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## **STEM Office of the Ukrainian Language of the Institution of General Secondary Education (Ukrainian Experience)**

**Lesia Kharitonenko**

*Graduate Student Department for Adult Education National Pedagogical Drahomanov University, Kyiv, Ukraine, <https://orcid.org/0000-0003-3870-8154>*

**\*Correspondence email:** [lesja.vesna@gmail.com](mailto:lesja.vesna@gmail.com).

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**Abstract:** The implementation of the program for the creation of the STEM cabinet of the Ukrainian language allows to achieve the following mandatory learning outcomes for the following educational fields: for the linguistic and literary field of education: the ability to perceive, analyze, interpret, critically evaluate information in texts of various types, in particular informational and artistic texts, media texts, and use information to enrich one's own experience and development; to express one's own thoughts, feelings, attitudes and ideas, to interact with others in writing, in particular by interpreting informational and artistic texts; if necessary, interact with other persons in the digital space, observing the norms of the literary language. The purpose of the research is to analyze the specific features of the formation of the STEM education in Ukraine and to find out the ways the STEM office of the Ukrainian language of the institution of general secondary education. The main methods used in the work were: comparativistic, method of abstraction, deductive method, concretization. concretization. This study conducts a systematic review of analyzes of 56 articles from 2012 source papers.

The results state that in the war time in Ukraine it is very important to keep the development of the culture from generation to generation and to form the STEM office of the Ukrainian language of the institution of general secondary education. The conclusion is oriented on the improving the importance and the development of the STEM education, based on the increasing interest on the Ukrainian language.

**Keywords:** STEM education, Ukrainian language, secondary education institutions, competence, developed personality, innovation, critical thinking, project.

## **Introduction**

The STEM-oriented approach to education, based on interdisciplinary principles in the construction of educational disciplines and individual didactic elements, aims to comprehensively form the key professional, social and personal competencies of young people, which determine their competitiveness in the labor market. The use of the leading principle of STEM education - integration allows for the modernization of methodological principles, content, volume of educational material of subjects of the natural and mathematical cycle, technologicalization of the learning process and the formation of educational competencies of a qualitatively new level. Today, the development of STEM education is important and a priority for Ukraine, is realized and implemented in all kinds of educations: formal, which is supported and carried out through all types of education: formal, informal, informal - based on online platforms, media products, STEM centers/laboratories, virtual STEM centers, through non-standard methodical STEM techniques: tours, quests, contests/competitions, festivals, hackathons, workshops, etc.

## **Research Problem**

Today, at the time of reforming the education sector, holding a traditional lesson, where the teacher is the main source of knowledge, is not an incentive and motivation for education seekers. Today's graduates are competitive future innovators, patriots, and therefore should receive thorough knowledge of technical and natural sciences, language and literature. In addition, students must be able to communicate, work in a team and solve problems in the context of innovative opportunities and current societal needs. It is the use of STEM - education that makes it possible to implement these tasks.

## **Research Focus**

STEM education is becoming for Ukraine one of the key directions for modernization of the educational sector, a component of the state policy on strengthening the economy and development of human capital, one of the main factors of sustainable innovative development. STEM education is one of the areas of anticipatory education for sustainable development, which is expected to respond to the current and future demands of Industry 4.0. It is she who must provide high-tech production with the necessary personnel. In the modern realities of the development of Ukrainian culture and language, the STEM cabinet of the Ukrainian language of a general secondary education institution is necessary for Ukrainian secondary education institutions.

## **Research Aim**

The main purpose of the article is to reveal the essence and peculiarities of the STEM classroom of the Ukrainian language of the general secondary education institution, which makes it possible to carry out: modernization of methodological principles, content, the volume of educational material of subjects of the natural and mathematical cycle; technologization of the learning process and the formation of educational competencies of a qualitatively new level; better training of young people for successful employment and further education.

## **Research Questions**

Today, the development of STEM education is important and a priority for Ukraine, that can be viewed in all types of education: formal, informal, and informal - based on online platforms, media products, STEM centers/laboratories, virtual STEM centers, through non-standard methodical STEM techniques: excursions, quests, contests/competitions, festivals, hackathons, workshops, etc. For the effective development of STEM education, the primary task is to develop the scientific base and special teaching aids; training and advanced training of special courses of workers in different fields of science and pedagogy; expanding the network of regional STEM centers/laboratories; creation of an information base for the development of STEM education in Ukraine using IT technologies, etc.

## **Research Methodology**

The theoretical and methodological basis of the study became the fundamental provisions of modern economic theory, the work of leading Ukrainian and foreign scientists and practitioners in the field of STEM education formation, the role of the Ukrainian language, and the development of the Ukrainian culture. In the research process, general scientific research methods were used, namely: system analysis, synthesis, deduction and induction, typology, historical-logical, institutional analysis, and structural-functional analysis.

## **Literature Review**

The theme of STEM education has become a true mainstream in the contemporary scientific-educational discourse. While the initial stage of research on STEM education issues was primarily related to technical and natural sciences, in modern studies, this format encompasses virtually all disciplines and specialties taught in the secondary education system.

The peculiarities of STEM education development in the Ukrainian educational space have been explored by Boichenko (2021) and Buturlina et al. (2021). A comparative analysis of the development of the STEM space in the Ukrainian and American education systems was conducted in the research by Boichenko and Boichenko (2019). Similar scientific investigations comparing Ukrainian and European STEM education were carried out by Pukhovska and Leu (2020).

The specifics of applying STEM methodology at different educational levels were highlighted by Kushnir et al. (2018). STEM-oriented learning was separately examined in the segment of secondary education (Liashenko, 2019).

The linguistic cluster of secondary education has gradually started to incorporate STEM elements into the learning process (Leshchenko et al., 2018). The impact of STEM resources significantly

enhanced the level of knowledge acquisition in foreign (English) language studies (Tytarenko et al., 2021).

The issue of designing STEM education concerning the arrangement of a secondary school classroom where the Ukrainian language is taught is addressed in the work of Osadchyi et al. (2020).

## Research Results

Clause 10 of Article 18 of the Law of Ukraine "On Education" states that professional development is a continuous process of learning and improving the professional competencies of specialists after obtaining higher and/or postgraduate education, which enables the specialist to maintain or improve the standards of professional activity and continues throughout the entire period his professional activity (Honcharova, 2017). Currently, teachers are working in the conditions of a new model of education, the implementation of the "New Ukrainian School" concept, and the introduction of new approaches, in particular, STEM education.

Nowadays reality forces the teachers think for the future life, to be ahead of his time, which involves the improvement of hard and soft skills, constant analysis of pedagogical activity, and making corrections by social demands during the entire professional activity. Information and communication technologies radically transformed the educational space, qualitatively changed the environment, opened up new opportunities, and became the basic system-creating factor of the development of education in general and director of postgraduate pedagogical distance education. When organizing professional development courses for teaching staff, distance learning methods are increasingly used, which makes the process of acquiring knowledge and skills more accessible and effective, encourages teachers to study throughout their lives, and is a real impetus for the development of informatization of education, and IT-oriented learning tools.

Organization of the educational process in wartime is a new challenge for the pedagogical community. Because in some regions of Ukraine there is a real threat to the life and health of civilians, it is recommended to organize the work of educational institutions depending on the specific situation, with the priority of ensuring the maximum possible safety for every child, every employee of the education system (letter of the Ministry of Education and Science of Ukraine dated 06.03.2022 No. 1/3371-22). The teacher's task is to adjust the educational process so that it is comfortable and safe for both students and himself, therefore, the optimal form of organizing the educational process in the conditions of martial law is a mixed form of education - a combination of online education, traditional and independent education (Tang et al., 2022).

Table 1 is presented the number of schools that STEM education and the number of STEM offices in the Ukrainian language of the institution of general secondary education.

**Table 1**

*The Number of Schools that STEM Education and the Number of STEM Offices in the Ukrainian*

	2010	2016	2017	2018	2019	2020	2021

STEM offices	24	423	865	1065	1634	1976	2765
STEM Ukrainian offices	14	46	67	97	139	153	174

*Source:* created by the author.

The Ministry of Education and Science of Ukraine has implemented several educational initiatives for teachers, students and their parents regarding distance learning, psychological support and information. In addition, several recommendations on how to organize the teaching of educational subjects in the conditions of martial law were provided by the State Service for the Quality of Education. Teachers can use the resources of the Ukrainian State Center for Out-of-School Education, and the National Ecological and Naturalistic Center for Pupils to organize remote classes in out-of-school education institutions; to listen to lectures by Nobel Prize laureates and scientists from all over the world offered by the National Center "Small Academy of Sciences of Ukraine".

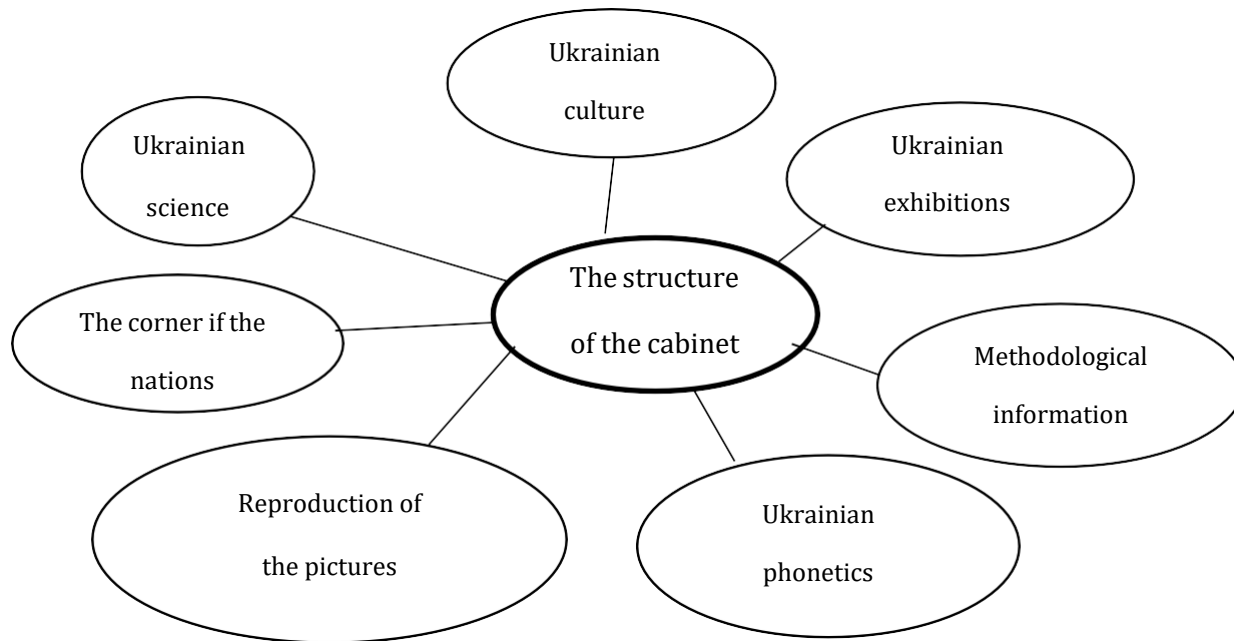
The introduction of STEM education is carried out taking into account the principles: a personal approach, aimed at taking into account the age, individual characteristics of those seeking education, their interests and abilities, special educational needs; constant updating of the content of education taking into account the achievements of science, the development of technologies and the requirements of the labor market; continuity – formation of necessary competencies at all components and levels of education; patriotism and civic orientation; productive motivation of education seekers to carry out research and project activities, inventions; the essential role of mathematics in the integrative approach to the implementation of STEM education, its consistent, thorough, high-quality teaching; encouraging the formation and development of "flexible skills" among students (presentation skills, group work, communication); use of developmental and problem-based learning technologies; development of institutions of specialized scientific education (Korshunova et. al., 2018; Yadegaridehkordi et al., 2019).

The organization of STEM education is based on the further implementation of the "New Ukrainian School" reform, which will begin in September 2022 at the level of basic secondary education, taking into account the Action Plan for the Implementation of the Concept for the Development of Science and Mathematics Education (STEM Education) until 2027, which determines a set of activities related to the formation and development of scientific research.

To ensure scientific and methodological support for STEM education, it is important to develop integrated curricula for all types of educational institutions for teaching special, elective courses, electives, organizing the work of scientific and technical circles, robotics, engineering, natural and agricultural disciplines, modern scientific directions, the latest technologies, taking into account the best national and international experience (Patrikeeva et. al., 2018). The structure of the office needs to look the following way, as it is analyzed in figure 1.

**Figure 1**

*The Structure of the Cabinet of the STEM Office the Ukrainian Language of the Institution of General Secondary Education*



*Source:* created by the author.

The development of STEM education in institutions of general secondary and extracurricular education in the 2022/2023 academic year is carried out by:

- Laws of Ukraine "On Education", "On Comprehensive General Secondary Education",
- "About extracurricular education", "About scientific and scientific and technical activities",
- "About innovative activity", "About culture";
- The state standard of primary education, approved by Resolution No. 87 of the Cabinet of Ministers of Ukraine dated February 21, 2018 (Balyk et al., 2017);
- State standard of basic secondary education, approved by Resolution of the Cabinet of Ministers of Ukraine dated September 30, 2020 No. 898;
- The concept of implementation of the state policy in the field of general secondary education reform "New Ukrainian School" for the period until 2029, approved by the order of the Cabinet of Ministers of Ukraine dated December 14, 2016, No. 988-r;
- Concept of the development of science and mathematics education (STEM education), approved by the order of the Cabinet of Ministers of Ukraine dated August 5, 2020 No. 960);

- Plan of measures for the implementation of the Concept of development of science and mathematics education (STEM education) until 2027, approved by the order of the Cabinet of Ministers of Ukraine dated January 13, 2021, No. 131-r; Plan of measures for the popularization of natural sciences and mathematics until 2025, approved by the order of the Cabinet of Ministers of Ukraine dated April 14, 2021, No. 320-r;

- Regulations on the procedure for the implementation of innovative educational activities, approved by the order of the Ministry of Education and Science of Ukraine dated November 7, 2000 No. 522, registered in the Ministry of Justice of Ukraine on December 26, 2000, under No. 946/5167 (as amended by the order of the Ministry of Education and Science, Youth and Sports of Ukraine dated November 30, 2012 No. 1352);

- order of the Ministry of Education and Science of Ukraine dated 16.10.2019 No. 1303 "On approval of the Standard for specialized education in the scientific direction";

- order of the Ministry of Education and Science of Ukraine dated April 29, 2020 No. 574 "On approval of the Standard List of teaching aids and equipment for classrooms and STEM laboratories" and other legislative acts.

## **Discussion**

The effectiveness of training depends on many components: the skill of the teacher, teaching methods, content of the program, training equipment, and means of managing the training process. Life requires the complex use of various materials to ensure a comprehensive impact on the development of a child's personality. However, the presence of an adequate material base in itself does not decide the success of the case (Zhao et al., 2021). A scientific organization of work is also needed, thanks to which it is possible to achieve high pedagogical effectiveness with the least expenditure of energy and effort. The most favorable conditions for the rational use of the entire complex of educational equipment are provided by work in school classrooms. Currently, schools have literary and language classrooms, and most often classrooms of a mixed type (linguistic and literary). In modern scientific and pedagogical literature, the following definition of a study room is given - it is a single, organically connected system of educational equipment, mounted in a separate room, designed by the requirements of the scientific organization of the work of the teacher and student, which ensures a high level of teaching the subject (Chang et al., 2022). The main tasks of the study room are:

1. Implementation of the practical and creative components of the training content.
2. Provision of in-depth study of literature and organization of specialized training in high school.
3. Ensuring that teachers can use modern pedagogical means of learning.
4. Generalization and dissemination of the experience of the best teachers.
5. Organization of extracurricular work with students.
6. Conducting meetings of the school methodical association
7. The possibility of individual preparation of the teacher for classes and raising his scientific and methodical level.

All material resources of the language and literature office can be conditionally divided into three groups:

- educational equipment - books, educational and visual aids, audiovisual means;
- general equipment - furniture and devices that facilitate the use of educational equipment;
- special means for the scientific organization of work (Peterson, 2020).

When organizing the work of the office, language teachers must constantly involve schoolchildren in this activity. Only under these conditions will the office be able to successfully fulfill the functions of a modern school of the 21st century: - to promote the rapid, active assimilation of necessary scientific information by students; - to create optimal conditions for educational and cognitive activities of schoolchildren; 6 - to contribute to the formation of a spiritually rich personality. The office should be bright, meaningful and aesthetically decorated. As psychologists note, the correct selection of colors used to paint doors, windows, furniture, and walls is of great importance. The work of school classrooms is carried out by the Regulations approved by the order of the Ministry of Education and Culture of Ukraine dated July 20, 2004 No. 601 (Patrikeeva et al., 2018).

Among the main objects of this room should be noted:

- Equipment for quality training. This list includes books, magazines, training manuals, audio and video tools, and other elements of a technical nature;
- General referral equipment. Furniture, teacher's workplace, desks and chairs for students, various devices for working with educational equipment, etc.;
- Special tools for the scientific coordination of work.

Go to the section Stands in the office of Ukrainian language and literature

It should be noted that it is necessary to constantly involve students in the process of designing the office of Ukrainian language and literature. This is how the improved assimilation of educational material and the development of the cognitive activity of each child will take place. Today, there are a lot of stands for this cabinet, among which such shields as:

- History of Ukrainian literature;
- Ukrainian writers;
- Literary map of Ukraine;
- Quotes by famous Ukrainian writers and others.

It should be noted that the production of stands for this room should first of all be based on the quality of the material for execution and the symbolic filling of the information boards. After all, the stands are a defining part of the classroom interior and play an important role in the aesthetic and educational segment of this room.

Please provide the interpretation of obtained results and compare them with the results of previous studies. Highlight the limitations of your study. Add conclusions if the discussion section is short and simple to read.

## **Conclusions and Implications**

The implementation of STEM education is carried out using such basic organizational forms as a lesson/class, project, quest, hackathon, and others. A STEM lesson/class involves the integration of three or more STEM disciplines (biology, physics, chemistry, geography, mathematics, and technology). The STEM project is an educational and research activity of students that involves an interdisciplinary approach and the creation of a practical product. A STEM quest is an intellectual competition that includes a set of challenging tasks with elements of a role-playing game, the implementation of which may require any resources, in particular, Internet resources. A STEM hackathon is a form of conducting an educational session/event, during which teams solve a certain thematic, or social problem in a limited period (Ledger et al., 2022). Examples of the implementation of such forms of education can be found on various educational resources or in collections of materials, for example: the best gender-sensitive STEM lessons; useful resources for conducting STEAM lessons; STEM rising (resources for conducting STEM classes); ideas for creating spectacular STEM projects; "STEM projects in elementary school"; STEM projects (a description of STEM projects from the Kolosok magazine; Mechanics in Ukrainian; STEM experiments (an online resource for teachers who want to implement STEM and are looking for new project ideas); Scientix (an online platform containing didactic materials for teachers natural and mathematical disciplines, and also informs the European educational community about innovative educational competitions - European STEM Discovery Week (STEM Discovery Week) and STEM Ahead Competition); learning strategies and resources that are designed to arouse students' interest in scientific research); Mathigon (mathematical platform containing interactive resources for interesting mathematics classes); Collection of materials "STEM- school-2021"; Collection of materials "STEM-week - 2021" ; Collection of materials "STEM Week - 2020"; STEM Library Laboratory.

The use of the above-mentioned and other innovative and interactive methods and forms of work allows to effectively implement the requirements of the Concept of the New Ukrainian School and will contribute to the formation of critical thinking, creativity, scientific research, engineering, and invention skills in students.

Observing the rapid development of technology, it is difficult to predict what the world will be like, even shortly. Is the modern school capable? to prepare schoolchildren for mastering the specialties of the future, adaptation to quick changes? STEAM - education can be the answer and help. After signing of the Memorandum on the creation of the STEM-education Coalition on September 16, 2015 of the year in Kyiv, the issue of introducing elements of STEAM education in a modern school became relevant. Their implementation should become a priority direction in solving the problem of increasing children's interest in future specialties (Institute of Education Content Modernization, 2017).

The creative space of the child's worldview, where he fully realizes his own needs becomes one of the ways of spreading STEAM education within the framework of Nova Ukrainian school. However, it is important to understand that STEAM is not just a technical education. She covers a much broader concept, namely a successful combination of creativity and technical knowledge. The main goal of STEAM education is the development of creative thinking and skills the use of an engineering approach to solving real problems, understanding the importance of design, awareness of the role of technology

in their decision. It is important to involve the teachers who have to become real in the changes agents of educational reform changes.

It is interesting that during STEAM lessons in the focus is not on the teacher, but on the practical task required solve. Students learn to solve this practical task by means of tests and mistakes, rather than studying the "dry" theoretical part. It is fair to note that we live in a not quite "linear" world, everyone every second of our lives intersects with different disciplines. During the campaign in movies, shopping, etc. The child is forced to figure out how apply certain knowledge in different life situations (Bygstad et al., 2022). Quite often this one the process takes place with errors, while STEAM education teaches from the school desk successfully combine the acquired knowledge to solve real life situations. As a result, the child enters the adult world much more prepared and not so much afraid of problems and difficulties.

It is necessary to conclude that the goal of the development of STEM education is the comprehensive spread of innovative teaching methods and the unification of the efforts of participants in the educational process and social partners in the formation of the necessary competences of education seekers, which provide an opportunity to offer solutions to the problems of society by combining natural sciences, technologies, engineering and mathematics. One of the systemic components of the formation of the content of STEM education is the transfer of knowledge, which ensures the implementation of the achievements of the scientific sphere in the educational process. The methodological basis of the formation of the content of STEM education is a transdisciplinary approach.

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