he must follow. There are certain indicators of the subject knowledge assimilation and skills, which he must check and evaluate. Besides the lack of time the question of the of the teacher's competence in other disciplines often appears- one thing when it comes to applied physical problems, the other is when the teacher has to deal with the problems of biology or chemistry which may be beyond his competence. On the other hand, a new federal state educational standard requires from the teacher to form meta-subject skills that is skills to use knowledge in practical activities (Federal State Standards General education, 2012). It is worth mentioning the fact that more and more assignments of the final state attestation both for the basic course and for the course of a full secondary school become practical-oriented. If earlier such tasks could be found in blocks of the basic level of complexity only, now they appear in a second, advanced, part of the examination in mathematics which requires from the graduates a higher level of meta-subject competencies. In addition to that, in the current conditions of early profiling students who study deeply the non-mathematical disciplines,

sometimes do not have enough opportunities for realization and assimilation of a huge number of mathematical methods and techniques that are used in their profile. There is a need to fill the educational space with a new interdisciplinary content.

## MATERIALS AND METHODS

### Research Methods

The following methods were used to carry out the research: analysis of psychological and pedagogical literature, educational and methodological works on mathematics and natural sciences for the basic school; Analysis and Generalization of the experience of the teachers in the temporary creative team and their own experience in the Interdisciplinary courses implementation. The main tools for achieving meta-subject results by the students in these courses are interdisciplinary content, tasks of an open type and project activity; analysis of educational products; method of thought experiment; forecasting, systematization and generalization of facts and concepts; modeling and design; method of expert evaluation; educational activities results analysis; Development and application of teaching materials; pedagogic experiment.

### Experimental research base

The research was carried out by conducting an experimental teaching of an interdisciplinary course "Mathematics in Natural Science" for the classes of the natural-science profile in the 7-9th grades of the basic school in the classes of teachers working in the temporary creative team organized by the Education Development Institute of the Kirov region; experimental teaching has been conducted since 2014.

### Stages of research

The research is conducted in three stages.

At the first stage the state of the problem studied was revealed in the theory and practice of teaching Mathematics and related disciplines (chemistry, biology) to the students of the 7-9 grade of the main school. For this purpose the study and analysis of psychological and pedagogical literature, educational and methodological work on mathematics and natural sciences for the basic school, observation and analysis of the experience of the educational institution and subject teachers were performed in order to study the possibilities of including interdisciplinary content in the process of additional education to develop meta-subject competences of the students.

At the second stage methodological approaches to the implementation of the course with interdisciplinary content "Mathematics in natural science" for classes of the natural-science profile were developed. The tasks of the open type and the project activity of students in the implementation of the strategy for the formation of creative personality of the student were included there. Selection of the content was conducted both from the viewpoint

of mathematics and related disciplines, the corresponding tasks of an open type, subjects for project activity of students. The model implementation has been and continues to be discussed through regular work of teachers working in a temporary creative team, as well as in reports at conferences and seminars at different levels. That leads to a consistent improvement of the proposed organizational model and methodology for its implementation in profile education of schoolchildren associated with mathematics.

In parallel with the second stage, the third stage has been and continues to be implemented, during which the author and other teachers of the temporary creative team conduct experimental teaching and approbation of suggested course with interdisciplinary content. So the author and his colleagues have been conducting the course since 2014 in the 7-9 grades of the basic school of the for the Education Development Institute of the Kirov region.

## RESULTS

### General issues of the structure and implementation of the interdisciplinary course program

For 7-9 grades with profound study of biology and chemistry we developed a systematic course "Mathematics in natural science". The course implies studying in the context of additional classes, the hours for which are taken at the expense of some part of the curriculum, formed by participants in the educational process which allows to solve partially the problem with the lack of time in the lessons of mathematics. The aim of the course is to provide additional level of mathematical preparation of schoolchildren on the material of profiling through the demonstration of mutual interpenetration of mathematics and natural science. The main objectives are to increase students' interest to mathematics through demonstrating the connections of mathematics with other sciences and life, increasing the level of mathematical knowledge, preparation of children for project activities in the field of mathematical Knowledge at the level of interdisciplinary projects and in solving problems of an open type (Duran & Dökme, 2016).

The material reveals the relationship of mathematics and natural sciences, shows how the development of a single scientific field stimulated the development of another. An idea is given of the mathematical method used in related fields of knowledge. It is demonstrated how the results obtained in mathematics served as a source of new ideas and results in separate sections of the natural sciences.

Classes are held once a week. The course material is divided into four thematic blocks during every year of training (102 hours). The last two lessons of each block are devoted to summarizing and control that can be organized in a variety of forms - from routine testing to setting a round table on the discussion of problems, which will show the level of topic knowing by the students. In addition, at the end of each year of study, an academic hour is

allocated for a generalized repetition. All classes of the course are provided with tasks of an open or partially open type.

It is worth noting the wide possibilities of using the method of interdisciplinary projects during the course -students can develop both short-term projects with their defence at the end of the study of the topic (lessons of the generalizing repetitions) and long-term ones, which they will defend at the end of the school year (Gorev & Luneeva, 2014).

You can implement the project within one lesson, for example, to provide the solution of a task in the form of a model, workpiece or even of a real product that could later be used by the student or teacher (for example, models that demonstrate symmetry in the surrounding world or Mathematical methods for measurements on terrain, etc.).

The material capable of ensuring students' interest to study the course contents should be added to it.

Not long ago a 45-volume edition "The World of Mathematics" was published in Russian. It is intended to popularization of mathematical knowledge. We believe that when preparing for the course the teacher can use .They can be offered to students as additional reading (Bassa, 2014; Corbalance, 2014; Alsina, 2014; Grima, 2014; Navarro, 2014; Corbalance & Sunz, 2014; Laos-Beltra, 2014; Rue, 2014; Guevara & Puig, 2014).

**Specific content of the course "Mathematics in Natural Science"**

The first topic in the 7th grade is "Percentages, Mixtures, Alloys" (9 hours). The topic "Percentages" is studied in the 6-th grade but the lack of time and some unconscious character of these issues study at that time by schoolchildren leads to inadequate knowing of the material by students. And from the ability to find a percentage of the number or the number from Its percentage in adulthood depends not only the financial state of a person but sometimes life itself, especially for people working with chemicals of different concentrations. Therefore, the main goal of this topic study has become the need to provide students with skills for solving applied problems on percentage. Here, to some extent, the preliminary study of chemistry is carried out, in which problems of this kind are important at the stage of initial study. It is suggested to consider the following issues: Percentage; Simple and compound percentage; Tasks for changing percentage; Multi-path tasks for changing percentage; Tasks on concentration, mixtures and alloys; Tasks on mixtures and alloys solved with the help of linear equations; Complex tasks on concentration (Shevkin, 2003).

The section of discrete mathematics "Graphs" is not a part of the school course, it is usually referred to as so called "contest mathematics". However, graphs can depict any structure in various fields of Natural sciences. Thus, in the analysis of natural systems, linear and tree-like(hierarchical) structures are often used. The graphs are widely used in chemistry (King, 1987). Graphs are mathematical objects so they can be characterized by numbers and matrices. In particular, the structure of molecules can be expressed by numbers that are

related to the structure of molecular graphs - "topological indexes". Therefore, the introduction of the topic "Graphs" (7 hours) is fully justified and involves the study of the possible application of graph theory in natural science disciplines. There are classes for studying of the following mathematical questions: the concept of graph; vertex degree and the number of edges; connected and disconnected graphs; graph isomorphism; trees; directed graphs (Genkin, Itenberg & Fomin, 1994).

The study of the Combinatorics (10 hours) is aimed at forming clear understanding of its practical orientation and preparation for the study of the concept of probability in the natural sciences. There are lessons here that reflect the basic combinatorial methods and techniques, namely: enumeration of options, enumeration criteria; enumeration reduction; rules for combinatorial multiplication and addition; combinatorics problem solving without formulas; permutations without repetitions, the factorial of a number; placement without repetition and with repetitions; combinations without repetition; solution of various combinatorial problems. Closely related to these is the next topic "The probability of events" (7 hours), which is of special importance for all sciences - the necessity of calculating the probability of a particular event or result of experience rises before every scientist and you can not make mistakes here. It is proposed to study the following issues: experiment and events, kinds of events; probability of the event: a statistical approach; probability of the event: the classical approach; key theorems of probability theory; the solution of probabilistic problems on the basis of the natural sciences (Vilenkin, 1975; Bunimovich & Bulychev, 2002).

The beginning of the 8th class is connected with the introduction of another natural science discipline – chemistry. This gives us the possibility to perform many experiments and the measurement system realization. Besides, the content of physics lessons is expanded, the students also conduct a sufficient number of laboratory and practical works with measurements and calculations. In this regard the topic "Approximate calculations and errors" (9 hours) was included in our course. When it is studied, such mathematical problems are underlined: the absolute and relative errors; the standard form of the number; approximate calculations; SI system prefixes and the standard form of the number; approximate values record; calculations with the approximate values; the relationship between the values. The topic is of great importance in the natural sciences. There are no irrational numbers both in chemistry and in physics. The irrational number contains an infinite number of characters in the decimal notation. These sciences are experimental, they operate with the results of measurements which are expressed either in whole numbers or in fractional, but obtained with finite accuracy, as a rule with no more than 4 significant digits. For example, the refractive index of a substance can be 1.414, but it Is not equal to the root of 2. Therefore, the numbers π and e, often occurring in chemical and physical calculations are usually rounded to 3.14 and 2.72, respectively (Eremin, 2000).

The most common mathematical model of a real situation is the equation. And if in the course of Mathematics the equations of the first and second degree with one variable are studied in sufficient measure, their solutions with respect to parameters are analyzed, the

study of equations with two variables reduces to their geometric representation to a certain line on the coordinate plane. However in real life most often occurs a dependence of two factors from each other, and accordingly, as their models are considered equations with two variables. That is why the course includes the "Uncertain equations" block (7 hours). Here the following issues are considered: dividers and multiples; NOD and NOC, the relationship between them; linear equations with two unknowns; general equation of a straight line; the mutual arrangement of two lines in the coordinate plane (Galkin, 2005).

Geometry as a science has occurred directly from practical necessity and in modern conditions Its concepts are increasingly used in scientific research. The golden proportion, symmetry - are very capacious terms of consideration in the natural sciences questions. Therefore, special attention is paid to the topic "Geometry in natural science" (10 hours). The main goal is to form an idea of universality of geometric concepts in the nature and objects of human activity. This is done during the consideration of such problems as: axial symmetry; composition of axial symmetries; central symmetry; symmetry in space; symmetry in nature; proportional segments; golden section, golden rectangle, golden spiral; golden section in nature.

In the course of the previous two topics, the "Measurements on the ground" block (7 hours) is introduced. It is done to obtain skills of geometrical methods application for decision of practical problems. It is worth noting that similar tasks can be found in the module "Real mathematics" of the final test for the basic school course. The following mathematical questions are offered here: measuring instruments and topographic plan; measurement and construction of corners on the ground; level lines, study of surfaces along lines level; the use of similarity in the measurement of heights; the use of similarity in the measurement of distances.

The first topic of the 9th grade is "Processing of statistical information" (9 hours). Its introduction is justified by a large number of interdisciplinary problems in this field. Besides, the topics of lessons take into consideration the tasks of the module "Real mathematics" for the final test of the basic school course. During the study there is an opportunity to apply a whole range of mathematical methods when collecting information, for example, from chemical or physical experiments and then systematize it and present it in various forms. Here the following mathematical questions are considered: reading and recording of information presented in the form of tables; reading and recording information presented in the form of diagrams; analysis of statistical information; calculations by formulas; Natural Science models based on equations; Natural Science models based on inequalities.

For the same purpose the thematic block "Variational series" (7 hours) is also introduced. This topic also has great applicational and project potential. That means its study can become the basis for interdisciplinary projects. Here the following topics are proposed: variational series, ranking; graphical Representation of variational series; Mean values: mean value, median; Variation indicators: range, variance, mean square deviation; tasks with variational series for natural science (Kremer, 2002; Bavrin 2003).

Another mathematical model of real situations, available to the student and widely used in the natural sciences is a system of linear equations. In this connection, the topic "Matrices, Determinants, Systems of linear equations "(10 hours) is introduced. Here we discuss methods for solving systems, which are not included in the main course, but having great practical importance. The following topics are suggested for lessons: matrices, types of matrices, application in natural sciences, presentation of graphs in the form of matrices; linear operations on matrices; matrix multiplication; determinants of the second order; determinants of the third order; systems of linear equations, Cramer's method; Gauss'method for solving systems of linear equations; different ways of linear equations systems solving.

According to the program of the 9th grade, at the end of the planimetry course introductory lessons in stereometry are given. And the initial information on the topics "Polyhedra" and "Bodies and surfaces of revolution" is considered. In the course of these lessons there is no time for studying the applied problems of the interdisciplinary orientation - the exam is coming, so there is an opportunity to consider them in the classes of our course within the topic "New sides of Geometry in natural science "(7 hours). In addition to that, lessons on the concept of a fractal are included. The following topics are proposed: regular and semiregular polyhedra; polyhedra and the lattice of chemical structures; fractals: concept and meaning in natural science; fractal curves: structure and analysis.

Thus, during the course conditions are created for students to develop systematical knowledge and to form full range meta-subject skills and interdisciplinary conception. Besides, we believe that the proposed course "Mathematics in Natural Science" should become the link that will allow the students of natural science classes not to lose interest in the subject of mathematics but, on the contrary, to understand better how mathematical laws allow us to comprehend the surrounding reality, nature, and the life itself.

**Open tasks and project activities of students in learning of interdisciplinary courses**

As we have pointed out earlier (Gorev & Utemov, 2011; Utemov, 2012; Utemov, Zinovkina & Gorev, 2013), open-type tasks have an uncertain condition from which it is not clear how to act, what to use for the solution, but the required result is understandable. Such tasks presume a variety of solving ways; there are many options for solutions, but there is no concept of a correct solution: it is either applicable to the achievement of the required result or not. As an example, we give a task from the topic "Measurements on the ground" of the 8-th grade course "Mathematics in natural science".

A task. A man picking mushrooms approached a river. Offer him 2-3 ways of the river width measurement with the help of only improvised means. The measurements should be as accurate as possible. For solving a problem many different acceptable variants are possible such as: 1) to tie a stone and throw it across the river, then find out the length of the thread measuring it with his steps; 2) take sticks, bind them together, measure the width of the river, and then, knowing his height, make notes on sticks and count the length; 3) look

on the map using the cell phone; 4) take a picture with a tree, knowing personal height, measure the length of the tree, and then drop it across the river; 5) note object A on the opposite bank and stand In front of it it; Turn 90 degrees and go along the bank; Put a stick; again in the same direction we make The same number of steps and put a stick; Then turn 90 degrees and go from the bank until we are on the same line with the selected object and the first stick: M – the desired point; Segment from the second Stick to M will equal the width of the river (**Figure 1**).

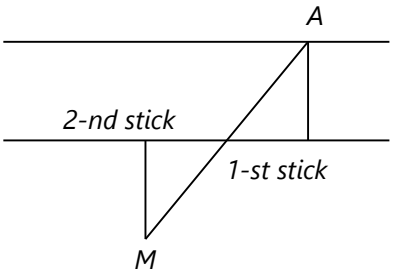


**Figure 1.** A drawing to the task about the river's width measuring

The tasks of an open type include the possibility of applying standard knowledge to a non-standard situation. While fulfilling such tasks, the student can show the ability to a logical and abstract thinking.

That is, the ability to classify, generalize and draw analogies, predict the result, applying intuition, imagination. The tasks of an open type involve students in universal educational activities (goal-setting, planning, argumentation, analysis, synthesis, comparison, control and self-control. And, as a result, they contribute to the achievement of meta-subject results.

Versatile development of personality is impossible without active independent work of the student with subject and non-subject material. Understanding the project as a time-limited event aimed at creation of unique products or obtaining new results, we believe that the project activity allows to form an active, independent and practical position of the participants, to develop research, reflexive, self-evaluation skills, to form abilities directly connected with experience of their application in practical work, to develop intellectual interest that characterizes the level of meta-subject results achievement. A special role in the development of meta- subject competencies of the students belongs to work of schoolchildren on interdisciplinary projects, connecting Mathematics with other fields of knowledge, with the natural sciences in particular (Sababha et al., 2016).

Here is a short list of projects that students can implement in the framework of the described interdisciplinary courses: "Using the symmetry of a birch-tree leaf for bioindication of the atmosphere air state", "The frequency of global catastrophes", "Determination of the fluid lifting rate through the vessels of a plant", "Description of spiral galaxies structure by mathematical functions", "The world through the eyes of a scientist: almanac- photo

exhibition", "Myths, legends and fairy tales: a view from the standpoint of science", "Graphs and their application to the solution of practical problems from different spheres of human activity", "Problems of combinatorics and probability theory in science and everyday life", "The derivative in tasks with practical content", etc.

## DISCUSSIONS

At present we have the experience of conducting various mathematical courses in additional education of schoolchildren. We can say that many works on the theory and methods of teaching mathematics has been devoted to the problem of their formulation and development. We can mention such researchers as N. Ya. Vilenkin et al. (1996), I. Ya. Depman & N. Ya. Vilenkin (1999), L. F. Pichurin (1999), E. E. Semenov (1999), I. M. Smirnova & V. A. Smirnov (2007), G. A. Simonovskaya (1997), V. V. Firsov, O. A. Bokovnev & S. I. Shvartsburd (1977), L. P. Shibasov & Z. F. Shibasova (1997), etc. Nevertheless, in the organization of courses there are still unresolved problems related to the content selection, in particular of an interdisciplinary character and for the development of meta-subject competencies of students.

Any mathematical course is inconceivable without a certain set of tasks corresponding to it. The tasks are used as a very effective means for students to learn concepts, methods, as the most effective means of developing a culture of thinking, as an essential tool for teaching the students skills in practical applications of mathematics (Episheva & Krupich, 1990). A large potential of the open-type tasks in mathematical education should be noted (Gin & Barkan, 2014; Utyomov, 2012; Gorev, Yachina & Nurgaliyeva, 2015) for development of meta-subject competencies of students.

Development of the meta-subject competencies of students is impossible without interdisciplinary content studying. Thus, dealing with problems of interdisciplinary content, I. S. Sergeev (2006), G. K. Selevko (2006) show the possibilities of effective use of design technologies for work with interdisciplinary content.

Despite the huge contribution to the study of the formation and development of meta-subject results of students made by A. V. Khutorskiy (2016), Y. V. Gromyko (2001), S. V. Galyan (2014), for the time being, still there exist a problem of the filling of school education with content that can effectively influence upon development of meta-subject competencies of students.

Analysis of psychological-pedagogical, methodical literature, experience of teachers of mathematics and related disciplines shows that the formation of meta-subject results of a student in teaching mathematics is of great importance today. It is necessary to create conditions for students that promote the desire to gain knowledge, to master the ways of using them and influencing the formation of skills of independent thought activity that would allow them to have success in life using their inner potential, both intellectual and creative.

Thus, the proposed methodological approaches to the formation of mathematical courses with interdisciplinary content, the ability to include open-type tasks in them and the widespread use of the project activity of students represents a new direction in the methodological work of the teacher of mathematics, make it possible to create conditions for achieving high meta-subject results of teaching.

## CONCLUSION

Having analyzed different viewpoints on the development of the meta-subject competencies of basic school students by means of Mathematics a thematic course of interdisciplinary nature "Mathematics in Natural Science" was developed and implemented in the educational practice. Approbation of the course content was made to improve the quality of mathematical training for students of natural science profile. That made it possible to build methodological approaches to inclusion of open type tasks and project activities of students. As a result of the work made by creative group of mathematics teachers and researchers during last three years methodological approaches were formed, the key ideas on the use of open-type tasks and the project activity of schoolchildren in interdisciplinary courses were developed. Practical use of the course "Mathematics in Natural Science" allows you to indicate the achievement by schoolchildren meta-subject results and the success of students.

Thus, the selected interdisciplinary content of the course and the inclusion of open tasks and project activities of schoolchildren in it allow to organize meta-subject activity (activity beyond the framework of the academic subject aimed at teaching generalized ways of working with any objective concept and is connected with life situations) on the basis of the meta-subject approach (teaching students the methods of working with knowledge).That allows to achieve meta-subject results (students mastered generalized methods of activities, applicable both within the educational process, and in real life situations).

Usage of open tasks and project activity allows to improve the results of students' program material learning. Monitoring of the schoolchildren's educational activities results shows positive dynamics. Today evaluation of activity in quantitative terms is considered convincing, but numbers can not measure everything. Meta-subject results are results for the future successful life of our children. In addition, when solving educational and extra-curricular tasks, students show creativity of thinking, initiative, resourcefulness, activity, the ability to emotionally perceive tasks and reasoning, take responsibility for choosing the way of solution and the answer. Hence, open tasks and project activities can be a means of achieving personal results.

Speaking about the means for the formation of universal educational activities among students, it should be noted that the proposed methodological solutions should also be universal. A teacher of any subject can use open tasks and project activities. This confirms the importance of mastering common methods of creative thinking development.

## RECOMMENDATIONS

The materials of the article can be useful in practical terms for teachers of mathematics, biology, chemistry, informatics, teachers of additional education for schoolchildren, who are trying to improve the level of development of their pupils from the point of view of their achievement of meta-subject results.

A promising development direction for the implementation of interdisciplinary courses in the practice of educational institutions is supplementation of the methodology by aspects related to remote learning technologies, namely: remote support of student activities during the educational period and the extension of the model to several educational institutions with the implementation of Interaction between educators and program developers.

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