

INTERNATIONAL RUSSIAN-BULGARIAN MITE PROJECT IN ARKHANGELSK REGION

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Abstract. The article is devoted to the history of the MITE project implementation at the pilot sites of the Arkhangelsk region for the period from 2010 to 2018: the course of experimental testing of the technology of teaching geometry using GeoGebra, the author’s developments of experimental teachers, the experience of using GeoGebra to support the educational and research activities of schoolchildren, private methods developed by teachers and students of the Northern (Arctic) Federal University named after M.V. Lomonosov (NArFU), teacher training programs.

Key Words: *dynamic geometry systems (DGS), GeoGebra, project “Methods and information technologies in education” (MITE).*

The MITE project (Methods and information technologies in education) was launched in 2005 on the initiative of the Academy of social management of the Moscow region (ASOU) and the Institute of mathematics and Informatics of the Bulgarian Academy of Sciences (IMI BAS), which is headed by Sava Grozdev, PhD, from the Bulgarian side, and Tatyana Sergeeva, PhD, from the Russian side.

In 2010, the Lomonosov Pomeranian state University joined the project and signed an agreement with ASOU on cooperation in the field of education and science. The project coordinator was Dr. Maria Shabanova. This work continued within the framework of the quadripartite agreement concluded on 16 October 2012 on cooperation in the field of science and education between NArFU (PSU became a part of it), ASOU, IMI BAS and the Higher school of insurance and Finance (Sofia, Bulgaria).

One of the directions of the project is to develop a technology for teaching geometry using DGS GeoGebra. The MITE project managers developed the theoretical provisions of the new technology and created a diagnostic software for teaching planimetry in grades 7, 8 and 9 – the educational and methodological kit (EMK) “Visual planimetry” for grades 7–9, including electronic disks and workbooks [1–2]. In 2010, the program “Technology of teaching geometry using an interactive geometric environment” (2010–2013) was developed at the Department of methods of teaching mathematics of NArFU. 7 pilot sites were opened in schools in Arkhangelsk and 5 in schools in the Arkhangelsk region. In 2011, there were 11 and 7, 2012 – 12 and 14, and since 2013 – 12 and 16, respectively.

Approbation of The visual planimetry EMK allowed us to obtain data on the effectiveness of the developed technology: improving the quality of geometric training of students; increasing the level of geometric literacy (the ability to achieve an average level of functional literacy); increasing the level of educational motivation associated with the study of geometry by introducing an experimental approach, increasing the visibility of learning, using computer technology in the classroom; reducing the level of educational anxiety of students due to the convergence of the nature of educational knowledge with the samples included in the subject experience of students, providing students with opportunities to solve geometric problems at the experimental level; it was found that the use of DGS contributes to the formation of students’ logical thinking.

The creative team made adjustments to educational materials and adapted their content to the mass school. the teaching materials were supplemented with didactic materials and methodological guidelines [3–4]. The results of methodological research aimed at identifying the capabilities of the GeoGebra program, as well as the development of private methods for their use, are published in the collective monograph [5].

In 2012, 11 articles on the project were published in the collection of scientific papers of participants of the international scientific conference “Informatization of education as a target orientation and strategic resource of education” (grant of the Russian Foundation for basic research (RFBR), project no. 12-07-06005-g). A special feature of the conference was the organization of master classes on building dynamic features in the DGS GeoGebra and attendance of open geometry lessons in one of the pilot sites of the project – the Arkhangelsk sea cadet corps.

Many of the experimental teachers reached the level of pedagogical innovations, which made it possible to develop their own teaching materials: the educational project “Building parquet floors” in the DGS GeoGebra, a system of additional tasks for studying the topic “Regular polygons” (M. Belorukova), an interactive model for proving the sine theorem and its consequences

(T. Tomilina), a workbook for the 9th grade “benefit of the bisector of the inner angle of a triangle” (V. Parsheva), a workbook for students class 6 “Visual planimetry with GeoGebra” (N. Anokhina).

In 2013, the new project “Improving the quality of General mathematics education through the creation and use of electronic content for research mathematics education in accordance with the requirements of the Federal state educational standard” (2013–2018) was a continuation of the completed project and the development of its results.

The main activities of the experimental stage were the development of a didactic model of research training in mathematics in the style of experimental mathematics, testing of various pedagogical scenarios for the implementation of the model in educational and extracurricular activities, and the introduction of new tools and educational materials for computer support of research training in various sections of the school course of mathematics. Based on the model, several pedagogical scenarios of research training in the style of experimental mathematics have been developed, which are assigned to different levels of research training [9].

At the pilot sites, the technology for developing students’ research competence was tested using the GeoGebra IGC [6–7], implemented in the following educational and methodological materials: an electronic workbook for the topics of the stereometry course for grades 10–11: “Axioms of stereometry”, “Parallelism of straight lines and planes”, “Polyhedrons”, created by the Russian-Bulgarian collection of authors under the guidance of T. Sergeeva; interactive model and workbook “Solving equations and inequalities with a parameter by the graph method”, remote module “Method of regions” (M. Belorukova, R. Ovchinnikova); workbook “Touch to hyperbole” (V. Parsheva); materials of the circle “Experimental mathematics” (M. Pavlova); laboratory computer workshop on algebra and the beginnings of mathematical analysis (N. Fomina). The main results of theoretical and experimental research are published in the collective monograph [10].

On November 16–20, 2014, the international scientific conference “Theoretical and applied aspects of mathematics, computer science and education” was held at NArFU. The conference was organized with the support of the RFBR (project 14-01-20417-g), and one of the co-founders was the Institute of mathematics and Informatics of the Bulgarian Academy of Sciences. The collection includes 10 articles on the project.

Within the framework of the conference, on November 19, the birthday of the great Russian scientist Mikhail Lomonosov, a solemn ceremony was held to award the diploma of Honorary doctor of the M. Lomonosov NArFU, PhD., Professor of IMI BAS S. Grozdev (<https://narfu.ru/life/news/university/179298/>). During the open lecture, the Professor told the audience about Bulgaria and

various notable facts from the history and science of this country, and touched upon the topic of organizing work with gifted children in the field of mathematics. Sava Grozdev was congratulated on the award of the honorary degree not only by representatives of NArFU, but also by participants of the international mite project, students of Severodvinsk and Arkhangelsk schools. In the book of honorary guests of NArFU Sava Grozdev, Georgy Ivanchev and Veselin Nenkov wrote: “May there always be sunshine, and may Russian-Bulgarian friendship always flourish!”



Figure 1. The ceremony of awarding the diploma of Honorary doctor NArFU named after M. Lomonosov Sava Grozdev

Within the framework of the project, several competitions were organized for students of secondary schools in the Arkhangelsk region, distributed by time.

November. Bulgarian math tournament for students in grades 6–11 “Perpericon” has been held since 2015. In the first years of the contest organization, one of the authors of the contest tasks – Rosen Nikolayev, PhD, head of the Department of statistics and applied mathematics at the University of Economics in Varna.

December-January. Regional (correspondence) round of the international competition of research projects of students “Mathematics and design” among students of grades 7–11 is a kind of “start-up” to participate in the full-time international round of the competition, held in Moscow in early May. It has been held since 2011. Almost all students who have passed through the correspondence stage become winners and prize-winners of the main competition. Sava Grozdev, a member of the jury of the competition in the category “Geometric miniatures”, highly appreciated the work of students of the honored teacher of the Russian Federation V. Parsheva, presented them with his books on second-order curves

and invited them to cooperate. The scientist suggested that these students are very promising and they will be successful in the future with a serious attitude to work.



Figure 2. Sava Grozdev with the winners of the VIII international competition “Mathematics and design” Ilya Pyatin, Andrey Lakh, Kostya Maksimovsky and their supervisor – Valentina Parsheva

February-March. Experimental math tournament for students in grades 7-9 is held not only on the basis of educational organizations of the city of Arkhangelsk and the Arkhangelsk region, but also on the base sites of schools in Moscow, Krasnoyarsk, Novosibirsk, the Republic of Sakha and the Republic of Kazakhstan. The developers of the tasks are M. Pavlova, R. Nikolaev, A. Shibnev, A. Yastrebov. It has been held since 2015.

April. Competition of students 'research papers in the framework of the VIII regional scientific and practical conference" research activities of students in the field of mathematics, applied mathematics and computer science" is the final event for school children. Every year between 30 and 50 students from Pomerania schools present their works. Many works since 2015 are made in the style of experimental mathematics. Reresults of the conference issued a collection of materials “Scientific-research activity of students in mathematics, applied mathematics and computer science”, executive editor – S. Kotova.

The exchange of experience between experimental teachers was held every year as part of the Festival of methodological developments. Every year, the Arkhangelsk region team, consisting of the winners and prize-winners of the festival, went to Moscow to participate in the final full-time round of the competition “Mathematics and design”. Experimental teachers M. Belorukova, V. Parsheva and M. Pavlova have repeatedly become winners and prize-winners.

For the purpose of professional development, one-year courses and a scientific and methodological seminar on the MITE project were organized. Over the years of the project, more than 250 people have completed professional

development. Teachers of the Department regularly held field sessions of the seminar for experimental teachers in remote areas of the region, gave master classes and lectures in other cities (Vologda, Vidnoye, Yaroslavl) and countries (Kazakhstan, Bulgaria). Also, a remote module “GeoGebra educational opportunities and their use in teaching geometry to primary school students” was developed for teachers of the region and new experimenters who joined the project.

Professional development courses were also organized on the Bulgarian side: from 2011 to 2016, 11 teachers at the IMI BAN courses improved their qualifications. Among the teachers of the courses from the Russian side were T. F. Sergeeva, M. V. Shabanova, A. Lukankin and others, from the Bulgarian side – S. Grozdev, B. Banchev, R. Nikolaev, T. Chehlarova and others.

Courses in Bulgaria were filled not only the fruitful learning and scientific communication, but also the friendliness of the Bulgarian people, warm Black sea, the flavours of Bulgarian cuisine, an extensive cultural program with visits to historical and memorable places of Bulgaria: ancient Nesebar, Aladzha rock monastery, a natural phenomenon – Stone forest, the legendary Cape Kaliakra with a monument to F. Ushakov, the Botanical garden and the Romanian Queen Palace in Balchik, the ancient capital of Bulgaria – Veliko Tarnovo.

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