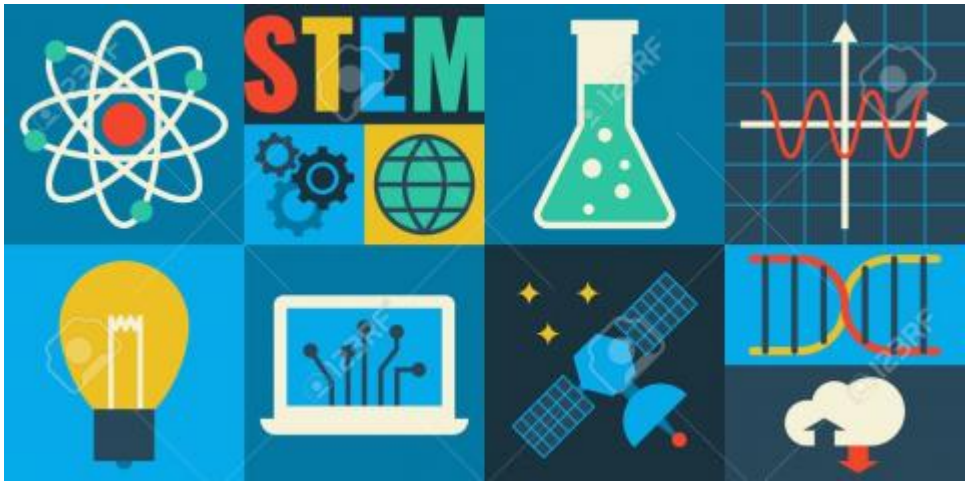


[1]

*"Білімді ел - Образованная страна" №20 (57), 25.10.2016* [2]

Currently, the world witnesses the 4th technological revolution: rapid flow of information, high-tech innovations and inventions are transforming all aspects of our lives. Society needs, the interests of an individual are changing.

For example, if back in the day during arts and crafts class girls made aprons, and boys worked with wood or metal, now it is simply not enough. Robotics, designing, programming, modeling, 3D-designing, etc. - this is what modern schoolchildren around the world are interested in nowadays.

For the materialization of these interests more sophisticated skills and competencies are required. It is important not only to know and understand, but also to explore and invent. It is necessary to progress simultaneously in such key academic areas as science, math, technology and engineering, which can be combined in one word - STEM (science, technology, engineering and mathematics).

STEM is an integrated learning approach, within which the academic scientific and technical concepts are studied in real life context. The aim of such an approach is the creation of sustainable links between the school, community, work and the whole world, contributing to the development of STEM-literacy and competitiveness in the global economy *(Tsupros, 2009).*

The acronym "STEM" was first proposed by the American bacteriologist R. Colwell in the 1990s, but began to be used actively starting the 2000s. Based on STEM, new versions of this concept appeared, the most common of which are STEAM (science, technology, engineering, arts and mathematics) and STREM (science, technology, robotics, engineering

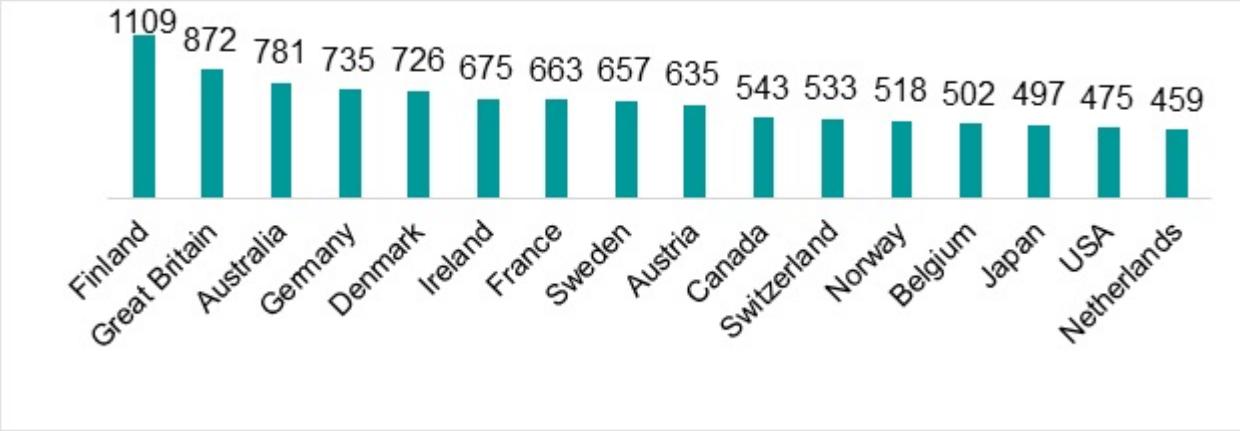
and mathematics).

Currently, STEM is one of the main trends in global education. Thanks to the rapid development of technologies, new professions appear, the demand for STEM professionals grows universally.

For example, in EU countries, the share of employed professionals in this area has increased by 12% from 2000 to 2013. Also, in European countries it is predicted that the demand for STEM professionals will grow by 8% by 2025, whereas the demand for other professions will grow only by 3%[1].

In 2011, among 16 OECD countries under consideration, Finland had the highest number of graduates of STEM-professions: 1,109 per 100,000 citizens aged 20-39 years. This figure is twice higher than in Canada and Switzerland.

**The graduates of STEM-professions in the world, 2011 (the number of graduates per 100,000 citizens aged 20-39 years)**




*Source: Sources: Statistics Canada; OECD; The Conference Board of Canada. http://www.conferenceboard.ca/hcp/provincial/education/sciencegrads.aspx [3]*

In Finland, STEM development institutional framework was created 13 years ago. In particular, the National Science Education Centre LUMA coordinates the interaction between schools, universities, industry and business.

This center develops activities for students, such as science and technology camps, as well as organizes on the job training courses and workshops for teachers. In addition, LUMA serves as a resource center, providing a variety of educational materials in the field of STEM[2].

In the US, the graduates of STEM-professions accounted for only 475 per 100,000 citizens aged 20-39 years. The limited talent pool is supported by the fact that, as of 2012-2013 in this country, there were only 23.9% of graduates with undergraduate and/or graduate education in STEM.

Nevertheless, the status of STEM-education in the United States becomes more significant. In particular, the average income of STEM workers amounts to about 34.44 US dollars per hour, which is almost twice as much as in other sectors (about 18.68 US dollars per hour).

The unemployment rate in STEM professions is 3.1%, which is 4.3% lower than in other professions.

In addition, the increase of the proportion of workers in this field is expected to be 16% in 2014-2024 (19% - computer science, 12% - engineering, 16% - new production technologies), whereas in other industries - only 11%. According to the experts, by 2020 the demand for STEM professionals will add more than 1 million new jobs in the United States[3].

The relevance of STEM-education in the United States is highlighted by the 5-Year Federal STEM Education Strategic Plan adopted in 2013. Plan's framework calls for preparation of 100,000 new STEM teachers by 2020 and provide effective support to the current contingent of teachers.

Another goal is to increase the proportion of students involved in STEM each academic year of high school up to 50%. It is also planned to increase the number of graduates of colleges and universities in STEM-majors by 1 million people[4].

Other countries also adopted state programs for the development of mathematical and scientific technical education. For example, Malaysia Education Blueprint 2013-2025 provides for STEM-education reform.

Stage 1 of this reform (2013-2015) - improving the quality of STEM-education through the improvement of curriculum, teacher training, use of integrated learning methods;

Stage 2 (2016-2020) - increasing public awareness and interest in STEM through media campaigns and partnership connections;

Stage 3 (2021-2025) - evaluation of the success of the initiatives of the first two stages and the development of future road map with the new initiatives and programs[5].

In 2015, Australia adopted national strategy for STEM-education development in schools in 2016-2026 (National STEM School Education Strategy). The Strategy defines 5 key objectives: 1) increase the abilities, involvement and interest of students in STEM; 2) increase the capacity of teachers and quality of teaching of STEM subjects; 3) support opportunities for STEM-education in schools; 4) promote effective partnerships with universities, business and industry; 5) establish a sound database[6].

More than 10 European countries have similar national strategies and initiatives (Austria, Germany, France, Italy, Netherlands, Norway, Great Britain, Italy, Ireland, Spain, etc.).

With regards to international cooperation in the field of STEM-education development, one of the largest international projects is "InGenious" which lasted from 2011 to 2014. Austria, Belgium, Czech Republic, Denmark, Estonia, Finland, Germany and others participated in it.

This project aims to create a repository of innovative practices in industrial and educational area, distribute and promote advanced and innovative practices. More than 1,500 teachers were attracted for participation, cooperation was established between 158 schools and industry representatives, various seminars, summer schools, online conferences, etc. were organized.[7]

In 2013, a three-year project "MASCIL" was launched, in which 11 countries took part: Austria, Bulgaria, Cyprus, Czech Republic, Greece, Lithuania, Netherlands, Norway, Spain, Turkey and Great Britain. The project entails the development and organization of training courses for teachers with the support of the industrial sector. The course content includes a variety of educational materials and resources for work and professional development of teachers[8].

"INSTEM" project (2012-2015) is aimed at promoting research training with the purpose of gathering innovative teaching methods and improving the interest of students in science, as well as providing comprehensive information on careers in the field of STEM. Austria, Germany, Greece, Ireland, Italy, Norway, Romania, Turkey and Great Britain took part in INSTEM. The project also serves as a comprehensive source of training materials and teaching methods for STEM subjects[9].

"Mind the Gap!" is a project aimed at improving the teaching of science in secondary schools of Europe by reducing the gap between theory and practice in scientific education based on research. In particular, the project activities are focused on engaging female students in STEM-education. This project, being implemented since 2008, is a consortium of five partners from the UK, Spain and the Netherlands[10].

Educational robotics became a new trend in the world STEM system which allows developing the skills of programming and designing, being an integrator of all four STEM components. For example, a three-year project "ER4STEM" was launched in 2015 (Austria, Bulgaria, Greece, Malta and the United Kingdom), which is aimed at creative and critical use of educational robotics to maintain the interest of students to the scientific technical sector.

The aim of "ER4STEM" is to develop an open and conceptual framework allowing children to explore various areas of educational robotics and STEAM, as well as to solve practical problems of increased complexity. The project framework envisages conducting workshops on educational robotics in five countries for more than 4,000 children. European Conference on Educational Robotics will be held once a year (2016 - Austria, 2017 - Bulgaria, 2018 - Malta). The outcome of the project will be the development of large-scale ER4STEM repository for teachers[11].

Kazakhstan has also started active development of STEM education. The proof for this is the marked transition to the updated content of school education within the context of STEM within the framework of the State program for education and science development for 2016-2019. The implementation of the new educational policy entails the inclusion of STEM-elements in the curriculum, designed to develop new technologies, scientific innovation, mathematical modeling.

A new interdisciplinary and project-based approach to learning will be introduced which will allow students to strengthen the research and scientific and technological potential, to develop skills of critical, innovative and creative thinking, problem solving, communication and teamwork. The number of "cross-cutting themes" between science subjects will be increased.

Starting 2015-2016, every first-grade student studies "Natural science" subject, which is the basis for the study of natural sciences in higher grades.

In addition, starting from 2016-2017 academic year, it is planned to begin equipping all schools with information and communication technologies, digital educational resources, providing access to Internet.

Also since 2019, the science subjects in senior classes will be studied in English, which will facilitate the acquiring of new knowledge in the original language and the entry into the international scientific community.

Particular attention is paid to the development of educational robotics in the country. For example, annual Republican Olympiad on Robotics has been held in Nazarbayev Intellectual Schools since 2014.  Since 2015, Karaganda has been hosting the annual International Festival of Robotics "RoboLand", which is also attended by the representatives of other countries (Serbia, Russia, others)[12].

In 2016, educational robotics laboratories began to open for the first time, the first of which appeared in high school No 159 in Almaty. There are plans to open another 90 laboratories in other schools in the country in the nearest future. Teaching staff is also being trained: at this stage 64 trainers were prepared at the elective course "Robotics"[13].

There is a positive experience of international cooperation in the field of STEM-education. For example, a five-year Partnership program of the United Kingdom and Kazakhstan "Newton - Al-Farabi" has been implemented since 2014 with a total budget of 20 million pounds. The goal of the Program is the interaction of two countries to strengthen research and innovation potential, staff exchange and creation of joint research centers[14].

Thus, our country is moving in the same direction with the developed countries. STEM-education is the bridge between education and career. Its concept prepares children for the technologically developed world. The professionals of the future need comprehensive training and knowledge of different educational areas of natural sciences, engineering, technology and mathematics.

*Nogaibayeva G. [4], Zhumazhanova S. [5]*

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[11] http://er4stem.com [16]

[12] http://edu.gov.kz/ru/pavlodarcy-zanyali-2-mesto-na-mezhdunarodnom-festiv... [17]

[13] http://robotics.nis.edu.kz/?p=5922 [18]

[14] http://www.roboland.kz/2-3-aprelya-2016-goda-sostoyalsya-mezhdunarodnyj-... [19]



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**Links**
[1] http://iac.kz/sites/default/files/styles/img_800/public/47336400-istock-photo.jpg?itok=iTZFgFGB
[2] http://iac.kz/sites/default/files/no20.pdf
[3] http://www.conferenceboard.ca/hcp/provincial/education/sciencegrads.aspx
[4] http://iac.kz/ru/expert/gulbarshin-nogaybaeva
[5] http://iac.kz/ru/expert/saniya-zhumazhanova
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