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## CURRENT TRENDS IN STEM EDUCATION DEVELOPMENT IN UKRAINE

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*The article reveals current trends in STEM education development in Ukraine, which have been determined on the basis of the analysis of scientific research and regulatory documents on STEM education development in Ukraine as well as practices of providing STEM education services in the domestic general secondary and out-of-school education institutions. These trends include improving normative-legal regulation of STEM education development in Ukraine; transferring STEM education to the primary and secondary schools; diversifying STEM services provision in the out-of-school education institutions; popularizing STEM education and STEM professions among pupils, students, their parents, teachers and other stakeholders; developing program-methodological support of STEM education.*

*Key words: STEM education, STEM education services, STEM education development, general secondary education, out-of-school education, Ukraine.*

**Introduction.** In modern conditions of reforming Ukrainian education system, the issue of implementing STEM components at all levels of its functioning has become especially relevant. It is undisputable that rapid development of high-tech industry necessitates preparation of the new

generation of specialists. Today in Ukraine, as well as all over the world, there is a growing demand for highly qualified IT specialists, programmers, engineers, bio- and nanotechnology specialists who serve high-tech industries at the intersection with the natural sciences and creative industries. At the same time, obtaining modern professions requires comprehensive training in various educational fields of sciences, mathematics, engineering and technology.

**Analysis of relevant research.** The problem of implementing STEM component in Ukrainian education system at different levels of its functioning has become the subject of scientific interest of domestic and foreign scientists V. Andrievska, S. Babiichuk, M. Boichenko, J. Brown, J. Christenson, E. Chute, I. DeCoito, S. Dembitska, L. English, K. Guyotte, O. Honcharova, A. Kim, O. Korshunova, O. Kuzmenko, Y. Li, N. Morze, O. Patrykeieva, N. Polikhun, A. Sbruieva, V. Seyranian, G. Sinatra, I. Slipukhina, N. Sochaka, M. Rau, J. Waltter, S. Wu and others.

**The purpose of the article** is to determine the current trends in STEM education development in Ukraine.

**Results.** The urgent need for introducing STEM education in our country became relevant after significant events: publication of the Report of the European Parliament “Encouraging STEM studies for the labor market” (March, 2015); proclamation of the Incheon Declaration “Education 2030: Towards inclusive and equitable quality education and lifelong learning for all” (May, 2015); adoption of the Resolution “Transforming our world: the 2030 agenda for sustainable development”, etc. (September, 2015).

As a consequence of these events, on February 29, 2016, the Order #188 of the MES of Ukraine “On the establishment of a working group on the implementation of STEM education in Ukraine” to ensure innovative development and integration of science and mathematics, strengthening the

research component in the education institutions of different levels, introduction and development of STEM-education in Ukraine was published at the official website.

On May 5, 2016, the Ministry of Education and Science of Ukraine approved the relevant action plan for 2016-2018, which contained four sections reflecting the priority areas of STEM education in Ukraine, in particular:

- regulatory and legal support (development of the draft Concept of STEM education in Ukraine; improvement of regulatory and legal documents; signing of memoranda and agreements; development of regulations “On the All-Ukrainian scientific-methodological virtual STEM center” and “Standard regulations on the STEM center”, development of integrated curricula of special courses, electives, clubs, etc.);
- scientific-methodological and organizational work (creation of the All-Ukrainian scientific-methodological virtual STEM center; creation of a national network of STEM centers/STEM laboratories; establishment of cooperation with stakeholders; development of methodological support of STEM education in different types of education institutions at different levels; conducting scientific events (conferences, seminars, symposia, webinars, competitions) at the national and regional levels, etc.);
- work with pedagogical staff (supplementing the curriculum of advanced training courses for students of postgraduate pedagogical education institutions by the module “STEM-education: methodological aspects of implementation”; initiating a permanent seminar to exchange experiences in the field of STEM education between teachers; conducting online competitions for STEM teachers and so on);

- informational-educational and publishing activities (conducting educational events and advertising campaigns, developing websites of leading providers and regulators of STEM education and their information content; preparation and publication of information-analytical and methodological materials in the media, etc.) [1].

Pursuant to the Order of the MES of Ukraine #708 “On conducting research and experimental work at the national level on the topic: “Scientific and methodological foundations of creation and operation of the All-Ukrainian scientific and methodological virtual STEM center (AUSMV STEM center)” for 2017-2021 on June 8, 2017 the Minor Academy of Sciences (MAS) of Ukraine together with the Institute of Gifted Child of the National Academy of Pedagogical Sciences of Ukraine created and presented a virtual STEM center, which was designed to become the newest resource for STEM-education in Ukraine, having united pedagogical workers of the relevant field in the process of interactive communication, accumulation of progressive experience and scientific information and exchange of existing resources. An important purpose of the newly created STEM center was to involve children and students, as well as their teachers in research activities [2].

It should be noted that the newly created All-Ukrainian STEM center is currently at the experimental stage of its development, which is designed for five years. The experiment involved 15 education institutions-partners of the Minor Academy of Sciences of Ukraine, which at the time of creation of the research center already had some experience in the field of STEM education.

The outstanding event in the development of STEM education in Ukraine was adoption on August 5, 2020 of the Concept of development of scientific-mathematical education (STEM-education).

As stated in the introductory provisions of the document, a significant impact on the formulation of its conceptual framework was exerted by the program document of the International Bureau of Education of UNESCO “Exploring STEM competencies for the 21st century”, published in February 2019. STEM competencies include a number of skills required to perform various STEM tasks, namely:

- cognitive skills;
- manipulative and technological skills;
- skills of cooperation and communication [4].

The Concept of development of scientific-mathematical education (STEM-education) highlights the purpose and terms of its implementation, outlines possible ways to solve problems in the field of STEM education, predicts its consequences to meet the key interests of stakeholders, possible results, funding, material and human resources that are necessary for its implementation [3].

It should be noted that Ukraine has not yet implemented a large-scale STEM education in general secondary education institutions. In our opinion, this situation has occurred for a number of reasons, the most important of which are:

- undeveloped national legislation on teaching STEM as a separate discipline in secondary schools;
- lack of funding for STEM education programs;
- insufficient qualification of secondary school teachers in order to teach an integrated STEM course.

It should be noted that, as evidenced by the analysis of scientific sources on the organization of STEM education in Ukraine, at the present stage, some enthusiastic teachers are introducing elements of STEM education in general secondary education institutions. Among such elements we can single out, first of all, implementation of STEM educational

projects, teaching the integrated STEM content during individual lessons, and so on.

At the same time, STEM education in Ukraine is actively developing within the extracurricular level. At the same time, the MAS of Ukraine is one of the leaders in the introduction of STEM education in this chain. The main activities of the Minor Academy of Sciences of Ukraine include research and experimental work in the field of engineering and technical sciences, robotics, technology, physics, astronomy, chemistry, biology, mathematics, computer science, etc., which are the components of STEM.

Recently, there have been significant quantitative and qualitative changes in the activities of the MAS of Ukraine. For example, in the early 2000s the number of students was about 50 thousand people, and in the 2019-2020 academic year their number has tripled and in modern conditions is more than 150 thousand people [6].

The structural subdivision of the Minor Academy of Sciences of Ukraine is the Virtual All-Ukrainian STEM center – an interdisciplinary laboratory complex “MANlab”, which gives students the opportunity to work in a real scientific laboratory as real researchers. As noted on the website of the Center (<https://stemua.science/>), STEM laboratory MANLab is a center of real and virtual educational research, aimed at supporting and developing STEM education in Ukraine. The center offers distance and full-time professional methodological and technological assistance in the organization of STEM training of Ukrainian student youth [8].

In addition to the MANlab complex, the Minor Academy of Sciences of Ukraine has established the International Center for Children’s Scientific Creativity MANLAB.CAMP (Pushcha-Vodytsia), which houses an educational observatory, where students participating in MAN summer schools have the opportunity to use the laboratory’s optical telescopes conducting experimental research. To this end, a method for working with

the Celestron and Coronado astronomical computerized telescopes has been developed and implemented, which allows for visual night observations and studies of the Sun.

According to I. Savchenko and Ya. Savchenko, in the development of STEM education in Ukraine such educational projects as the All-Ukrainian scientific profile schools of the Minor Academy of Sciences of Ukraine play a crucial role; All-Ukrainian summer specialized schools of technical and natural sciences (school of physics, chemical and biological school, school of mathematics, school of robotics, school of astronomy), which involve students in grades 9-11 in the in-depth study of STEM specialization by listening to lectures, participation in experiments (including virtual ones), etc.; research expeditions of the Minor Academy of Sciences of Ukraine; permanent field lectures-workshops “Science of the XXI century: promising areas of development” (together with the National Academy of Pedagogical Sciences of Ukraine and leading domestic higher education institutions); Educational research expedition “My axiom of infinity (MAN)” [7].

Very important are such STEM activities as the All-Ukrainian Internet Tournament in Natural Sciences “Open Sciences Demonstration” (involving students in grades 7-11 to increase their interest and motivation for in-depth study of natural and computer sciences); All-Ukrainian interactive competitions “MAS-Junior Researcher” and “MAS Junior Erudite”, which every year attract students of 5-11 grades of general secondary education institutions and pupils of the out-of-school education institutions of the appropriate age in the following nominations: “Historian-Junior”, “Astronomer-Junior”, “Ecologist-Junior”, “Technician-Junior”.

In addition to those outlined above, in order to promote the ideas of STEM education among students, the Minor Academy of Sciences of Ukraine holds the following annual mass events:

- hackathon “Team.Hack” of the Youth Design Bureau “Geek Workspace”;
- hackathon of solar technologies “SunnyDay” of the Youth Design Bureau “Geek Workspace”;
- All-Ukrainian competition-defense of research works of students-members of the Minor Academy of Sciences of Ukraine;
- International student scientific-practical conference “Ukraine through the eyes of young people”;
- All-Ukrainian Olympiad in Robotics;
- All-Ukrainian school-seminar “Modern methods of brain research”;
- All-Ukrainian meeting of the winners of the All-Ukrainian student Olympiads in basic subjects and All-Ukrainian competition-defense of research works of students-members of the Minor Academy of Sciences of Ukraine for scholarships of the President of Ukraine;
- All-Ukrainian festival of innovative projects “Sikorsky Challenge”;
- All-Ukrainian scientific-technical exhibition-competition of youth innovative projects “Future of Ukraine” [2].

As emphasized in the action plan for the development of STEM education for 2016-2018 introduced by the Ministry of Education and Science of Ukraine, one of the priority areas is creation of a national network of STEM centers/STEM laboratories.

In particular, such a laboratory was established in Mariupol on the basis of the scientific and methodological center of the Department of Education of the Mariupol City Council. This laboratory provides scientific and methodological support for the organization of STEM education in education institutions of different levels, acts as a coordinator of activities in the field of STEM, supports teachers in their professional development and so on. The main tasks of the laboratory “STEM education of Mariupol” are:

- implementation of political initiatives of Ukraine aimed at the development of scientific and technical direction, in particular in the light of the provisions of the Concept of the New Ukrainian School;
- increasing interest and awareness of student youth about engineering professions;
- disclosure of students' creative potential;
- formation of students' stable motivation to study the disciplines on which STEM education is based;
- improving teachers' professional competence [5].

Within the laboratory "STEM education of Mariupol" student youth participates in practice-oriented research, creative, experimental project activities; work of experimental laboratories, scientific events (conferences, seminars), trainings, competitions, tournaments, etc. Also, considerable attention is paid to the professional development of teachers in order to improve the quality of STEM education in education institutions of the city.

**Conclusions.** Thus, analysis of scientific research and regulatory documents on STEM education development in Ukraine as well as practices of providing STEM education services in domestic general secondary and out-of-school education institutions allowed determining the current trends in STEM education development in Ukraine, namely: improving normative-legal regulation of STEM education development in Ukraine; transferring STEM education to the primary and secondary schools; diversifying STEM services provision in the out-of-school education institutions; popularizing STEM education and STEM professions among pupils, students, their parents, teachers and other stakeholders; developing program-methodological support of STEM education.

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