

МАТЕМАТИКА И МАТЕМАТИЧЕСКО ОБРАЗОВАНИЕ, 2021
MATHEMATICS AND EDUCATION IN MATHEMATICS, 2021
*Proceedings of the Fiftieth Spring Conference
of the Union of Bulgarian Mathematicians
2021*

IMI–BAS AS A CATALYST FOR THE SCIENTIX SUPPORT
TO THE BULGARIAN STEM TEACHERS*

Toni Chehlarova, Krassimira Ivanova, Petar Kenderov,
Evgenia Sendova

The role of IMI–BAS as a National Contact Point (NCP) of Scientix 4 is considered based on its performance in the previous phases of Scientix. Inquiry Based Mathematics and Science Education (IBMSE) activities envisioned to be carried out in both online and offline settings are discussed.

1. Introduction. In the last decade the European Community of STEM teachers, researchers in education, policymakers and other STEM education professionals has been substantially supported in terms of collaboration and resources by the Scientix Project (<http://www.scientix.eu/>). Scientix has proven that its activities *contribute to the growing of a network that supports the exchange of the ideas, practices and experiences essential for the teaching of STEM to be fresh, relevant and engaging* [1].

The project has been launched as an initiative of the European Commission’s Directorate-General for Research and Innovation and run by European Schoolnet (EUN), also under the EU’s 7th Framework Programme for Research and Technological Development [2]. Dr. Agueda Gras-Velazquez, astrophysicist, is the Scientix Project Manager.

In its **first phase (2010–2012)**, the project built an online portal to collect and present European STEM education projects and their results and organized several teacher workshops.

The **second phase (2013–2015)** expanded to the national level. Through the network of the National Contact Points (NCPs), Scientix reached out to national teacher communities and contributed to the development of national strategies for wider uptake of inquiry-based and other innovative approaches to science and math education.

This activity was continued in the **third phase (2016–2019)** of Scientix, expanding the networking to include more Scientix ambassadors and training programs.

The **fourth phase (2020–2022)** of Scientix continues and expands the fruitful works of previous project’s phases, aimed to promote inquiry-based science education (IBSE).

The Institute of Mathematics and Informatics at the Bulgarian Academy of Sciences (IMI-BAS) was selected as a National contact point for Bulgaria for the last three phases (the coordinator on behalf of the Institute for the second and third phase being Evgenia Sendova, and for the current, fourth phase – Toni Chehlarova).

*This work is supported by the Scientix 4 project, Grant agreement ID: 101000063, Funded under H2020-EU.5.a.

Key words: STEM, teacher network, professional development, IBMSE.

The Scientix 4 phase continues to deal with collecting and displaying information about the STEM projects and their results through the internet portal established within the frame of Scientix 2. Furthermore, it aims to increase the professional development activities, to enhance community building and to establish European partnerships and School networks.

2. What makes IMI-BAS a reliable National Contact Point. The Institute of Mathematics and Informatics at the Bulgarian Academy of Sciences (IMI-BAS) is a leading national organization for research and applications in the field of mathematics and informatics. In parallel with the high-performance scientific production and close connections with avant-garde scientific centers and scientists all over the world, IMI-BAS is the only institute of the Bulgarian Academy of Sciences with an Educational Department. The education-related activities of the Institute include the Professional Development (PD) of teachers, mentoring PhD and MSc students, and developing the research competences of high-school students having shown great potential in doing mathematics and informatics [3–5]. These specifics of IMI-BAS and its successful participation in the previous two phases of Scientix [6–9], made it a reliable candidate for a National Contact Point for Bulgaria during Scientix 4.

It should be noted, that the IMI-BAS is the main provider of scientific, methodological and technical support in inquiry-based mathematics, computer science and IT education at all levels and forms, in Bulgaria. This support is carried out by designing strategies and a system for implementing IBMSE in a national context, by organising various types of PD courses [10–12] and by developing open access learning environments [13] that enhance IBMSE with a focus on the acquirement of key competences [14, 15].

Thanks to the system for PD of teachers in mathematics, IT and informatics, which IMI-BAS has developed, a network of such teachers acting as multipliers of the IBSE ideas has been established which facilitates and encourages teacher and practitioner engagement at a national level. Thanks to the activities of IMI-BAS as the National Contact Point (NCP) for Bulgaria within Scientix 2 and Scientix 3, this network was enhanced and enriched further with a closer collaboration with educators, researchers and teachers in physics and chemistry. The IMI-BAS was helped significantly in its Scientix-related activities by some of the ambassadors, and the collaboration with their respective institutions turned out to be very fruitful in a broader context.

Thanks to its IBMSE activities the IMI-BAS became a member of the *European STEM Professional Development Centre Network* consisting of around 30 institutions from across the Europe. Based on this network the innovative Erasmus+ project *European Network of STEM PD centres* was carried out (2016 – 2019) in which IMI-BAS was a partner [16].

Since 1985 the IMI-BAS has been dedicating significant efforts in the development and dissemination of virtual educational resources. The educational resources in support of IBMSE currently developed and maintained by the IMI-BAS team are of a great variety in terms of: forms (e-resources, handbooks, manipulatives); topics (algebra, geometry, integration between science and art); target audience (K-12 students, teachers, parents). The platforms *VirMathLab*, *VivaCognita* (Fig. 1) and the Bulgarian sites of Mascil (Mathematics and Science for Life) and Scientix (Fig. 2) were designed and developed by the IMI-BAS team, providing an open access to learning environments related

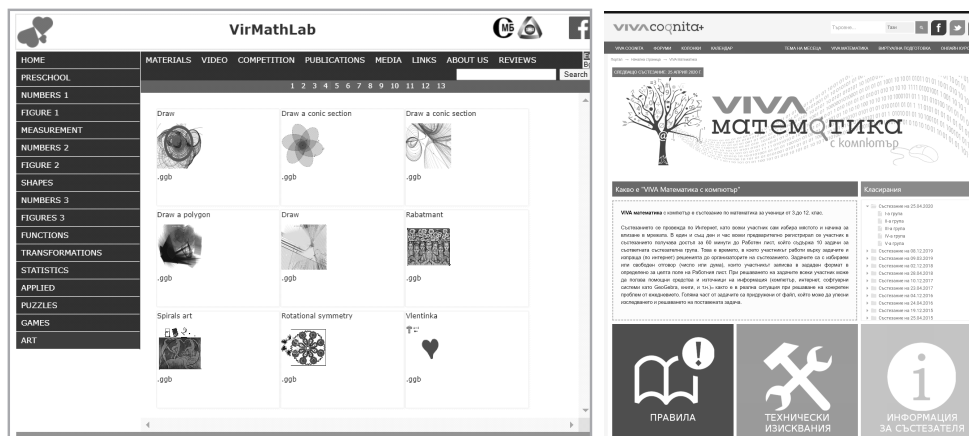


Fig. 1. The Virtual Mathematic Laboratory (VirMathLab - <http://cabinet.bg/>) and Viva Cognita site (<http://vivacognita.org>)

to mathematics and its connection with science, IT and arts [17, 18].

New forms of contests (*Theme of the month, Mathematics with a computer*) have been launched on these platforms, allowing for indirect methods of evaluating the effectiveness of the teachers' professional development through the performance of their students in these contests [19–21].



Fig. 2. The Bulgarian sites of the European projects Mascil (<http://www.math.bas.bg/omi/mascil/>) and Scientix (www.facebook.com/Scientix.Bulgaria)

Another important feature of the educational aspect of IMI-BAS is that it works directly with high school students through its Junior Branch, known as the *High School Student Institute of Mathematics and Informatics* (HSSIMI), established in 2000 (jointly with the *Union of Bulgarian Mathematicians* and two foundations). Its mission is to enhance the research potential in mathematics and informatics among high-school students

throughout the country at all levels of the inquiry-based learning (IBL) with emphasis on the 3d level (*guided inquiry*) and the 4th level (*open inquiry*). Every year more than 100 school students from all over the country are given the chance to work on their own research projects. The project results are then reviewed, presented and evaluated at two conferences, one of which is held as part of the *Annual conference of the Union of Bulgarian Mathematicians*. The best performers are invited to participate in a three-week *Summer Research School* (SRS) where they get useful insights into how the science works and what it has to offer as a profession. A teacher seminar is also held within SRS during which ideas on how to improve teachers' mentoring skills at the highest levels of IBL are presented and discussed.

Since 2016, the Summer Research School of the HSSIMI has an international component, which would also contribute to the exchange of knowledge between different countries at the highest levels of IBMSE [22]. This successful initiative inspired BAS to expand this idea and to create *High School Student Institute at the Bulgarian Academy of Sciences* (June, 2014) which already embraces open inquiry at school age in all the sciences.

3. STEM education in Bulgaria. The application and impact of IBSE in relation to varying learning goals, policy contexts, and timeframes has been discussed in [23] based on selected major European initiatives in STEM Teacher Education, in particular where inquiry-based strategies have been applied.

The specifics of Scientix with respect to the inquiry-based STEM education, to the building, maintaining and extending networks bringing together educators, researchers, teachers, policy makers, and parents for raising the awareness of mathematics and science is of a vital importance to the modernization of the Bulgarian educational system.

A *Law on pre-school and school education* (effective from 01.08.2016) has made some changes in the structure of the school system (e.g., the first stage is 1-7 grade) and in the educational forms as well. The main novelty concerns the standards, which, under the old law, had been developed based on cultural-educational disciplines, whereas the main focus according to the new law is on the key competences. In addition to the eight key competences for LLL as identified by EC [14], a 9th one has been added – *skills to support sustainable development and healthy lifestyle, and sports*. Thus, what seems to be an effect of the efforts of the Ministry of Education and Science to reflect the main ideas of recent European projects in the New Law on Education is the integration of the key competences, the inquiry-based learning and the vocational education.

Bulgaria is a country in which STEM education is considered a priority and is addressed through various strategies. In each of these strategies different aspects of STEM education have been considered in terms of how they might contribute to solving some general problems facing the Bulgarian education system, and more specifically – how to recruit more STEM teachers at all levels. The main problem with promoting STEM careers is the limited number of higher education candidates who choose to study these fields at university. In 2019 the Ministry of Education and Science has started a National program *Innovative Schools* in harmony with the Law of Pre-school and School Education. The Innovative schools are a model of the modern school in which students will improve educational outcomes and increase critical thinking and creativity through innovative educational processes, teaching methods, school leadership and curricula. For

2020 more than 500 schools in Bulgaria have been adopted as innovative under this program.

It is with certain professional pride we could claim that IMI-BAS has contributed to a great extent to the implementation of these ideas with its achievements in the context of a number of recent European educational projects including InnoMathEd, Fibonacci, Meetings in Mathematics, Math2Earth, DynaMat, KeyCoMath, MaSciL, STEM PD Net, ENSITE, Scientix 2, Scientix 3.

IMI-BAS activities. As a research center of mathematics and informatics the IMI-BAS has the potential of conveying any level of complexity of ideas in these fields to teachers and students and direct them to implement those in inquiry-based learning style. Thus, several types of PD courses of webinars are planned within the frame of Scientix 4. Professional development courses for teachers with a focus on IBL are envisaged to be organised jointly by the IMI-BAS and the Ministry of Education and Science as a continuation of a 3-year successful experience reflecting the harmony between the educational strategies promoted by IMI-BAS and the National PD programs concerning the STEM education.

Distant learning courses on IBL and Webinars with a focus on IBL with teachers from the whole country to provide a link between activities at a European and a national level are envisaged to be organized jointly with IMI-BAS and the Laboratory of Telematics at the Bulgarian Academy of Sciences withing Scientix 4. They will reflect the knowledge and experience gained in the context of distance learning [24], including the challenges of the most recent times [25].

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Toni Chehlarova
e-mail: toni.chehlarova@gmail.com
Krassimira Ivanova
e-mail: kivanova@math.bas.bg
Petar Kenderov
e-mail: kenderovp@cc.bas.bg, vorednek@gmail.com
Evgenia Sendova
e-mail: jenny.sendova@gmail.com
Institute of Mathematics and Informatics
Bulgarian Academy of Sciences
Acad. G. Bonchev Str., Block 8
1113 Sofia, Bulgaria

ИМИ–БАН КАТО КАТАЛИЗАТОР НА ПОДКРЕПАТА НА SCIENTIX ЗА БЪЛГАРСКИТЕ STEM УЧИТЕЛИ

**Тони Чехларова, Красимира Иванова, Петър Кендеров,
Евгения Сендова**

Ролята на ИМИ–БАН като национална контактна точка на Scientix 4 се разглежда въз основа на опита на Института в предишните две фази на Scientix. Представят се планираните образователни дейности в изследователски стил, подходящи за дистанционен и присъствен формат.

Ключови думи: STEM, учителска общност, професионално развитие, изследователски подход в образованието, ключови компетентности