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Science Education for Responsible Citizenship: Analysis and Prospects of Legal Implementation of Recommendations to the Ukrainian Educational System as an Aspect of Socio-Cultural Dialogue

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The article reveals the main results of the analysis of "Science education for responsible citizenship" report as a set of basic European recommendations that can be used to modernize and reform the education system in Ukraine at the formal level. The authors presented a number of main positions of "Science education for responsible citizenship" and analyzed the existing legal system that regulates activities in the education and science system of Ukraine, with the aim of identifying the basis for the implementation of European recommendations.

Keywords: science education, responsible citizenship, educational system, European integration, European recommendations, global transformation, Education 4.0., STEAM, socio-cultural dialogue, legislation, humanitarian law.

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Introduction

Continuous dynamic development of Ukraine in the humanitarian sphere, European integration and building a high-quality socio-cultural dialogue with European partners generates a number of challenges. Such challenges are connected (among other things) with the development of the education system in Ukraine and its corresponding legal support.

The process of updating the content of education is a defining component of the reform of education in Ukraine and provides for bringing it into line with the modern needs of the individual and society (Resolution of the Cabinet of Ministers of Ukraine "On the State National Program "Education"" (Resolution, 1991). Such a process involves the study of the European experience and the existing situation in Ukraine: it concerns both the practical implementation of the principles and their legal support with the determination of prospects for further development.

One of the basic topics in such a case is the introduction of European standards of science education in Ukraine. As you know, at the very beginning of the development of Ukrainian statehood, the requirement to observe the principle of scientificity, including in the field of education, was established at the imperative level. In turn, the level of development of science and technology at the national level is a determining factor in the progress of society, improving the well-being of citizens, and their spiritual and intellectual growth. This is due to the need for priority state support for the development of science as a source of economic growth and an integral component of national culture and education, creating conditions for the realization of the intellectual potential of citizens in the field of scientific and technical activities, ensuring the use of achievements of domestic and world science and technology for the satisfaction of social, economic, cultural and other needs (The Law of Ukraine, 2015).

According to the authors of report, one of the basic modern European framework documents with recommendatory force is "Science education for responsible citizenship", which was developed in 2015 by a number of European experts with the highest qualifications in the field of education. The analysis of the recommendations specified in this document makes it possible to create an idea of the standards in the field of science education in Europe and implement the alignment of the existing Ukrainian educational system, based on the capabilities and needs of Ukraine. Trying to become a real part of the European family, Ukraine should intensify the socio-cultural dialog at all the spheres of social life: education, science, culture, economy, politics, etc. Thus, effective European practices of science education could be rationally implemented in the Ukrainian education area.

"Science education for responsible citizenship" and one's role in education globalization and socio-cultural dialogue

"Science education for responsible citizenship" as report to the European Commission of the expert group on science education: "This publication on science education offers a 21st century vision for science for society within the broader European agenda. It is the culmination of many months of work by a group of experts brought together by the Commission in 2014" (Science education for responsible citizenship, 2015: 5). The document offers the global (at least, European wide) vision of science education development.

The mentioned report is aimed primarily at science education policymakers. The document has seven main paragraphs: addressing societal challenges, a description why science education

matters, problems and challenges in science education, the way forward, recommendations to the European Commission, a program for science education research, and interesting practices promoting responsible science education. This paragraphs qualitatively reveal the specifics of building responsible citizenship through reforming the education system in the vector of strengthening science education.

At the beginning, like an explanation of addressing societal challenges, attention is focused on the variability of the modern world, which is caused by the continuous development and integration of all spheres of social life. Such a situation encourages the development of all systems and their dynamic interrelationship. One of such systems is the educational system, which has created to form a new dynamic personality (Science Education for responsible citizenship, 2015: 12-13).

In addition to this, in the next chapter, the report provides clear arguments for why science education matters and is extremely relevant: it encourages the development of a culture of scientific, analytical and critical thinking; provides confidence in the future; promotes talent development and career growth, integration of labor markets in the EU, expansion of the sphere of influence of the scientific community, etc. (Science education for responsible citizenship, 2015: 14-15).

Problems and challenges in science education are constantly growing and today are characterized by the unevenness of basic scientific literacy, the lack of equal access to science for all those who want it, the decrease in awareness and interest in science, the lowering of the qualifications of teachers, the lack of investment and strategic cooperation (Science education for responsible citizenship, 2015: 16-17).

The way forward for the implementation of science education is revealed through six main views:

1. Science education should be an essential component of a learning continuum for all, from pre-school to active engaged citizenship;
2. Science education should focus on competences with an emphasis on learning through science and shifting from STEM to STEAM by linking science with other subjects and disciplines;
3. The quality of teaching, teacher induction, pre-service preparation and in-service professional development should be enhanced to improve the depth and quality of learning outcomes;
4. Collaboration between formal, non-formal and informal educational providers, enterprise, industry and civil society, should be enhanced to ensure relevant and meaningful engagement of all societal actors with science and increase uptake of science studies and science-based careers to improve employability and competitiveness;
5. Greater attention should be given to promoting Responsible Research and Innovation and enhancing public understanding of scientific findings and the capabilities to discuss their benefits and consequences;
6. Emphasis should be placed on connecting innovation and science education strategies, at local, regional, national, European and international levels, taking into account societal needs and global developments (Science education for responsible citizenship, 2015: 18-26).

In the last chapter of the document, we can see interesting practices promoting responsible science education: two sets of examples have been chosen to inspire teachers and teacher educators and trainers, enterprise and industry, social organizations and policymakers to promote responsible science education: "The first set provides examples from EU FP7 projects. The second set includes a wide range of initiatives that have been tried out in schools, classrooms, in pre-service and professional development programmes, with enterprise, industry and municipalities and in other formal, non-formal and informal educational settings. All examples show, that with creativity and motivation and through collaboration, responsible science education can be enhanced to the benefit of citizens of all ages" (Science education for responsible citizenship, 2015: 42).

The main massage of the discussed report is to identify six key objectives and associated recommendations, which in combination, can help bring about the systemic changes required to generate a sustainable effect across societies and in communities (Science education for responsible citizenship, 2015: 7). We see, that representation structure of objectives and recommendation to them is logical and also colludes actions.

As an example, for the first objective there are two main recommendations:

"Education policies and systems should:

- ensure that science is an essential component of compulsory education for all students; support schools, teachers, teacher educators and students of all ages to adopt an inquiry approach to science education as part of the core framework of science education for all;
- address socio-economic, gender and cultural inequalities in order to widen access and provide everyone with the opportunities to pursue excellence in learning and learning outcomes;
- create mechanisms to foster individual reflection and empowerment.

Science education should balance requirements of breadth and depth of knowledge about science to ensure young people and adult learners are both motivated for learning and equipped to fully engage in scientific discussions and decisions and to facilitate further and deeper study" (Science education for responsible citizenship, 2015: 8).

The current state of the Ukrainian legislation in the sphere of science education

Today, the issue of science education in the current legislation of Ukraine is insufficiently regulated, which is evidenced by the current normative legal acts, as well as existing draft laws in the field of education.

It remains clear that the issue of strengthening the scientific nature of education in Ukraine is a European integration process, and the adaptation of Ukrainian legislation and educational practice to EU legislation and standards is a priority component of the process of Ukraine's integration into the EU and a priority direction of Ukrainian foreign policy (The Law of Ukraine, 2004).

The analysis of "Science education for responsible citizenship" proves the purely advisory nature of the European recommendations, but highlights the main trends and vector of development not only of the practical nature of the implementation of educational activities, but also the normative consolidation of the paradigm of the scientific nature of education. In addition, the study and implementation of the specified EU recommendations is part of

international cooperation in the education system, which the state contributes to by, among other things, creating legal conditions, i.e. making appropriate changes to the current legislation and subordinate regulatory legal acts.

Analysis of the Law of Ukraine "On education" indicates that innovativeness (based primarily on scientific knowledge) is one of the main indicators of education as a state priority (The Law of Ukraine, 2017: article 5, clause 1), and the direct scientific nature of education and integration into the international educational and scientific area are the basic principles of educational activity in Ukraine (The Law of Ukraine, 2017: article 6). In addition, it is necessary to note the fact that the Ministry of Education and Science of Ukraine, the National Academy of Sciences of Ukraine, national branch academies of sciences of Ukraine, bodies for ensuring the quality of education, central bodies of executive power to which educational institutions are subordinate, academic, branch research institutes, educational institutions, other scientific, scientific-methodical and methodical institutions in cooperation with relevant enterprises, creative unions, associations, societies, public associations, including professional organizations (professional associations), employers' associations, independent educational assessment and quality assurance institutions (The Law of Ukraine, 2017: article 75).

However, at the empirical level, science education in Ukraine is mistakenly associated exclusively with higher education or specialized science education. In the case of higher education, the legislator implements a direct reference to the inseparability of the scientific, scientific-technical and innovative component in the activities of higher education institutions (The Law of Ukraine, 2017: article 17), which, first of all, concerns the training of Ph.D. and doctors of science. In the case of scientific direction specialized education, the legal norm goes deeper into the formulation of the definition: "Scientific direction education is a type of specialized education based on research-oriented training, aimed at in-depth study of specialized subjects and acquisition of competencies necessary for further research, experimental, design, inventive activity" (The Law of Ukraine, 2017: article 21).

The legislator emphasizes that the state is entrusted with the duty of creating conditions for the involvement of student youth in scientific and scientific and technical activities, including through the system of specialized education institutions of a scientific profile, in particular the Junior Academy of Sciences of Ukraine (organizes and ensures the participation of student youth in research and experimental, scientific, design, inventive and search activities, contributes to the formation of the intellectual capital of the nation, the education of the future scientific change, the status and principles of its activity are determined by the Law of Ukraine "On scientific and scientific-technical activity" (The Law of Ukraine, 2015).

In terms of the practical implementation of EU recommendations in the field of science education, the main task of the Law of Ukraine "On scientific and scientific-technical activity" is to define the main goals, directions and principles of state policy in the mentioned fields including international scientific and technical cooperation. During the analyze of the legally established goals of Ukrainian policy in the field of scientific and scientific-technical activity, it is possible to select those goals that are directly correlated with educational activity:

- achieving a high level of development of science and technology;
- multiplication of national wealth (educational and intellectual potential belongs to the intangible wealth of the nation) based on the use of scientific and scientific-technical achievement;
- creation of conditions for achieving a high level of intellectual development by using modern achievements of science and technology;

- creation of conditions for realizing the intellectual potential of citizens in the field of scientific and scientific and technical activities;
- ensuring the free development of scientific and scientific-technical creativity;
- integration of the domestic sector of scientific research and scientific-technical (experimental) development into the global scientific and European research areas (The Law of Ukraine, 2015: article 45).

An additional example of the norm of national legislation of Ukraine, which correlates with the issue of normalization of science education, is the Law of Ukraine "On extracurricular education" (The Law of Ukraine, 2000: article 15). In this case, the emphasis is on the formation of a number of competencies aimed at expanding the scientific worldview, preparation and involvement in active research, experimental, design and inventive work, mastering modern equipment and technologies, etc.

The next level of educational regulations, which cannot be bypassed during the analysis of the regulatory system, are secondary regulations. Decree of the Cabinet of Ministers of Ukraine dated November 3, 1993 No. 896 "On the State National Program "Education" ("Ukraine of the 21st Century")" emphasizes that one of the priority directions of education reform is the achievement of a qualitatively new level in the study of basic academic subjects, including mathematics and science, which can be achieved by:

- ensuring the development of education on the basis of new progressive concepts, introduction into the modern educational process pedagogical technologies and scientific and methodological achievements;
- harmonious integration of education and science, active use scientific potential of higher educational institutions and research institutions, the latest theoretical developments and achievements innovative teachers, public creative associations in educational process (Resolution of the Cabinet of Ministers of Ukraine, 1991).

Analysis of the norms of the State National Program "Education" gives the right to conclude that since the establishment of Ukraine's independence, the basic educational legal acts have already been filled with the idea of science education, including in the framework of international cooperation (UNESCO, etc.). And the further development to deepen the regulatory framework only cemented the need to implement European standards in education, an example of which is the "Concept for the Development of Science and Mathematics Education (STEM Education)". The above-mentioned concept is a product of the process of modernization of education to meet society's demands for science-intensive education, and the formation of competencies relevant to the labor market, and is based on the Resolution of the UN General Assembly "Transforming our World: The 2030 Agenda for Sustainable Development" (25.09.2015), Reports of the European Parliament "Encouraging STEAM Studies for Labour Market" (2015), Incheon Declaration "Education 2030" of the World Education Forum under the auspices of UNESCO (19-22.05.2015), program document of the UNESCO International Bureau of Education "Exploring STEAM competences for the 21st century" (2019). Implementation of this Concept is planned for the period until 2027. The main goal of the Concept is to promote the development of science and mathematics education (STEM education) as the basis of the competitiveness and economic growth of our country, the formation of the latest competences of citizens, the training of specialists of a new generation capable of learning knowledge and the development and use of the latest technologies (Decree of the Cabinet of Ministers of Ukraine, 2020).

As part of the study of the national regulatory framework in the context of science education, attention is also drawn to the "State standard of basic and complete general secondary education" (Resolution of the Cabinet of Ministers of Ukraine, 2020) and "Standard of specialized scientific direction education" (Order of the Ministry of Education of Ukraine, 2019).

The first of the above-mentioned standards "… is based on the principles of person-oriented, competence-based and activity-based approaches, which are implemented in educational fields and reflected in the effective components of the content of basic and full secondary education" (Hotsuliak & Halchenko, 2016). The attention of the standard authors are drawn to: competence in the field of natural sciences, engineering and technology, which involves the formation of a scientific outlook; the ability and willingness to apply the appropriate set of scientific knowledge and methodologies to explain the natural world; gaining experience in researching nature and formulating evidentiary conclusions based on the information obtained; understanding of changes caused by human activity; responsibility for the consequences of such activities (Resolution of the Cabinet of Ministers of Ukraine, 2020: article 7). In addition to this, requirements for learning outcomes are established, which include: knowledge of the natural world by means of scientific research; processing, systematization and presentation of information of natural content; awareness of the laws of nature, the role of natural sciences and technology in human life; responsible behavior to ensure the sustainable development of society; development of one's own scientific thinking, gaining experience in solving problems of natural content (individually and in cooperation with other persons) (Resolution of the Cabinet of Ministers of Ukraine, 2020: article 16).

The second standard mentioned, no less significant in the perspective of the discourse of science education, it determines the content of specialized scientific direction education acquired at the levels of basic and specialized secondary education, the total volume of the educational load of students of specialized educational institutions of a scientific profile, additional requirements for their competences determined by state standards of general secondary education and the results of research-oriented training (Order of the Ministry of Education of Ukraine, 2019: article 1, section 1).

The standard specifies that the acquisition of specialized science education should ensure the development of the research competence of the students in accordance with their interests and study profile, the formation of values and personal qualities in them, which ensure a research culture, academic integrity and readiness for research activities (Order of the Ministry of Education of Ukraine, 2019: article 1, section 2). It is noted that the specialized scientific direction education is focused on the formation of universal human values in students, as well as demandingness to the quality of one's own research, discipline and productivity in research activities, responsibility for the results of one's own research and their impact on the life and health of people and the environment, courage in defending one's own thoughts and views, the ability to independently make rational decisions and put forward hypotheses, a tolerant attitude towards criticism, other views and opinions (Order of the Ministry of Education of Ukraine, 2019: article 2, section 2). Cross-cutting content lines that are implemented in this kind of education are environmental safety and sustainable development, civic responsibility, health and safety, entrepreneurship and financial literacy (Order of the Ministry of Education of Ukraine, 2019: article 5, section 2).

The study of the provisions of the current educational legislation and secondary regulatory legal acts makes it possible to assert that the legal field has already implemented the actualization

of certain aspects of science education (without giving the definition of the concept itself), namely: personally oriented and activity-based approaches to learning; emphasis on the student's independent activity; striving for practical application of the knowledge acquired by the student; improvement of the student's research activity and skills of independent educational activity, as a task of individual educational branches: "We can assume that from a legal point of view science education can be considered as a specification of the concept of "differentiated education" on the basis of separately taken criteria, namely: independent scientific activity of the student in the learning process; minimization of the teacher's role in the process of the student's acquisition of knowledge" (Hotsuliak & Halchenko, 2016).

Therefore, the analysis of the main legislation, which contains norms that directly or indirectly regulate the issue of science education development in Ukraine, makes it possible to assert the existence of a basis for the future implementation of the paradigm of science education, including through the implementation of European recommendations. Such implementation of the recommendations of the European Union can theoretically be of a complementary nature by making changes to the existing legislation with the aim of clarifying or creating new, specific by-laws in the form of standards.

Conclusions

In the process of analyzing European recommendations in the field of science education ("Science education for responsible citizenship"), the following conclusions were formulated. The mentioned report is a complex multi-vector educational document that was created in 2015 by a group of European experts and is not mandatory. The main task is to identify six key objectives and associated recommendations, which in combination, can help bring about the systemic changes required to generate a sustainable effect across our societies and in our communities: science education should be an essential component of a learning continuum for all, from pre-school to active engaged citizenship; science education should focus on competences with an emphasis on learning through science and shifting from STEM to STEAM by linking science with other subjects and disciplines; the quality of teaching, from induction through pre-service preparation and in-service professional development, should be enhanced to improve the depth and quality of learning outcomes; collaboration between formal, non-formal and informal educational providers, enterprise and civil society should be enhanced to ensure relevant and meaningful engagement of all societal actors with science and increase uptake of science studies and science-based careers to improve employability and competitiveness; greater attention should be given to promoting Responsible Research and Innovation (RRI) and enhancing public understanding of scientific findings and the capabilities to discuss their benefits and consequences; emphasis should be placed on connecting innovation and science education strategies, at local, regional, national, European and international levels, taking into account societal needs and global developments (Science education for responsible citizenship, 2015: 7).

In the course of the analysis of the existing normative and legal framework of Ukraine in the field of education, the fact of the imperative of the scientific direction of Ukrainian education was established: the norms of the current legislation emphasize the need for a scientific approach and the application of existing effective European methodologies of science education within the framework of the integration of Ukraine into the European Union. Based on the above, it is possible to conclude about the normative readiness of the

national educational legislation for the implementation of the standards of science education, the absence of normative contradictions in this area, and the existence of a basic foundation. At the same time, attention was drawn to the fact that the norms of current legislation in the field of education do not have details regarding the implementation of such European practice, which makes it possible to implement projects in the field of educational norm-making by creating new subordinate legal acts, as well as making changes to existing legislation.

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