NEW FORMATS OF MATHEMATICAL EDUCATION

Tatiana Sergeeva[1,*], Nina Pronina[2]

[1] *Moscow city university, 4 Vtoroy Selskohoziajstvenny proezd, Moscow, Russia*

[2] *High school “Vidnovskaya gimnaziya”, Zhukovsky pr. 12, Vidnoe, Moscow region, Russia*

[1,*] *Corresponding author: cirr1@mail.ru*

[2] *ninavid@mail.ru*

Abstract. The article considers the trends that most strongly influence the advance of mathematics teaching: performance improvement, constructivist method, e-learning, performance support, informal learning, game learning. It has been shown how mathematics teaching changes under the influence of these trends. Possible risks to be aware of, such as erosion of the fundamental nature, drop in the level of proof of mathematical assertions and degradation of mathematical culture, have been pointed out.

Key Words: *mathematical education, performance improvement, constructivist method, e-learning, performance support, informal learning, game learning.*

The many investigations on education have isolated several key trends that significantly impact development of mathematical education.

First off, this is a desire to improve the education quality and results of education aimed at creating a specific product based on the knowledge obtained.

This trend makes itself felt in teaching math’s for shaping mathematical awareness as a component of a person’s functional competence.

Mathematical awareness is defined as “an individual’s ability **to formulate, apply and construe mathematics in various contexts.** This includes **mathematical deliberations, the use of mathematical notions, procedures, facts and tools** for describing, explaining and predicting occurrences. It helps people to understand the role of mathematics in the world,

express substantiated judgments and take decisions needed by a constructive, active and cogitating citizen"[1].

Inclusion of mathematical literacy into the mathematical education implies the use of special dedicated tasks. These disclose the math's ability in optimizing life functions and help to enrich the trainees' social experience.

Another topical trend came to be defined as "constructivism". The constructive approach implies an individual perception of the surrounding world that reflects uniqueness of each personality with its own perception of the world, persuasions and outlooks.

One of the basic ideas of the constructive approach consists in the fact that it is impossible to transfer knowledge as a finished product; it is only possible to create pedagogical conditions for successful self-education. The process of education is designed as «a trainees' learning and research activity aimed to address a problem» [2]. In this case, a set of channels through which trainees receive information is essentially increased which stems from the fact that a teacher is not the sole source of knowledge. The teacher's functions in the constructive approach also have their specifics, i.e., he is not just an instructor, but also an adviser, organizer and coordinator of the trainees' problem-specific research and learning activity.

The training based on the constructivist approach results in obtaining one's own knowledge, which is accrued in the course of the trainee's cogitating activity on the basis of a previously acquired experience.

The learning process in mathematics based on the constructivist technique is characterized by training via asking questions and using the Socrates method, assignments for explanation, team work, creation of intellectual and cluster cards, support synopsis and other procedures.

Today, one of the most significant manifestations of the constructivist approaches to mathematics teaching is organization of learning by using geometric interactive media (GIM). This is "educational software for teaching that makes it possible to create dynamic images of mathematical objects and use them for studying their properties" [3].

Technical and methodological capabilities of GIM allow teaching math based on the research method. This is manifest in creation of conditions for the trainees to independently advance hypotheses they evolve in experiments with geometrical objects created in the geometric interactive medium.

The teaching process with the use of a geometric interactive medium can be organized as a step-by-step mastering of mathematical procedures in the course of the trainees' independent targeted work towards solution of educational and research problems associated with visualization, transformation and study of mathematical models of geometrical objects.

The third trend is knowledge management. In the course of training a system must be built for gathering, storing, and exchanging information and expertise. In teaching mathematics this is particularly well observed in organizing collective research and development efforts. This can be exemplified by network research projects enabling integration of the trainees, trainers, and researchers. The core problem of the network project can be considered with regard to all target groups' interests. While associating with scientists in the framework of research network projects the trainees obtain a significant experience in transforming the research conduct into a research work characterized by awareness and structural division. Therefore it is essential to maintain not only remote contacts between the trainees and their tutors who now supply digital technologies, but also arrange face-to-face meetings, maximally informal, so that the trainees would feel free in discussing the problems and solutions to them. During such face-to-face meetings, the project participants do not only progress in specific areas, but also adopt a value system-based attitude to research. Also, this helps to develop an algorithm for its implementation taking into account one's own preferences and strategies and to reflect these activities.

Another branch that efficiently develops in organizing network projects is scientific communication which becomes increasingly important for involving trainees in research and development efforts.

The interaction of researchers and school pupils cooperating on projects and research work helps the future researchers to easily obtain experience and expertly relate about their inventions.

Acquisition by pupils of skills in research communication implies informing them about scientific and popular science platforms on whose basis they can regularly present their developments, acquire communication skills, draw up presentations and write articles about how to popularly explain sophisticated research terms and search for unconventional approaches for relating about science. Acquisition of research communication skills will enable trainees to master the functions of a scientific communicator as a mediator, «a popularizer» and «a translator» of science in terms of the subject under consideration and to effectively present its results. To do this, special measures and events must be envisioned through which the network project participants will be able to show the said skills. And, of course, a public defense of the project must be organized involving the maximum number of experts. For defense, it is necessary to develop the procedure itself, including criteria whose combination must ensure a demonstration of a maximally available variety of skills for conducting research and presenting its results.

The fourth trend seeks to create a system to support the education quality that ensures for its participants different levels of access to information when required.

The next trend, that becomes increasingly popular, is the e-learning involving integration of online education tools in the learning process. At issue is not a replacement of a tutor by a computer but a reasonable use of new technologies.

Implementation of the two said trends is well illustrated by the Moscow Electronics School [4]. This is a cloud platform that provides education resources, tools to create and edit them plus a designing system for the basic education system. Since September 1, 2017, this project is available to all educational institutions of Moscow.

The Moscow Electronics School makes it possible to automate most of the organizational, methodological and educational problems faced by educational institutions. This eases accessibility to education and offers a possibility of using various approaches and pedagogical methods, including mixed, remote and electronic teaching.

Facilities of the Moscow Electronics School envision a possibility of building remote teaching platforms for distance learning and education management and monitoring based on digital tools. Special digital technologies enable Moscow's tutors to draw up lesson plans, create «popular» textbooks, teach-yourself manuals and test programs the pupils use at lessons, in doing a design work at school and in the course of self-sustained learning. The most interesting materials that undergo an expert study become available to the entire teaching community of Moscow.

By using an electronic scenario of a lesson a teacher can effectively conduct training sessions while the students can access the lessons created by the best teachers of the city. Electronic versions of textbooks enable the teacher to better supply his students with higher quality content at the lesson and diversify the assignments. The testing system in the Library enables the teacher to carry out tests or surveys and allows the students to check on their capabilities and prepare for a test or an examination.

The sixth trend can be defined as «informal learning». Informal learning is essentially unofficial, unscheduled, at times spontaneous methods of obtaining knowledge and skills. This trend is closely associated with yet another one, introduction to the teaching of educational games.

Teaching games, for instance, «how to start one's own business», that can be used in an informal environment, make it possible to organically integrate a mathematical knowledge, an actual situation and a role behavior.

This not only improves the quality of mathematics teaching but also enriches the trainees' social experience and demonstrates the mathematics' ability to enhance the quality of life and optimize professional activities.

We have considered several essential, in our opinion, trends in updating mathematics teaching characteristic of all levels and stages. Also, attention should be given to possible risks that must be taken into account in such updating, i.e., erosion of the fundamental nature and an excessive emphasis on practical aspects to the detriment of substantiated proofs of mathematical assertions and mastering of the deductive method of learning, followed by degradation of mathematical culture.

References

[1] PISA 2012, Assessment and Analytical Framework: Mathematics, Reading, Science, Problem Solving and Financial Literacy, OECD Publishing, 2013.

[2] Choshanov, M., The Process of Continuous Design and Reorganization, j. *School Master*, 2000, – 84 s., p. 3.

[3] Sergeyeva, T., M. Shabanova, S. Grozdev, *Fundamentals of Dynamic Geometry*, M.: ASOU, 2016.

[4] https://mes.mosedu.ru/?post_type=mes_about