EDUCATION FOR THE DEVELOPMENT OF STEAM SKILLS FROM THE PERSPECTIVE OF CURRENT CHALLENGES IN THE CONTEXT OF EU ACCESSION

Aurelia LITVIN[1], Elena FLEACA[2]

[1]*Technical University of Moldova, 168, Stefan cel Mare bd, Chisinau, Republic of Moldova*
[2]*National University of Science and Technology POLITEHNICA Bucharest, 313 Splaiul Independtei, Bucharest 060042, Romania*

Abstract. STEAM (Science, Technology, Engineering, Art and Mathematics) education is an approach that integrates the disciplines of science, technology, engineering, art and mathematics to encourage students to develop critical thinking, problem solving, creativity and collaboration skills. STEAM education also focuses on developing skills that are in demand in the modern world. Students learn to analyze information, find solutions to problems, argue their ideas and work in a team. One of the key principles of STEAM education is making connections between different fields. For example, through projects, students can combine knowledge from mathematics, physics and programming to design and build working models or solve problems. This approach allows students to better understand the relationship between different sciences and to apply the acquired knowledge in practice.

Keywords: *Education, European Union, STEAM, Sustainable development.*

JEL code: *I21, I23, I25*

"**Education is the most powerful weapon that you can use to change the world**,"
Nelson Mandela.

STEAM development is an important trend in education due to the rapid pace of innovation and the changing nature of the labour market. Education is under pressure for professional implementation to respond to a changing world. As old tasks are disrupted by technology and outsourcing, the ability to solve new problems becomes increasingly vital. This brings STEAM to the forefront of education, and teachers who can successfully incorporate these approaches into their curriculum can help students prepare for the challenges and innovations of the modern world.

Any modern person, no matter who he is or what he does, will agree that knowledge in all its guises is the basis of the progressive development of humanity at all stages of its history. Discrepancies in the understanding of the role and place of the processes of obtaining transfer and application of knowledge begin, perhaps, when practical steps are discussed and formed under the conditions of a certain country, a certain historical period, in relation to various aspects of the life and activities of certain communities. It is worth noting that countries that are most successful in developing knowledge acquisition and application systems, such as those in the European Union, are characterized by a departure from a purely utilitarian approach. Knowledge and educated people - represent a significant value not only and not so much from the point of view of solving practical problems and tasks of socio-economic development (economic growth), but also in terms of creating conditions and premises for the creation of a harmonious society. To paraphrase a well-known aphorism, we can say that "there is no such thing as too much knowledge". However, each country and society must not only create incentives for the development and acquisition of more and more modern knowledge, but also take into account the real opportunities they have at any given time. An example is the Republic of Moldova, where an economy-oriented approach prevailed. Its essence is that the content and volume of education must fully comply with the requirements of the environment

in which the individual lives and works (will live and work), and beyond that, it was assumed that there is nothing and there is no need to learn it. [8]

Now, the main task of education is to learn to weave STEAM trends into classical education and convey to students the value of this process.

The STEAM approach to education is based on the following principles:

➢ The project form of the educational process. Students form groups to solve problems and projects collectively, which promotes the development of communication and teamwork skills. Projects often relate to real-life problems and challenges, which helps to stimulate interest in academic subjects.

➢ Practical prejudices. Educational tasks have a practical orientation, and the results of their solution can be used in real life. This allows students to see real-life applications of the subjects they study and develop skills in applying the knowledge gained in practical situations.

➢ Interdisciplinary approach. Learning tasks are interdisciplinary in nature and require the simultaneous use of knowledge and skills from several academic subjects. This promotes the integration of knowledge and the development of coherent thinking.

➢ Covering key subjects. The STEAM approach focuses on topics that are fundamental to a future engineer or applied science researcher. These include natural science disciplines such as physics, chemistry and biology, as well as modern technology and engineering disciplines [8].

All of these principles work together to support student development in science, technology, engineering, art and mathematics, as well as key skills such as critical thinking, problem solving, communication and collaboration.

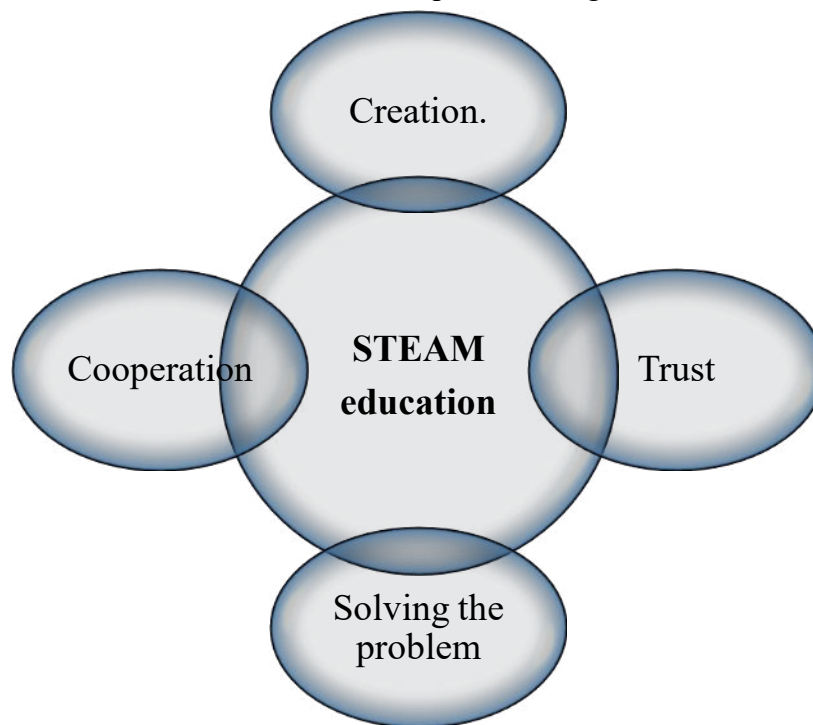The main benefits of STEAM education are present in figure 1.

Figure 1. New skills: 4 benefits of STEAM education.
Source: Elaborated by authors

Creation. Teaching students to think "outside the box" forces them to approach problems differently. They learn to be creative using a wide range of thinking processes and skills throughout the lesson and throughout the school day.

Trust. Approaches based on visual arts, drama and creativity give students practical experience and confidence in communicating ideas verbally and non-verbally. Combined with science, math and technology subjects, children learn to confidently solve complex problems.

Solving the problem. Learning new skills, whether technical or creative, teaches students to approach new, potentially challenging situations with a positive attitude. Using STEAM, teachers can help students solve problems creatively using a variety of methods.

Cooperation. STEAM courses or lessons focus on increasing teamwork. Students work together to gain new information using multiple sources of theoretical or practical information. They learn to share responsibility and compromise while working on group projects involving different disciplines.

American researchers have started important studies related to these projects and are implementing programs that facilitate STEAM education, with the aim of increasing the competitiveness of students at the global level, encouraging creativity and ingenuity. This vision led to the appearance of new challenges facing the modern educational process: the reconceptualization of curricular contents, the implementation of innovative strategies, and the training of teachers, both at the level of initial and continuous training.

The student, within these learning methods, is subjected to a challenge, actively interacts with his teammates, but also with the teacher, exchanges ideas and discusses finding the solution. The challenge is genuine, because a situation or problem from the immediate reality that the learner faces is addressed, thus increasing the motivation to learn.

The teaching method based on the STEAM concept places students in challenging situations where they observe and question phenomena, explain what they observe, design and conduct experiments in which data are collected to support or contradict their theories, analyse the data obtained.

These learning situations do not seek to obtain a single "correct" answer to a particular question being addressed, but rather engage students in the process of observation, questioning, experimentation, or exploration and lead them to analysis and creative thinking.

One of the most important variables in implementing STEAM projects is the teacher. This one has to be somewhat atypical. [8]

The teacher, in this context that involves creativity in the development of learning situations with a scientific substrate, places the student at the center of the action. Research-based learning involves the promotion and development of students' skills related to research practice and involves the application of teaching-learning strategies that link research to teaching. Problem solving can be implemented through the active participation of both students and teachers, who discuss and analyse the scientific progress achieved, the method is the ideal situation for the best learning and for training students as future researchers.

Researcher competence is trained by knowing the stages, methods, research tools guided by the teacher. The PBL method focuses on a meaningful question, challenge, or problem for the student to research and answer and/or solve. Students' knowledge moves to the level of "know," "understand," and "can" in inquiry-based academic endeavour. Intrinsic curiosity is stimulated and questions are generated, which help students search for answers, thus guiding the student towards desirable 21st century skills. They can choose the way to solve tasks, revise the plan and even the entire project.

The problems, research process, methods and results are presented, just as in real life, where scientific research or projects are evaluated and subjected to constructive criticism. In the process of implementing this method, the teacher becomes a project designer, identifying the project concept, distributing the tasks between the student teams, coordinating the activities to achieve the project objectives, while also acting as a project evaluator at each stage of development. [3]

Following the analysis of studies on how teachers perceive STEAM education [5], it is found that they have noticed a high motivation of students in the act of learning, and their academic achievements are increasing, feeling more in control and confident himself.

A very important aspect emphasized by teachers involved in STEAM teaching is related to the development of teamwork skills, collaboration and interaction and involvement. In the successful

realization and implementation of a STEAM project, teachers have a significant role in guiding the student. At the same time, they must go through the steps necessary for learning through projects.

1. Information. In this step the teacher selects an essential question or problem that he conveys to the students. It focuses on making the question or problem real, well-focused, clear, and with reference to both the STEM and the arts.

2. Planning.The plan that will fulfil the expected tasks and the necessary resources is being prepared. These, being clearly defined, are distributed among the group members, who will achieve them through effective collaboration.

3. Implementation. Here they use their own skills, processes and knowledge that have been accumulated in the previous stages. It is the step of the process in which the answer or solution to the problem is sought. The creative activities of each group member are carried out according to the action plan, through responsible work.

4. Control. It is the stage where the teacher can analyse the gaps students have in their own skills and processes and intervene as a support person or consultant. It is the phase that is about active research and intentional teaching.

5. Presentation. This phase of the process emphasizes sharing with others. Everyone expresses their opinion, expresses feedback and receives one.

6. Evaluation. It refers to the loop that closes the activity. It is intended to give students the opportunity to reflect on the process and the results obtained. The teacher will provide the feedback, identify any gaps and at the same time highlight the quality of the final product. Based on this reflection students will be able to self-correct and improve their own skills, abilities and knowledge.

STEAM education is the education that will make it sustainable. Education for sustainable development is not a particular program, but rather a central point, both for the multiple forms of education already existing, and for those to be created. Education regarding sustainable development supports efforts to rethink the educational program and system (methodology and content) of poorly developed societies. This affects all components of education itself: legislation, policy, finance, curriculum, training, learning, assessment. Thus, education for sustainable development appeals to the continuous learning process and recognizes the fact that the educational needs of people change throughout their lives. [4,5]

Many people and organizations around the world are already implementing education for sustainable development.

The term sustainability, most often associated with sustainable development, was introduced by the Commission's Report Brundtland from 1987. According to this first official document, sustainable development has three dimensions: ecological, economic and equity, and is understood as a sum of actions by which "current needs are met without compromising the ability of future generations to meet their own needs " (according to the 1987 Report of the World Commission on Environment and Development). In recent years, the concept of sustainable development has evolved towards the integration of increasingly complex fields, which approach in a spirit multidisciplinary social, economic and environmental dimensions. [6]

The concept of sustainable development starts from the awareness of the role played by humanity, through economic, social and political processes, in the generation of global problems. With the launch of the term sustainability, the notion that "development is essential for satisfying human needs and improving the quality of life" was increasingly promoted in international development. Thus, the need to integrate qualitative aspects in measuring development is emphasized, and sustainable development is a central concept that refers to a new way of understanding the world, but also to a method of solving global problems.

The 2030 Agenda outlines 17 complex objectives that define global efforts in development until 2030. According to the criteria of sustainable development, economic development must take into account the social and environmental dimensions, and be based on an efficient and responsible use of finite resources - natural, human and economic - of society. A sustainable society is one that has the ability to sustain itself from one generation to the next, that is far-sighted, flexible and wise enough not to undermine its own physical and social support systems.

Education for sustainable development is aimed at transmitting information in the field of sustainable development and training skills in its promotion. The formation of competent and confident citizens can create new opportunities to have a healthier and more productive lifestyle, in harmony with nature and with care for social values such as equality or cultural diversity.

Sustainable development can only be achieved through a joint effort of all global citizens. As understood by the international community, the term "global citizen" refers to the assumption of an identity that goes beyond the borders of a nation or a certain geo-political space, by virtue of the existence of the aforementioned global interdependencies. According to this global perspective on citizenship, all people are already global citizens, even if not everyone yet understands the implications of this. Hence the need for information and awareness, to develop attitudes, values, behaviours of global citizens, to be passed on at the community level, through personal example and through education.

Sustainability education involves developing a deep understanding and practical skills regarding environmental, social and economic issues with a focus on sustainable solutions. Here are some strategies and methods to integrate sustainability education: [4]

1. Integrated curriculum: introduction of sustainability concepts in all curriculum areas;

2. Project-based learning: hands-on projects and project-based activities allow students to explore sustainability issues in a real-world context;

3. Experiential learning: providing hands-on experiences (visits to organic farms, nature reserves) or participating in environmental conservation actions, helps students to directly experience aspects of sustainability;

4. Educational games: represent an interactive and engaging way to teach children and young people about sustainability, through role-playing games, virtual communities, etc.;

5. Partnerships with the community: collaboration with local organizations, NGOs and communities gives students a real perspective on sustainability issues and gives them the opportunity to get involved in green actions;

6. Developing critical thinking: stimulating critical thinking regarding complex sustainability issues;

7. Use of technology: Integrating technology into the learning process can provide access to online resources, educational games, simulations and other tools that support sustainability education;

8. University curriculum oriented towards sustainability;

9. Development of practical skills: focus on developing the practical skills needed to live sustainably;

10. Promoting personal responsibility: encouraging students to take responsibility for their actions and understand their personal impact on the environment and society. This can include adopting a sustainable lifestyle and reducing your personal ecological footprint. [4]

By using these strategies and methods, sustainability education becomes relevant and inspirational, contributes to the formation of active citizens in solving environmental and social problems.

The Republic of Moldova also focuses on quality education, one of the basic values of the European Union.

In the Republic of Moldova, the Education 2030 Development Strategy was developed following three rounds of discussions with the actors involved and in accordance with the Moldova 2030 National Development Strategy.

The Education 2030 Development Strategy project and the implementation program were developed by the Ministry of Education and of Research with the support of the team of national and international experts from the Institute of Public Policies and from UNICEF Moldova [1,2]. The derived specific objectives aim at:

1) connecting education to the requirements of the labor market from the perspective of the sustainable development of human capital, necessary in the information society, based on knowledge;

2) ensuring access to quality education for all through equitable inclusion in general, professional, technical and higher education and through other forms of lifelong education;

3) ensuring the qualified pedagogical, scientific-didactic and managerial personnel, necessary at all levels and forms of organization of the education and training system;

4) the creation of new effective learning environments, motivating throughout life, for all citizens of the Republic of Moldova;

5) capitalizing on modern information technologies;

6) the orientation of scientific research in the direction of promoting innovations and change in education;

7) increasing performance at all levels of the education system, achieved by: streamlining the school and university network; infrastructure modernization; strengthening managerial capacity; the development of the quality culture etc. [2].

In OECD studies, quality education depends on the integration of values and attitudes in the structure of competences, in general, of key competences in particular, employed pedagogically, psychologically and socially, in the achievement of strategic objectives, specific to sustainable training and development. [7]

In conclusion, STEAM education as a strategic objective, promoted by the 2030 Agenda for sustainable development, is centred on the skills necessary for the lifelong learner, acquired and perfected in the education system through the optimal combination of knowledge - skills (skills) - values and attitudes, which ensures social success, in an open context, in the short, medium and long term.

References

1. The National Development Strategy "Moldova 2030", approved by the Government | United Nations in Moldova [Internet]. [cited 30.08.2023]. Disponibil: https://moldova.un.org/en/15729-national-development-strategy-moldova-2030-approved-government, https://moldova.un.org/en/15729-national-development-strategy-moldova-2030-approved-government
2. Strategia Națională Educația 2030
3. HEInnovate_eight_dimensions_040321.pdf [Internet]. Disponibil: https://heinnovate.eu/sites/default/files/HEInnovate_eight_dimensions_040321.pdf
4. CRISTEA Sorin, Educație pentru sustenabilitate CZU 37.01 | doi.org/ 10.5281/zenodo.4560639
5. MARGOT, K. C. & Kettler, T. Teachers'perception of STEM integration and education: A systematic literature review. International Journal of STEM Education, volume 6, Article number: 2 (2019),
6. MA-Ed.-Sciences_-Technologies-of-Learning-Communication-and-STEAM-Education_EN.pdf [Internet]. Disponibil: https://euc.ac.cy/wp-content/uploads/2022/11/MA-Ed.-Sciences_-Technologies-of-Learning-Communication-and-STEAM-Education_EN.pdf
7. OECD – Future of Education and Skills 2030. Pe: https://www.oecd.org/education/2030-project/
8. Litvin A., Stratila A., BEST PRACTICES OF STEAM SKILLS DEVELOPMENT IN HIGH EDUCATION. in the 5th Economic International Conference "Competitiveness and sustainable development", 2-3 November 2023.Chişinău: Tehnica-UTM, 2023. – 251 p. pag. 166-172, ISBN 978-9975-64-364-1 (PDF). https://doi.org/10.52326/csd2023.25