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Reforming Education in Ukraine Through the Introduction of STEM Technologies and Artificial Intelligence

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Abstract: *The relevance of the article is that in today's world of changes, there is a realization that in all spheres of public life, the achievements of science and culture, the new needs in the modernization of the education system of Ukraine. One of the possible ways of further development of this sphere is not only education reforms, but also innovations, i.e. controlled processes of emergence, perception, evaluation, development and application of innovations. The purpose of the article is to identify legislative innovations in the reform of education in Ukraine, innovative types of educational institutions in accordance with the reform, defining the essence of education reforms and innovations and features of the reform of the system of university education. It is possible to distinguish between reforms at the national and interagency (i.e., only within the education system) level, but any interstate reform is always coordinated with the highest state leadership and is accompanied by reforms in other spheres. Legislative innovations in reforming education in Ukraine are also introduced through pedagogical innovations - those innovations that are developed and implemented by state agencies and organizations of education and science. The article identifies innovative types of educational institutions in Ukraine in accordance with the reform, the innovative processes in the education system are studied; the essence of education reforms and innovations and peculiarities of the reform of the basic and university education system of Ukraine are defined.*

Keywords: *Innovative types of educational institutions, innovative processes, education system, education reforms, reforming the education system.*

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Introduction

Current reformed education in Ukraine is a system of educational and training institutions (general education and university) and activities that provide training and education in accordance with the interests, needs of society and the state, regulated by legislative innovations in the reform of education in Ukraine.

According to the legislative innovations in the reform of education in Ukraine the state policy in the field of today's education in Ukraine is based on the following principles and directions:

- humanistic nature of education: the priority is given to universal human values, life and health of people, the free development of the individual, education of citizenship, love of work, truthfulness and freedom, love of the environment, their country, the family;
- the unity of the European and domestic educational and cultural space;
- preservation and development of languages and cultures, spiritual and moral, ethnic values of peoples
- strengthening of national and cultural traditions;
- general accessibility of education, adaptability of education system to the levels and peculiarities of development and training of students, pupils
- scientific nature of education in all types of educational institutions;
- freedom in choosing the language of instruction;
- the secular nature of education in public and municipal educational institutions;
- state management of education through the development and implementation of educational programs, state educational standards, licensing, certification and accreditation of educational institutions, personnel policy
- state funding and resource provision of the education system in combination with other sources of funding and resource provision.

Numerous researchers have explored the examination of legislative changes within the context of education reform in Ukraine. For instance, in primary education, the focus is directed toward nurturing holistic child development. It is also noteworthy that these changes emphasize coherence and future-oriented planning. These reforms aim to address challenges in both education and personal growth, with a commitment to sustained and

frequent impact leading to desirable outcomes. Furthermore, these reforms should be distinguished from pedagogical innovations, as reforms are initiatives orchestrated and executed by the government.

Poltermann (2013), Ovcharuk et al. (2021), Melnyk et al. (2021), Onishchuk et al. (2020) demonstrate and certify the effectiveness of progressive types of highly developed educational institutions in Ukraine, with their benefits and drawbacks. At the same time, Komogorova et al. (2021), Gerasymova et al. (2019) and Maksymchuk et al. (2020) show why EU member countries should be focused on reforming education in Ukraine.

The article seeks to explore methods of implementing the ways of implementing the State standard and regulating the education system according to the legislative innovations of education reform in Ukraine; determine the innovative types of educational institutions according to the reform; clarify the essence of education reforms and innovations according to the legislative innovations in education reform in Ukraine, the peculiarities of the reform of the education system; compare reforms in other countries of the world (the USA, the UK, France); present the intensification of the reform process through the implementation of the Bologna Standards system in university education.

Adopting the State standard and regulating the education system in accordance with the legislative transformation in Ukraine's education reform

A legislative innovation in the reform of education in Ukraine is the introduction of the State standard, reflecting the social ideal of quality education, which meets its real needs and highlights the social guarantees of education of a certain level and quality, guarantees the quality of educational services, which the state provides free to all who seek basic education. It also stipulates the conditions necessary for obtaining a document at a certain educational level.

According to the Cabinet of Ministers of Ukraine (Kabinet Ministriv Ukrainy, 2020, p. 1), the State standard of Ukraine comprises the following:

- specifying the school's primary curriculum for grades I-III, which provides an all-encompassing view of the course material by year and its framework.;
- setting educational criteria for the school as a whole and for all subjects to achieve the objectives of general education.;

- ensuring pupils meet the lowest threshold of knowledge in primary, secondary and high school education.

According to the state standard the content of education in general and each subject consists of 2 parts: unchanging (basic) and variable part, which can be systematically updated and revised.

Ukraine's implementation of the State standard is distinctive because when constructing content for grade I schools, the creators are not focused on how much a child can learn, but rather on how it fits into the social order and what is provided for the child's further development (Kabinet Ministriv Ukrainy, 2020). In primary education, the main goal is to foster the well-rounded development of children and ensure their complete mastery of all aspects of the learning process. Consequently, the educational design considers several key factors: a) consistency and long-term outlook: ensuring a coherent and forward-looking approach; b) effective strategies for learning, education, and development: incorporating methods that are proven to be efficient; c) adequate duration and frequency of engagement: providing sufficient time and regularity of interactions to achieve desired outcomes; d) adaptability for students of varying levels of proficiency: creating a system that accommodates students with differing levels of proficiency.

The fundamental nature of primary education is effective. According to the criteria of UNESCO (2005), 80% of its results are compulsory, that is, 80% of what the student must learn, mastered in the educational institution of the first degree, so the basic component of primary education (its fixed part) is not correlated with regional characteristics and the natural environment.

Innovative types of educational institutions according to reform

According to legislative innovations in the reform of education in Ukraine, new types of educational institutions emerged in accordance with the reform.

Type I - Preschool

Types: a) preschool educational institution; b) preschool education institution of general type with the priority realization of one or more directions of students' development (intellectual, artistic-aesthetic, physical, etc.); c) compensatory preschool education establishments, with priority given to the qualified correction of deviations in the physical and mental development of pupils; d) composite-type preschool education establishments (a combined kindergarten may include general development, levelling, and recreational groups in various combinations); e) a child

development center is a kindergarten with the implementation of physical and mental development, correction and rehabilitation of all students (Poltermann, 2013).

Type II – an educational establishment

Types: a) primary school; b) secondary school; c) an educational establishment offering specialization in particular subjects (a particular subject (profile) may be designated: Chemistry, Mathematics, Physics and Mathematics, Humanities); d) lyceum; e) high school; f) evening-oriented general education schools; g) a learning center.

Type III - institution for children without parental care

Types: a) orphanage; b) school for orphans; c) institution providing education and accommodation for orphans and children without parental care; d) orphanage with a sanatorium.

Innovative processes in the education system

In accordance with legislative innovations in the reform of education in Ukraine have arisen in the 21st century in the educational sphere uses a large variety of innovations aimed at improving the quality of education. State reforms are implemented, innovations in the organization, content, methods and technologies of education are introduced. Educational enhancements include the following modifications:

- depending on the standing of education in society and the amount of money invested in the system;
- within the framework of the education system;
- with regard to educational content, covering curricula and programmes for all or individual subjects;
- in the school's internal system;
- in the relationship between teachers and students;
- in didactic approaches;
- in the context of supplying resources for educational institutions and using ICT in teaching;
- in construction of educational institution buildings and premises (Yoder, 2006).

The structure of the education system is a very mobile element of the education system (structures of the ministry, regional and district level education departments), in which changes often occur very often and not always positive.

The essence of education reforms and innovations in accordance with legislative innovations in Ukraine's education reform

The essence of the content of education is a stable factor, but it is also subject to change, which is the result of innovations in various fields of science in accordance with legislative innovations in the reform of education in Ukraine.

Innovations in teaching methods in accordance with the legislative innovations in the reform of education in Ukraine include: online and offline learning, group learning, various forms of individual work, various forms of team learning, implementation of developmental learning systems.

Changes in the equipment of educational institutions in accordance with the legislative innovations in the reform of education in Ukraine in the classroom include: the use of ICT, the use of audiovisual and other didactic means, slides, films, microfilms, players, tape recorders, programmed learning with and without a computer, radio broadcasting, television. The use of audiovisual and computer technology in the classroom requires the introduction of a new method of organizing training.

There is a difference between reform and pedagogical innovation in Ukraine. Reform refers to those innovations that are organized and implemented by the government. The reform could result in amendments to the social ranking of education, the shape of the education system, the material of education and the internal organization of the school.

A distinction should be made between reforms at the national and interdepartmental (i.e., only within the education system) levels. Any interstate reform, if it is significant enough, is always coordinated with the highest leaders of the country and is accompanied by reforms in other areas. And in this sense it makes no sense to divide reforms into intra-educational and extra-educational (national) reforms.

Educational innovations are another matter. They are, of course, the result of people's activities in the education system in Ukraine. Pedagogical innovations are innovations that are developed and implemented not by state bodies, but by workers and organizations of the system of education and science.

Any changes in the education system in Ukraine, that have been brought about by political, economic or social reforms, are the result of alterations in legislation. At the same time, the alterations to the infrastructure of educational institutions and the establishment of buildings in harmony with the legal transformations in the reform of education in Ukraine cannot be regarded as solely pedagogical revolutions. They are

rather the consequence of developments in computer science, production of teaching resources, architecture and construction.

Changes in the structural elements in the education system in accordance with the legislative innovations in the reform of education in Ukraine are pedagogical innovations, as they are innovations in education management. If management innovations do not originate from pedagogical innovations, then they may include changes in the internal organization of school activities. Therefore, changes occur only at the expense of pedagogical innovations:

- updating the content of education, its curricula and programs for all or separate subjects;
- updating the internal organization of an educational institution;
- updating the “teacher-student” relationship;
- emergence of new teaching methods.

The relationship between educational innovation and reform

According to legislative innovations in the reform of education in Ukraine, the broad innovation movement is a necessary phenomenon for reform. Its presence is an essential social condition for reform. Such a movement is not only an essential prerequisite for reform, but also a means of preparing for reform. An innovation movement helps to form the consciousness and direction of the pedagogical community and to create professional associations. Figuratively speaking, the innovation movement is the backbone of the education reform.

Innovation movement is a social and educational movement that goes beyond the sphere of education. It becomes the most important factor of self-organization and self-development of society, the energy of which ensures the implementation of programs of democratic reforms.

In accordance with the legislative modifications in the education reform in Ukraine, the purpose of current education is to generate conditions for the growth and self-realization of students to boost their capacity to make self-determined decisions, thus placing it at the heart of the new governmental educational policy (MacGregor, 2014).

The realization of this right required radical changes in the entire European education system, the formation of a new educational policy, reforming the goals of education, their economic basis, the administration of the education system, the arrangement of the educational institution, the form of payment for education.

The main reasons for the reform were:

- The desire to move away from totalitarianism in education and democratize the education system.
- The desire to humanize education, taking into account the interests of the individual.
- The need for adaptation in accordance with the economic conditions of society and the education system.
- Creation of a plane for the formation of the education system, capable of ensuring the quality assimilation of students' knowledge.

Unusual aspects of the education system reform

In Ukraine, the reform of education is seen to include its implementation during periods of political, economic and social crisis, as part of the legislative innovations. The catalyst for this reform stemmed from the political landscape, driven by the decision to align with the European direction. It could be seen as a pivotal prerequisite for the reform. In the early stages of reshaping the education system, the introduction of novel operational conditions played a pivotal role. These conditions enabled the exploration of the full spectrum of educational potential and laid the groundwork for the development of a system that could provide expansive educational opportunities.

Another sign of education reform was the parallel development of economic and political transformations and education reform. The education reform was intensified in tandem with the economic modifications in the country (Reddy, 2014).

Changes occur gradually, as cumulative, at the same time cardinal changes are not always called reforms, but are violent in nature, affected by the introduction of new regulations to ensure the functioning of educational institutions in the new economic environment. This not only expands the reform in the education system, but clearly conceals it. In subsequent stages, the reform was usually carried out under the slogan of adapting the education system to the prevailing economic and social conditions.

According to legislative innovations in the reform of education in Ukraine is focused on borrowing the strengths of the European education system, which has strengthened the state power of its potential and determined the consciousness of society, promoted the development of the necessary level of scientific and technical thinking, realized the intellectual potential of the country in terms of its international exclusion. In Europe, the education system was designed to empower young people through social

mobility, and it was ensured that everyone had free access to education at all levels, which made it widely available for everyone.

At the same time, the positive beginnings came into conflict with the socio-administrative structure of the economy, ideologized by the content of education. The impact on education in the state minimized the support of educational institutions by business and science. Could not contribute to the development of education and its consumers, that is, because of this there was very little sensitivity of the educational complex to the real needs of the individual child.

Comparison of reforms in other countries of the world (the USA, the UK, France)

The issue of national secondary school development is of inescapable importance in virtually every country in the world.

Most often this problem is solved today by modernizing and reforming education and schools in particular. Attitudes toward these processes vary from country to country. It stems both from the differentiation in the understanding of modernization and reform as phenomena in general, and depends on the one hand, both the traditions of national school development, and the socio-economic situation in which a particular country finds itself.

It should be noted that the processes of globalization occurring today, objectively affecting the development of education on a global scale, in relation to the national schools of different countries are not completely determinative. It is obvious that the model of globalization, which combines features of both global and local processes, is more likely to be implemented in the modernization and development of education. On this basis, we can state that the direction of progress for all national schools is the same, but each will follow its own path.

In turn, education reform in the United States is the prerogative of state authorities within the United States. In summary, the following are the directions of American high school reform:

- enhancing state educational standards through adopting a mutual framework of international testing standards in mathematics and native language to make sure students are able to succeed in the marketplace.;
- cooperating with education partners to put into action the most efficacious education systems and techniques in the U.S. education system;

- utilizing proactive procedures to recruit, train and retain teachers and school administrators as an approach to human capital advancement and advancement in secondary schooling;
- monitoring school performance with objectivity to uphold the national school system and ensure long-term high standards based on international best practices (Passow, 1975).

In examining the British school, it should be noted that it developed in the context of a struggle and search for harmony within the national political system between the two parliamentary parties, the Conservatives and the Liberals. These competing parties, coming to power, tried to introduce their vision of the functioning of the national secondary school, which, with the periodic change of the ruling party in Britain, introduced serious instability into its functioning. Reforming education had the following goals: to increase the importance of teaching and the authority of teachers, to discipline students, and to ensure their good behavior. The law also grants greater freedom to local educational authorities and the schools themselves to address practical issues of exercising their functions. At the same time the law changes the accountability of schools, shifting the control system from targeted and point-by-point inspections to broader, frontal ones. Under these conditions the issues of modernization of education in Great Britain are developed mainly by the educational community, which includes teachers, school administrators, parents, and other interested actors. In the process of modernizing education, several pivotal aspects include the departure from the conventional method of assessing schoolchildren through national testing at age 14, a transformation in the composition of the teaching staff, the establishment of extensive school complexes designed to encompass areas accessible by road rather than limited to walking distance, and the abandonment of antiquated ideal school models. Instead, there is an endeavor to shape new and more aligned models of an ideal school that better reflect the evolving needs of society.

In France, secondary school modernization and reform are concentrated in the hands of the Ministry of National Education of the French Republic. In this context, secondary school modernization is understood by the ministry as building a national school that meets the demands of society and the state, that provides for students to thrive, that is more equitable, that does not leave students on the sidelines of the “social road”, and that instills with pride and determination the young values of the French Republic. To this end, first of all, the national school budget is being revised, dynamic measures for the recruitment of new personnel and their initial training are being implemented to ensure the effective education of

students. Moreover, these activities should make school work and the teaching profession competitive in the labor market, which guarantees a high quality of personnel. In turn, the reform of national education carried out by the same ministry essentially involves the creation of an education system and school environment where all students acquire key knowledge and competencies. The emphasis is traditionally placed on the French language and mathematics. According to the ministry, the national school has faced problems of failure and degradation of the national education model in recent years. Therefore, the current cabinet has opted for education reforms that give priority to elementary school and early learning. This also reflects the multicultural specificity of the modern French school, where today half (and sometimes more) of primary and secondary school students do not speak French as their first language. In turn, the study of mathematics, since in the French school belongs to the most effective means of developing thinking and logic, as well as the foundation for the further successful study of other school disciplines.

Intensification of the reform process through the implementation of the Bologna Standards system in university education

In accordance with legislative innovations in the reform of education in Ukraine there is an intensification of the reform process, including the consistent implementation of the Bologna standards system in university education, which began after the revolutionary changes in Ukraine in February-March 2014. In 2014, the Law of Ukraine “On Higher Education” was renewed, and as a result, the scope of Bologna standards is growing. In particular, it involves:

- rectifying the cycles of the national higher education system (removal of the “specialist” and “candidate of sciences” titles, with the implementation of the “Doctor of Philosophy (PhD)” title);
- updating the curricula of the first cycle (discarding of mandatory subjects, transitioning to more succinct curriculum in undergraduate education);
- initiating a new type of short-term higher education (by teaching junior bachelors);
- introduction a fresh list of disciplines and specialties, decreasing the number of specialties, broadening their scope, initiating educational plans, expanding master’s training to 3-4 semesters for the second cycle courses;

- revamping the postgraduate framework for doctoral studies (licensing doctoral studies, incorporating an educational aspect, augmenting the training period from 3 to 4 years, implementing novel dissertation defense protocols, and augmenting emphasis and demands for research ethics);

- encouraging the expansion of collective instruction and research endeavors with international partners (Zakon Ukrainy “Pro vyshchu osvitu”, 2014).

This has changed a lot in the existing system of education, but caused natural resistance from the usual forms of educational organization. In particular, the country has actually replaced the postgraduate system of training doctors of philosophy and for the first time in Ukrainian history implemented licensing of their training. In many respects, such radical changes for scientific institutions of the country (academic, industry) were a shock, because they had never gone through such a painful process of licensing and accreditation before.

This period has seen significant reforms in the structure of education management and the promotion of university autonomy in Ukraine (Zakon Ukrainy “Pro vyshchu osvitu”, 2014).

In addition to the Ministry of Education, the National Agency for Quality Assurance in Higher Education was established in Ukraine. The National Agency assumes part of the functions related to the accreditation of programs and educational institutions, the development of standards for their modernization and approval, the creation, opening, closing, granting the right to liquidate, the right to operate various specialized academic councils, and also deals with the registration of degrees. At the same time, degrees are now the purview of higher education institutions and all the old structures have been eliminated.

According to legislative innovations in the reform of education in Ukraine today there is a significant expansion of university autonomy in the educational, scientific, personnel and financial spheres. Students are increasingly able to have an impact on the formation of their curriculum and play an active role in the administration of universities.

The creation of real mechanisms for the updating of academic management and the rejuvenation of the teaching staff is taking place in universities. In teaching and research these processes are going relatively well, but in personnel work it meets with quite strong resistance, and there is much misunderstanding both within universities and in the Ministry.

The most difficult point was the granting of autonomy to universities in the financial sphere due to legislative innovations in the

reform of education in Ukraine. The whole existing system of treasury services, budget planning create huge obstacles on this way and now it is one of the main issues facing Ukrainian reformers.

Recent innovations in the reform of higher education in Ukraine have borrowed the experience of European countries and have the following advantages:

- the licensing and accreditation system is being reformed, shifting the emphasis from formal requirements for evaluating the educational and scientific activity of the participants in the educational process reforming the licensing and accreditation system, shifting the focus from formal requirements for assessing the educational and scientific activity of the participants in the educational process;

- the criteria framework for awarding scientific titles is changing, focusing on internationally recognized results (SCOPUS, Web of Science); encouragement of competition between HEIs - introduction of open competition for state order places (without private HEIs);

- expanding the area of external independent testing (approbation of admission to graduate programs in law through this mechanism);

- active discussion of the need to build a new scholarship system (less populism, old approaches and equalization).

Despite the extensive reform effort in Ukraine, a number of significant issues remain unresolved. They are the following: a) regulations of fundamental importance, unprecedented in history, cannot be instituted at the right speed; b) more efforts and political determination are needed to form a new model of state financing of higher education institutions; c) launching a national system of quality assurance at all levels has not been feasible; d) no suitable models of national and research universities for the present situation have been developed; e) normative financing approaches for higher educational institutions have not been established; f) the dilemma of offering directed state-funded loans to pay tuition fees has not been resolved; g) the process of enrolling in higher education requires stabilization.

Legislative changes made to the reform of education in Ukraine have brought to light certain shortcomings.

According to legislative innovations in the reform of education in Ukraine, there is a need to develop national cultures and the education system, but there are fears of ignoring national specificity, and this must be taken into account.

Conclusion

The importance of the article lies in proving the importance of implementing the State standard and regulation of the education system according to the legislative innovation in the reform of education in Ukraine, because it reflects the social ideal of quality education, meets its real needs and highlights the social guarantees of education of a certain level and quality, guarantees the quality of educational services. The Law of Ukraine “On Higher Education” (Zakon Ukrainy “Pro vyshchu osvitu”, 2014), which the state provides free of charge to all who seeks a basic education. It also regulates the requirements for the applicant for a document on a certain level of education.

The article establishes the core principles of education reforms and innovations in alignment with legislative changes in the field of education reform in Ukraine. It is deduced that innovations in teaching methods, as per the legislative updates in education reform in Ukraine, encompass a wide range of approaches. These include online and offline learning, group-based instruction, diverse forms of individualized work, various modes of collaborative learning, and the implementation of progressive education systems that necessitate the utilization of information and communication technology (ICT). This entails the integration of audiovisual tools, such as transparencies, films, microfilms, radio broadcasting, and television, as the adoption of audiovisual and computer technology within the classroom calls for the development of new instructional methodologies.

The article also focuses on the intensification of the reform process through the introduction of the Bologna standards system in university education, the implementation of the Bologna standards system in university education, which began after the revolutionary changes in Ukraine in February-March 2014. The advantages and disadvantages of this system in Ukrainian education are also noted.

Acknowledgement

Author 1 carried out a critical review of existing publications on the problem of research, explored ways of implementing the State standard and regulation of the education system according to the legislative innovation in the reform of education in Ukraine.

Author 2 presented in the article innovative processes in the education system, defined innovative types of educational institutions according to the reform.

Author 3 dealt with an important issue: defined the essence of education reforms and innovations, peculiarities of education reform.

Authors 4 and 5 carried out a comparison of reforms in other countries of the world (the USA, the UK, France).

Author 6 presented the intensification of the reform process through the implementation of the Bologna standards system in university education.

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