ISSN 0798 1015

REVISTA ESPACIOS

HOME Revista ESPACIOS ÍNDICES / Index A LOS AUTORES / To the AUTORS

EDUCACIÓN • EDUCAÇÃO • EDUCATION Vol. 40 (Number 9) Year 2019. Page 22

Forming independent cognitive activities in schoolers of humanities classes in the study of mathematics

Formando actividades cognitivas independientes en escolares de clases de humanidades en el estudio de las matemáticas

IVANOVA, Avgustina Vasilievna 1; BUGAEVA, Aya Petrovna 2; GOGOLEVA, Irina Vasilyevna 3; DARBASOVA, Laura Agitovna 4; SCRIABINA, Alevtina Gavrilovna 5

Received: 21/02/2019 • Approved: 09/03/2019 • Published 25/03/2019

Contents

ABSTRACT:

The article deals with the formation of independent cognitive activities in humanities students while studying mathematics at a basic level. A questionnaire survey, discussion, logical and didactic analysis of the existing basic mathematics textbooks revealed low motivation to study mathematics in humanities schoolers; overloaded educational program at the basic level; a limited amount of applied tasks in the textbooks. It was proposed to select mathematical problems activating all stages of mental activities, providing the development of independence in the study of mathematics.
Keywords: independent cognitive activities, humanities schoolers, mathematics

RESUMEN:

El artículo trata sobre la formación de actividades cognitivas independientes en estudiantes de humanidades mientras estudian matemáticas en un nivel básico. Un cuestionario, una discusión, un análisis lógico y didáctico de los libros de texto de matemáticas básicas existentes reveló una baja motivación para estudiar matemáticas en las escuelas de humanidades; Programa educativo sobrecargado a nivel básico; Una cantidad limitada de tareas aplicadas en los libros de texto. Se propuso seleccionar problemas matemáticos activando todas las etapas de las actividades mentales, proporcionando el desarrollo de la independencia en el estudio de las matemáticas.
Palabras clave: Actividades cognitivas independientes, humanidades escolares, matemáticas

1. Introduction

The Federal State Educational Standard (hereinafter FSES) for general secondary education is aimed at teaching school leavers who will own a wide range of universal educational skills (personal, regulatory, cognitive and communicative), independently be able to define goals and objectives, to plan, design, implement, monitor and correct their educational activities.

Therefore, the paper deals with the problem of forming learner´s independent cognitive activities at a basic level in the context of the new FSES.

According to V.A. Uspensky (2014), "mathematics is a humanities science." Mathematics has a powerful potential for the formation of independent cognitive activities in schoolers studying in humanities classes. Mathematics is a discipline that promotes the formation of the thinking skills necessary for adaptation in the modern information society, the ability to take rational ways to achieve goals in various spheres of professional activities (Gogoleva, 2014).

The specificity of mastering the content of mathematics provides active learners' independent activities, enabling them to individualize their activities, which generates their interest in learning. At the same time, the logical and didactic analysis of mathematics textbooks leads to the conclusion that the potential of mathematics is not realized for the formation of students' independent cognitive activities at the basic level. Mathematics is not only a powerful tool for solving applied problems and a universal language of science, but also it is an element of general culture. The school subject "Mathematics" is compulsory for studying at the basic level of all profiles; it is aimed at forming a general culture, solving worldview, educational and developmental tasks of general education and socialization, at obtaining education in areas that do not require in-depth mathematical training. The problem of forming learners' independent cognitive activities in the study of mathematics at the basic level requires special attention, since schoolers studying mathematics at the basic level are much more (future philologists, lawyers, historians, artists, athletes, etc.) than those studying in natural science classes, who need a different approach to the study of this subject because of their physiological characteristics. Students of humanities classes have visual-figurative thinking prevailing, well developed visual perception, figurative memory prevailing, less developed ability to generalize, poorly developed random memorization and personal qualities: they are dreamers, visionaries, smart, curious, sociable, etc.

Currently, in the process of teaching mathematics, the parallel formation of students' independent cognitive activities, i.e. internal readiness and ability to purposeful cognitive activities, reflecting personal and civic positions in activities, the ability to set goals and build life plans, implement cognitive reflection regarding actions and solution of educational and cognitive tasks, becomes imperative. However, today, as shown by the analysis of mathematics textbooks, the survey and conversation with teachers and schoolers factors that constrain the formation of independent cognitive activities in the study of mathematics are: insufficient consideration of the characteristics of humanities classes students; task material in the textbooks does not motivate students to study mathematics, does not arouse interest in the subject, does not meet the needs and opportunities of humanities schoolers. The content of the task material does not differ from the tasks envisaged for students in specialized natural science-mathematical classes, there is no due amount of theory explanation for the students of the basic level of studies, textbooks present tasks only for applying and memorizing formulas, there are no tasks for conducting the simplest experiments, research, required to form independent cognitive activities, etc.

Thus, the focus on independent cognitive activities should be created through the solution of such tasks, the plot of which implies social, moral, ethical, socially significant values, taking into account the needs and capabilities of students. In the course of the research, the following tasks were solved: discussions were held with teachers of mathematics and a questionnaire survey of humanities schoolers was conducted; textbooks and didactic materials in mathematics intended for training at the basic level were analyzed; the principles were identified for selecting tasks in mathematics, aimed at the formation of independent cognitive activities of pupils studying in humanities classes.

1.1. Literature review

Recognizing the publications of domestic educators and psychologists, who noted that students' independence and creative activity develop most intensively in the process of their independent cognitive activities, it is worth underlining the works of contemporary researchers O.V. Petunin (2016) and V.N. Pustovoitov (2010) regarding in the development

of children's thinking and their abilities.

The task of the entire education system, including the mathematical one, is to educate a person with a need for systematic self-improvement and self-development. It is possible to achieve this goal through the individualization and differentiation of training on the basis of a personality-oriented approach aimed at identifying and developing the individual characteristics and abilities of each person.

The principles of differentiation are one of the fundamental concepts for student-centered education and realize themselves in the concepts of "differential training" and "differentiated approach" in teaching. The student-centered approach based on education individualization and differentiation is an effective means of forming (to form, to develop) independent cognitive activities. The student-centered approach provides for the teacher's assistance to the students in identifying and uncovering their potential, evolvement of self-awareness, in self-realization, self-development and self-affirmation.

According to O.V. Petunin (2016), student-centered learning provides schoolers with their own personal position, individual experience, contributing to the enhancement of cognitive independence. As stated by Z.S. Isakhanova (2017),"student-oriented approach is a methodological orientation in pedagogical activities that allows, by relying on a system of interrelated concepts, ideas and methods of actions, to ensure and support the processes of self-knowledge, self-construction and self-realization of a child's personality, the development of his or her unique individuality."

A differentiated approach solves the problems of effective pedagogical assistance to students in improving their personality. The differentiated approach is intermediate between front work with the whole team and individual work with each student. The individual approach is a principle of national pedagogy, according to which pedagogical interaction with each child is achieved in classroom educational work, based on the knowledge of his/her personality traits and living conditions " (MOE RF Decree No. 2783, 2002).

To fulfill the requirements of FSES - to form and develop the cognitive independence of students in acquiring knowledge and self-realization in the future, the following training technologies are being updated in the educational process: problem-based learning, design and research technologies, health-saving and case technologies, integrated teaching, developmental learning and differentiated learning.

The humanization of education and the humanistic nature of training are intended to create conditions that encourage students to engage in vigorous creative activity and ensure their participation in it. V.A. Testov (2012) put forward the following principles for the selection of the content of mathematics: the principle of "pedagogical adaptability" of the curriculum content, i.e. modern scientific knowledge should be accessible, consistent with the psychological and age characteristics of students, their interests and goals of education; the principle of compliance of the school mathematics content with the achievements of mathematical science as a part of universal culture and the development of the ability to apply mathematical methods for practical needs, with a focus on the formation of a modern mathematical worldview as an integral part of a general scientific picture of the world. In this regard, the principle put forward by G.V. Dorofeev (2011) and G.I. Sarantsev (1995) concerning the humanization of education (humanitarian orientation of mathematics), aimed at the development and formation of probabilistic thinking; the realization of interrelations between mathematics and the academic disciplines of the humanitarian program cycle, which are crucial for the socialization of the individual; the formation of human literacy; the general cultural significance of teaching mathematics; the introduction of students to the spiritual culture and creative activities acquires a special meaning – the meaning of becoming an independent person.

Considering the problem of forming independent cognitive activities of humanities class schoolers studying mathematics at the basic level, it is appropriate to discuss mathematics textbooks employed in different years and addressed specifically for use in humanitarian classes.

In the textbooks *Algebra 10*, *Algebra 11* for classes with in-depth study of humanities

(Vilenkin et al., 1992) an attempt was made to approximate the school course of mathematics to the needs of the humanities, the textbooks introduce the simplest elements of mathematical logic and the concepts of the theory of sets. The chapters "Correspondences and Relations" and "Mapping and Functions" provide basic concepts exemplified by facts from linguistics, history, economics, etc. Each chapter is accompanied by exercises for individual work, most of which have content relating to humanities. The first two chapters contain additional exercises for students who have shown interest in mathematics. The second part of the textbook for 11 form students describes periodic processes and trigonometric functions, exponential and logarithmic functions, elements of differential calculus and mathematical modeling.

Later in the textbooks *Mathematics 10*, *Mathematics 11*, published in 1996, V.F. Butuzov, Yu.M.Kolyagin and their coauthors took the path of combining knowledge in mathematics and computer science. These textbooks provide the simplest knowledge of computer, help form skills in programming. Some sections provide practical tasks containing mathematical material and requiring the use of computer to perform these tasks. The course of mathematics is not divided into algebra and geometry. The authors here are trying to give a general idea about the development of the concept of number. The textbook introduces topics on probability theory and mathematical statistics in an accessible and entertaining form.

Geometrical material is a common theme throughout and includes concepts and theorems from general education textbooks. The authors provide practical examples of geometric forms of the surrounding life. However, these examples are quite simple and do not fully reflect the sphere of activities of humanities schoolers, which is close to them. Historical information about the emergence of certain mathematical concepts, as well as the geometricians' biographies, is given very briefly at the end of the textbook. In our opinion, the combination of mathematics and computer science is not entirely successful, since computer science as a separate subject brings more benefits to all spheres of human activities.

In the mathematics textbooks for 10th and 11thgrades for humanities classes (Karp and Verner, 2002), special attention is paid to the ideological aspect of the issues under consideration. The main text is divided into 3 levels: compulsory for all students, more complex and most difficult. Questions on the material studied and the section "Check Yourself" are given at the end of each chapter, which allows assessing the degree of attainment of the level that is compulsory for all students. The textbook also contains paragraphs entitled "Read it yourself", intended for students who are prone to theoretical thinking and are interested in the history of science.

As can be seen, prior to the adoption of the Concept of subject oriented instruction (MOE RF Decree No. 2783, 2002), there were mathematics textbooks compiled specifically for humanities classes.

With the wide-scale transition to the subject-oriented instruction in 2004, the mathematics textbooks for 10th and 11th grades began to be published for general educational institutions, where the subjects "Precalculus Algebra" and "Geometry" were presented in a single course.

At present, mathematics textbooks for general educational organizations are published with instructions for studying at the basic and in-depth levels. Such textbooks can be used to teach mathematics both in the humanities classes and in the physical and mathematical classes. For example, since 2013-2014 academic year the following textbooks have been recommended by the Ministry of Education and Science of the Russian Federation for use in the educational process at educational institutions for teaching mathematics at the basic level (Mordkovich and Semenov, 2014a; Mordkovich and Semenov, 2013, 2014b; Smirnova, 2013; Smirnova and Smirnov, 2014a, 2014b; Mordkovich and Smirnova, 2013a, 2013b; Muravin and Muravina, 2013a, 2013b; Sharygin, 2013; Sedova, et al., 2013). All textbooks represent one subject – mathematics, alternating information from precalculus algebra and geometry in a reasonable sequence. These textbooks have their own line of methodology, historical material, good design; the correct location of the material is traced. However,

these textbooks are also not free from shortcomings: one-type exercises that do not develop creativity; lack of tasks with a humanitarian component; absence of practical tasks that could help in everyday life; due attention is not paid to assignments that encourage learners to carry out simple substantiations, to search for certain regularities; geometric material is uniform and not systematized; textbook tasks insufficiently take into account the factors contributing to the formation of cognitive activities (Ivanova and Skryabina, 2013).

In 2016-2017 academic year the following textbooks were added to this list: Aleksandrov et al., 2014; Kolyagin et al., 2014, 2015; Atanasyan et al., 2014 and some others.

Currently, the subject of "Mathematics" is represented by two separate disciplines "Precalculus Algebra" and "Geometry" for senior students.

The Ministry of Education and Science of the Russian Federation recommended mathematics textbooks by Alimov et al. (2017), Nikolsky et al. (2016), Kolyagin et al. (2016), etc. for the 2017-2018 academic year.

A brief analysis of the mathematics textbook by Alimov et al. (2017) suggests that the tasks are divided into compulsory, additional and difficult levels. In task materials contain many tasks for oral solution that form the students' communicative qualities. Each chapter includes tasks for a compulsory minimum and tasks for self-testing of an additional and difficult character. In general, the textbook is intended for a student of a basic level, but in our opinion, it lacks problems that take into account the needs of schoolers studying in humanities classes, there are no tasks which would help form cognitive independence.

The tasks for the basic and advanced levels of study are stated in the textbook by Nikolsky et al. (2016). Each chapter presents a historical background of the birth of science, provides a brief biography or information about scholars associated with the topic discussed. The task material is designed mainly for memorizing basic methods of solving and using formulas for solving problems, the language of presentation is comprehensible, and is meant for attentive reading by students. The textbook contains more theory than task material, i.e. it is provided for self-study by learners. However, for the humanities class students a dry presentation of exercises and actions will in no way encourage an independent analysis and study, and, moreover, the formation of independent cognitive activities in the study of mathematics.

The mathematics textbook written by Kolyaginand co-authors (2016) consists of multi-level systems of tasks and exercises, at the basic and advanced levels, of task material in sufficient quantity. The textbook contains materials for students interested in mathematics, tasks for self-testing and historical background on the topic of study. Though, if the textbook is intended for studying at the basic level, then in our opinion there are sufficient visual representations, illustrations, structure and content of the task material.

The analysis of mathematics textbooks for the 10th - 11th grades to be studied at the basic level showed that these textbooks do not enable to form independent cognitive activities of humanities class students, because they do not contain tasks that would excite the curiosity of learners, and therefore, they do not motivate students to study the subject itself. The basic level of the content is considered only as a reduction in the number of academic hours (at the basic level 3 hours are provided for algebra and 1 hour is provided for geometry) and programs, the theoretical part does not quite correspond to the capabilities and peculiarities of those studying in humanities classes, task material of the textbooks for studying at the basic level is distributed by types of tasks for the formation of certain actions: simplification, calculation, graph plotting, proof and comparison; there are exercises for the application of formulas and their memorization, which require a reproductive approach in solving; they lack tasks aimed at the development of creative activities and tasks for vocational guidance that would contribute to the conscious choice of a future profession; there are no tasks for carrying out the simplest experiments and research necessary for the formation of independent cognitive activities and special tasks, focused on the text of the basic Unified State Examination (USE).

As the Great Russian scholar M.V. Lomonosov (1711-1765) stressed the importance of studying mathematics, "... it organizes our mind". Mathematics has great capabilities that

allow forming and developing spatial imagination, logical thinking, it helps develop personal qualities and skills: the ability to analyze, generalize, reason and find regularities. Therefore, school mathematics for learning at the basic level as an effective tool of cognition, should be considered a subject that enables to discover the basics of beauty, harmony of natural phenomena and objects and thereby form and develop students' independent cognitive activities.

In general, the analysis showed that in current textbooks the task material of the basic level does not fully ensure the formation and development of independent cognitive activities of schoolers studying in humanities classes. In the above textbooks, the content of theoretical and task materials is aimed at students who are prone to left hemisphere thinking, the task material is not practice-oriented at the basic level.

Thus, teaching aids (the task material of a mathematics textbook at the basic level), which should contribute to the formation and development of activity, independence, initiative, creative abilities, etc., as specified in Article 48 of the Federal Law “On Education in the Russian Federation”, in fact fail to form and develop independent cognitive activity of humanities classes students; the content of the task material in the textbooks does not meet the requirement of the Federal State Educational Standard (FSES) for the formation of students’ regulatory, cognitive and communicative universal educational actions.

In modern conditions, the search for new approaches to the design of the educational process, aimed at developing the methodological and technological skills of teachers and educators is of fundamental importance (Barakhsanova, 2015).

Teachers are dissatisfied “that the subject requirements in exemplary programs need clarification, there is a lot of unnecessary detail in them, they limit the ability to vary the content of the subject” (Kuzovkova et al., 2018). Teachers consider typical the problems with computational and transformative actions; with the application of rarely used theorems; when working with poorly performing learners; in teaching trigonometry, differential and integral calculus, logarithmic and exponential functions, the lack of methodological literature.

For the purpose of enhancing students’ cognitive activities in the classroom V.V. Pomazkov and I.A. Vorontsova (2018) suggest “to use historical and archival materials, life situations when introducing and mastering certain subject material, to show its practical significance, available publications on this issue”. E.B. Gorshkova (2017) notes that the educational material, first of all, is knowledge about the world, which should be interesting to the students and should correspond to their personal experience, and the learning activity is individual cognitive activity, and the students themselves decide at their discretion how to choose it.

Thus, based on the logical-didactic analysis of mathematics textbooks operating in different years, we propose to include social, historical, practical, cognitive; regional; career guidance and interdisciplinary significance in the plot of mathematical tasks, where social significance should primarily concern the interests and needs of society, education, economics, politics, etc.; historical, practical and cognitive significance means the availability of historical facts, practical orientation, cognitive data in the tasks; regional significance implies reflection of the socio-economic, natural-geographical, socio-geographical, socio-demographic, economic, political aspects and directions in the content of the tasks; career guidance significance is reflected in the content of the task as the conformity of the importance of humanitarian specialties in human professional activity; interdisciplinary significance presumes that the content of the task should include questions from various academic subjects that enrich the knowledge of the surrounding reality and show the applied significance of mathematics.

2. Methodology

The methodological background of the study is formed by a personality-oriented approach in accordance with the principles of differentiation and individualization of education in the study of mathematics by students of humanities classes, using modern educational technologies. Theoretical and empirical methods (observation of students in the study of

mathematics, questioning of students, conversation with math teachers), and a pedagogical experiment were used in the research.

The following rural secondary schools were selected for the research: a secondary school in Hatystyr village of the Aldansky District; a secondary school in the Momsky District; a secondary school in Beidinga village of the Ust-Aldansky District, covering 68 students. These schools were selected because they are far from the center, information connection is weak there (the Internet, one of the most powerful means of obtaining instant necessary information, which has many didactic opportunities is absent or weak), teachers use mainly textbooks and additional literature in these schools.

The purpose of the research was to form independent cognitive activities in humanities schoolers while studying mathematics.

The following components were selected as indicators of formed independent cognitive activities: motivation for learning activities, the manifestation of will power in achieving the goal and the quality of knowledge acquisition.

To identify the formedness of independent cognitive activities in humanities students, the following methods were used:

- evaluation of the motivation for learning activities, observation of the students' will power manifestation when carrying out the tasks, the quality of knowledge in mathematics;

- analysis of the obtained results.

To diagnose the learning motivation of students, the authors used the diagnostic technique proposed by the group of authors: (Fetiskin et al., 2002). The method employs a questionnaire consisting of 7 motivation components and 21 ready-made answers, every three of which correspond to each component. The respondent must rate each of the ready answers on a scale from 0 to 3 points, where 0 almost does not matter, 1 is partially significant, 2 is noticeably significant, 3 is very significant.

The experiment consisted of three stages: ascertaining, formative and summative assessment. At the first stage, teachers were questioned to identify which textbooks were used to teach mathematics, which technologies were used in teaching mathematics; students were questioned to identify motivation, interest in the study of mathematics; it involved primary diagnostics of mathematical proficiency at the basic level; logical-didactic analysis of mathematics textbooks. At the second stage favorable conditions were created (compilation and use of math tasks that meet the needs and abilities of schoolers studying in humanities classes), using modern pedagogical approaches, methods, technologies and tools, which were aimed at the formation of independent cognitive activities in the study of mathematics. At the third stage, the level of the increase in mathematical proficiency was controlled and the obtained results were analyzed.

The components of motivation include: 1) a cognitive component - "I really like to learn"; "I have an interest only in individual subjects"; "I don't like talking and being distracted in class"; 2) a communicative component - "to communicate with friends, with a company at school is much more interesting"; "success in learning is an important basis for respect and recognition among classmates"; "I like it if they organize joint work (in pairs, groups, teams) in the lesson"; 3) an emotional component - "for me to learn a subject well, I must like a teacher"; "if the situation is malicious and unduly strict in the lesson, I have no desire to learn"; "it is fun at school, more interesting than at home"; 4) a self-development component - "knowledge helps me expand the mind, quick-wittedness and ingenuity"; "I want to know as much as possible to become an interesting, educated and cultured person"; "I read many books, in addition to textbooks";5) the position of the student – "if you are a student, you must learn well"; "to study well, not to miss the lessons is my civic duty at this stage of my life"; "studying at my age is the most important thing"; 6) achievements - "everything that I do, I do well"; "I feel a sense of satisfaction, uplift, when I solve a difficult problem on my own, learn the rule well, etc."; "I study well, as I always strive to be among the best"; 7) external impacts (rewards, punishments) - "for me it is absolutely important to get a good grade"; "we have to learn in order to avoid annoying morals and tongue-lashing from parents and teachers"; "I am very sensitive to the praise of the teacher and my

parents for my school success.

To identify manifestations of students' will power in carrying out certain activities, an observation method developed by A.I. Vysotsky was used to assess the volitional qualities (Istratova and Eksakusto, 2010). Signs of volitional qualities are: 1) self-reliance (performing adequate activities within one's power without help and constant external control; ability to find an occupation and organize one's own activities; ability to defend one's own opinion without showing obstinacy; ability to comply with the developed habits of independent behavior in new conditions of activities); 2) perseverance (the desire to constantly bring the begun work to completion; the ability to continue the activity even in case of reluctance to do it or when another desire occurs; the ability to persevere); 3) endurance (manifestation of patience in activities, the ability to behave in conflict situations; the ability to inhibit the manifestation of feelings with a strong emotional arousal); 4) self-discipline (observance of order – keeping books, workplace, objects of labor, etc. in order; planning one's own actions; ability to introduce a certain organization into one's own activities); 5) proactivity (manifestation of creativity, invention, rationalization; participation in the implementation of a reasonable innovation; the desire to show initiative).

Math tests were conducted to check the quality of acquired knowledge in mathematics, indicating the formedness of students' independent cognitive activities.

3. Results

The experiment was conducted from 2016 to 2018 among 10th and 11th graders.

In the 10th grade (2016-2017 academic year), the research was carried out to identify the level of formed independent cognitive activities of schoolers in the study of mathematics; for this, math tests and diagnostic activities were employed to determine the students' motivation and will power.

By the end of the experiment, in the 11th grade (2017-2018 academic year) summative assessment was performed. The results referring to the indicators of independent cognitive activity formedness are shown in the tables below.

The results of the ascertaining and summative assessment for the identification of learning motivation are given in Table 1.

Table 1

Results of learning motivation at the beginning and at the end of the experiment, in%

Number of students	Learning motivation components							Mean value
	cognitive	communicative	emotional	self-development	schooler's position	achievements	external impacts (awards, punishments)	
At the beginning of the experiment								
68	57.4	67.6	44.1	60.3	71	64.7	53	59.7
At the end of the experiment								
68	82.3	76.5	54.4	73.5	79.4	76.5	55.9	71.2

Students' motivation was assessed as follows: the optimal level was above 85%, the sufficient level ranged from 65% to 84% and the low level ranged from 40% to 64%. As can be seen from the table at the beginning of the experiment, students showed low motivation for learning activities (59.7%), and at the end of the experiment the learning motivation was

increased, corresponding to 71.2%.

The manifestation of students' will power was observed during two years. At the beginning of the experiment, students' independent activity was the smallest indicator of the identified components of will-power (32.3%), which is an evidence of no interest and motivation in studying mathematics; 39.7% of students displayed initiative activities poorly, i.e. they did not try to find a rational way of solving problems, to approach the problem solution creatively, etc. Some students (41.2%) did not display perseverance (persistence) in achieving the goal, i.e. they could leave the problem unresolved, due to not understanding the condition of the problem or due to cumbersome calculations, etc.

By the end of the experiment, the overall indicator of the will power manifestation increased by 13.9% in the students, i.e. the number of schoolers exhibiting volitional qualities in achieving the goal was 29 people at the beginning of the experiment, and by the end of the experiment it amounted to 38 persons.

The results of students' willpower diagnostics are given in table 2.

Table 2
Results of students' willpower diagnostics in the performance of actions, in%

Number of students	**Will power components**					**Mean value**
	self-reliance	**perseverance**	**endurance**	**self-discipline**	**proactivity**	
At the beginning of the experiment						
68	32.3	41.2	51.47	48.5	39.7	42.6
At the end of the experiment						
68	55.9	54.4	63.2	57.6	51.5	56.5

The quality of mathematical knowledge was assessed using the math tests proposed at the beginning and at the end of the experiment; the results are given in Table 3. In the 2016-2017 academic year students (10th graders) were only involved in the experiment and Table 3 shows their ascertaining results of the math test for that academic year and summative assessment of the same students in 2017-2018 at the end of the experiment.

The results of the questioning survey and observations at the ascertaining stage testified to the need to use new approaches, tools and learning technologies in the lessons of mathematics to form independent cognitive activities of students.

Table 3
Summarized data of math tests by schools at the beginning and at the end of the experiment, in%

Number of students	**2016-2017 (10th graders)**	**2017-2018 (11th graders)**	**Marks**
68	30.9% (21)	47 % (32)	"4" and "5"
	69.1% (47)	53% (36)	Positive assessment

The results of the discussion with the math teachers of humanities classes revealed: the educational program is very extensive, many textbook sections are perceived by students very difficult, including Trigonometry, Exponential Logarithmic Functions, Differential and Integral Calculus; due to the weak access to the Internet networks only presentations are

used mainly in the lessons; teachers try to diversify their lessons using interactive teaching methods. The results of questioning the students of humanities classes led to the following conclusions: they are particularly interested in mathematics, because in the future they see themselves in humanitarian professions; almost no one reads the theoretical material of the mathematics textbook; the tasks are very complicated, few people solve problems on their own.

The main types of work that were used to form independent cognitive activities in students in mathematics lessons included solving problems with the regional content; solving historical, practical, cognitive problems; giving integrated lessons (mathematics and informatics; mathematics and geography; mathematics and history, etc.); using modern educational technologies such as: project activities, problem-based learning, modular learning and so on; giving differentiated tasks with regard to the learners' capabilities and peculiarities; holding consultations, discussions, etc.; arranging compulsory reflection at the end of the lesson, where the students shared their opinions, what new things they learned for themselves and where they can apply the knowledge gained.

Four math tests were conducted to determine the level of mathematical proficiency, the indicator of independent cognitive activity formedness in the study of mathematics.

It should be noted that to form students' independent cognitive activities in school education, attention should also be paid to the professional growth and personal development of the teacher. Owing to the teachers' occupational proficiency, their example and personal qualities, students learn a lot, imitate and develop.

4. Conclusions

The results of the math tests enabled to conclude about the effectiveness of using tasks in mathematics lessons, the plot of which contains social, cognitive, practical, historical, regional, vocational guidance and interdisciplinary significance; applying various advanced pedagogical technologies in mathematics lessons.

Thus, the proposed principles for the selection of the content of math problems for pupils studying in humanities classes contribute to the manifestation of independent cognitive activities in the study of mathematics.

Based on the research, the following conclusions were made:

1. To form independent cognitive activities in students of humanities classes while studying mathematics it is required:

- to write problems with the plot based on social; cognitive, practical, historical; regional; career guidance and interdisciplinary significance;

- to take into account age, individual characteristics and personal qualities of students;

- to update and apply advanced educational technologies on a regular basis;

- to use a differentiated, individual teaching methods, based on a student-centered approach.

2. With skillful organization of the educational process mathematics is aimed to form the foundations of logical, algorithmic thinking, master the skills of using information technology tools in solving problems, the formedness of which indicates that the student independently accepts responsibility, overcomes difficulties in life, knows how to find the shortest path to solve the problem, etc.

Practical implementation of the principles for selecting task material whose plot is of social; cognitive, practical, historical; regional; career guidance and interdisciplinary importance will contribute to the effective formation of self-reliance among students in humanities classes while studying mathematics.

Bibliographic References

Aleksandrov, A.D., Verner, A.L., Ryzhik, V.I. (2014). Mathematics: precalculus algebra, geometry.Geometry (basic and advanced levels) 10th - 11th grades. Moscow:

Prosveschenie.

Alimov, Sh.A.,Kolyagin, Yu.M., Tkacheva, M.V. et al.(2017). Mathematics: precalculus algebra. 10th - 11th grades: A textbook for general educational organizations: (basic and advanced levels), 4th ed. Moscow: Prosveschenie.

Atanasyan, L.S., Butuzov, V.F., Kadomtsev, S.B., Kiseleva, L.S., Poznyak, E.G. (2014). Mathematics: precalculus algebra, geometry. Geometry (basic and advanced levels) 10th - 11th grades. Moscow: Prosveschenie.

Barakhsanova, E.A. (2015). Development of methodological and technological skills of future teachers in the design of electronic resources. In: Avksentyeva, E.Yu.,Barakhsanova, E.A., Vlasova, E.Z. (Eds.) E-learning at the university and at school. Proceedings of the network international scientific-practical conference, p. 41-43. St. Petersburg: Asterion.

Butuzov V.F., KolyaginYu.M., Poznyak E.G., SidorovYu.V., Tkacheva M.V., Fedorova N.E., Shabunin M.I. (1996). Mathematics.A textbook for the humanities students.10th grade. Moscow: Santax Press.

Dorofeev, A.V. (2011). Multidimensional mathematical training of the future teacher.Synopsis of PhD Thesis in Education. Kazan

Fetiskin, N.P., Kozlov, V.V., Manuilov, G.M. (2002). Socio-psychological diagnosis of personality and small groups' development. Moscow: Institute of Psychotherapy Press.

Gogoleva, I.V. 2014.General Mathematical Disciplines of Economic Directions for Bachelor's Degree.*Higher Education Today*, 7, 74-77.

Gorshkova, E.B. 2017. Issues of enhancing the learning activities of students based on the formation of their axiological attitude to independent cognitive activities. *World of Education – Education in the World*, 1(65), 250-255.

Isakhanova, Z.S. (2017). Technologies of student-centered approach in education.*Issues of Pedagogy,* 6, 31-32. https://elibrary.ru/item.asp?id=29435777

Istratova, O.N., and Eksakusto, T.V. (2010).Reference book of a secondary school psychologist. 6th ed. Rostov-on-Don: Phoenix.

Ivanova, A.V., and Skryabina, A.G. (2013). Opportunities of a math textbook for 10th -11th graders studying in humanities classes in the context of the introduction of the federal state educational standard journal / *Fundamental Research*, 11(3), 535-539. https://www.fundamental-research.ru/ru/article/view?id=33159

Karp, A. P. and Verner, A. L. (2002).Mathematics. Study guide for the 10th grade of the humanities profile.

Karp, A. P. and Verner, A. L. (2002).Mathematics.Study guide for the 11th grade of the humanities profile. Moscow: Prosveschenie.

Kolyagin, Yu.M.,Tkacheva, M.V., Fedorova, N.E., Shabunin, M.I. 2016. Mathematics: precalculus algebra, geometry. Precalculus algebra. 11th grade: A textbook for general educational organizations: (basic and advanced levels). 3rd ed. Moscow: Prosveschenie.

Kolyagin, Yu.M.,Tkacheva, M.V., Fedorova, N.E., Shabunin, M.I. (2014). Mathematics: precalculus algebra, geometry. Precalculus algebra. (basic and advanced levels) 10th grade. Moscow: Prosveschenie.

Kolyagin, Yu.M.,Tkacheva, M.V., Fedorova, N.E., Shabunin, M.I.(2015). Mathematics: precalculus algebra, geometry. Precalculus algebra. (basic and advanced levels). 11th grade. Moscow: Prosveschenie.

Kuzovkova, A.A., Mamalyga, R.F., Bodryakov, Yu.V. 2018. Ormation of cognitive interest in mathematics at students in classes of humanitarian and aesthetic orientation. *Mathematics at School,* 2, 35-43. https://elibrary.ru/item.asp?id=34970961

MOE RF Decree No. 2783. (2002). On approval of the Concept of subject oriented instruction at the senior level of general education. Order No. 2783 of the Minister of Education of Russia V.M. Philippov.*Public Education*, 9, 29-40.

Mordkovich, A.G., and Semenov, P.V. (2013).Mathematics: precalculus algebra, geometry.

Precalculus algebra. 11th grade (basic and advanced levels).Moscow: Prosveschenie.

Mordkovich, A.G., and Semenov, P.V. (2014a). Mathematics.Precalculus algebra.10th - 11th grades.Basic level.A set of 2parts (FSES). Moscow: Mnemozina

Mordkovich, A.G., and Semenov, P.V. (2014b). Mathematics: precalculus algebra, geometry. Precalculus algebra. 10th grade basic and advanced levels in 2 parts (a textbook + problem book). Moscow: Mnemozina

Mordkovich, A.G.,and Smirnova, I.M.(2013a). Mathematics: precalculus algebra, geometry. 10th grade.A textbook (basic level). Moscow: Mnemozina

Mordkovich, A.G.,and Smirnova, I.M.(2013b). Mathematics: precalculus algebra, geometry. 11th grade.A textbook (basic level). Moscow: Mnemozina

MuravinG.K., and Muravina O.V.(2013a). Mathematics: precalculus algebra, geometry. 10th grade (basic level), a textbook Moscow: Drofa

MuravinG.K., and Muravina O.V. (2013b). Mathematics: precalculus algebra, geometry. 11th grade (basic level), a textbook. Moscow: Drofa

Nikolsky, S.M., Potapov, M.K., Reshetnikov, N.N., Shevkin A.V. (2016). Mathematics: precalculus algebra, geometry. Precalculus algebra. 10th grade A textbook for general educational organizations: (basic and advanced levels), 3rd ed. Moscow: Prosveschenie.

Petunin, O.V. (2016). On the possibilities of student-centered learning technologies for enhancing the cognitive independence of students.In Modern educational values and updating of content.Collection of scientific papers on the Proceedings of the II International Scientific and Practical Conference, pp. 132-137.

PomazkovV.V., and Vorontsova I.A. (2018). Methodical designer of a modern lesson for activating cognitive activities of students in a lesson in accordance with the specifics of the subject area of knowledge.*Education at Modern School*, 5-6, 19-22.

Pustovoitov, V.N. (2010). Cognitive independence - a key competence and the competence of a personality.*Bulletin of the Pyatigorsk State Linguistic University*, 3, 290-294. https://elibrary.ru/item.asp?id=15575722

Sarantsev, G.I. (1995). Humanitarization of education and current problems of teaching mathematics.*Mathematics at School*, 5, 36-39.

Sedova, E.A., Chernyaev, A.P., Shikhaliev, Kh.Sh. (2012a). Mathematics: precalculus algebra, geometry. Precalculus algebra (basic and advanced levels).10th -11th grades. Moscow: Association XXI century.

Sedova, E.A., Chernyaev, A.P., Shikhaliev, Kh.Sh. (2012b). Mathematics: precalculus algebra, geometry. Geometry (basic and advanced levels). 10th - 11th grade Moscow: Association XXI century.

Sharygin, I.F. (2013). Mathematics: precalculus algebra, geometry. Geometry (basic level).10th - 11th grades. Moscow: Drofa.

Smirnova, I.M. (2013).Mathematics: precalculus algebra. Geometry.10th - 11thgrades.Basic level.A textbook.Moscow: Mnemozina

Smirnova, I.M., and Smirnov, V.A. (2014a). Mathematics: precalculus algebra. Geometry.10th grade. (basic and advanced levels). A textbook Moscow: Mnemozina

Smirnova, I.M., and Smirnov, V.A. (2014b). Mathematics: precalculus algebra. Geometry.11th grade (basic and advanced levels). A textbook Moscow: Mnemozina

Testov, V.A. (2012). Information Society: transition to a new paradigm in education. *Pedagogy*, 4, 3-10. https://elibrary.ru/item.asp?id=17804760

Uspensky, V.A. (2014). Mathematics is a humanities science. TROITSKY VARIANT, 2, 4-6. https://elementy.ru/nauchno-populyarnaya_biblioteka/432214/V_A_Uspenskiy_Matematika_eto_gumanitarnaya_nauka

Vilenkin, N.Ya., Simonov, A.S., Survillo, G.S. (1992). Algebra-10 for classes with in-depth study of humanitarian disciplines: in 2 parts. Novosibirsk: Nauka.

1. Doctor of Sciences (Education), Professor, Teacher Training Institute; M. K. Ammosov North-Eastern Federal University, Yakutsk, Russian Federation.Contact e-mail: Ivaya1@mail.ru

2. Candidate of Sciences (Education);Teacher Training Institute M. K. Ammosov North-Eastern Federal University, Yakutsk, Russian Federation

3. Candidate of Sciences (Education); Associate Professor of Applied Mechanics Department, Faculty of Engineering, Yakutsk State Agricultural Academy, Yakutsk, Russian Federation

4. Candidate of Sciences (Education); Associate Professor of Applied Mechanics Department, Faculty of Engineering, Yakutsk State Agricultural Academy, Yakutsk, Russian Federation

5. Senior Lecturer, Institute of Mathematics and Informatics, M. K. Ammosov North-Eastern Federal University, Yakutsk, Russian Federation

---

Revista ESPACIOS. ISSN 0798 1015
Vol. 40 (Nº 9) Year 2019

[Index]