



Reflexion of STEM Implementation in Ukraine

BUTURLINA Oksana (1), LYSOKOLENKO Tatyana (2), DOVGAL Sergey (3)

Dnipro Academy of Continuing Education, Ukraine (1)

Dnipro Academy of Continuing Education, Ukraine (2)

Dnipro Academy of Continuing Education, Ukraine (3)

Abstract

The article is devoted to the research of trends and mechanisms of STEM-innovations implementation in Ukraine. Attention is focused on measuring the understanding of STEM and its essence, on the prospects and difficulties of implementing these social technologies in Ukrainian realities. The paper presents the results of quantitative research conducted on the basis of author's methodologies, members of teaching staff, student youth, expert group and parents of high school students. On the basis of conducted monitoring results calculation, comparing the answers of different categories of respondents, the authors attempt to summarize the STEM technologies state in modern Ukrainian society and come to the conclusion that the implementation of relevant innovations contributes to the dissemination of dialogue among all participants in the educational process, parents and potential employers. Conducted research makes it possible to state the following.

Educators of experimental educational institutions have a sufficiently high level of motivation to innovate, open to cooperation and understand the importance of innovations in the modern Ukrainian school. STEM topics of interest to students are clearly outlined. Therefore, the majority of polled GEI students support the STEM direction and understand its prospects but do not understand in what sphere and where they will work in the future, even choosing the STEM profession. The results of the study showed that modern parents are motivated to influence the future profession choice their own children. However, the direct parents' influence on the future profession choosing is limited because a significant number of high school students have their own opinion on this issue, which is in part or does not coincide, with parents.

Keywords: *STEM, society, innovation, education, strategy of education development in Ukraine;*

Introduction. Modern model of society progressive movement is formed under the influence of humanistic tendencies, which are represented in economic theory and economic practice. As a result, innovations that are focused on building human potential, one of which is STEM innovation, are spreading in education.

STEM – a series or sequence of educational programs designed to solve the problem of the scientific and engineering specialists lack for high-tech industries and raise the competitiveness of the state. It is a priority in state policy towards economy strengthening and state social order to the educational sector. Consequently, relevance of STEM in the modern European institutional space is beyond doubt. However, today there is a certain dispersion of ideas, views and implementation directions of STEM-innovations. European countries have deferent initiatives for the STEM education implementation but all of them aimed at implementing policies in the following positions: development of scientific education for youth, ensuring wide awareness of the STEM industries development relevance, attracting young people to research in natural sciences and mathematics. The consequence is that today most countries have their own global approach to solve STEM issue at the national level: some have adopted national strategies, while others contribute to creation of specialized regional or local centers to improve the quality of teaching STEM subjects.

Multivariate in directions of STEM realization and implementation can be considered a definite ontological theory that deserves attention and reflection in the Ukrainian public space. In Ukraine, despite the very young direction of STEM, the implementation programs have been developed at the government level for schools, universities, science centers [1; 2]. In the other hand, STEM coalition of Ukraine brings together the efforts of the non-government sector (NGO, employers and other). Important role in the development of Ukrainian STEM education model is played by the efforts of scientists and practitioners who are trying to develop authorial technologies in the framework of experimental research at the national and regional levels. The data for this paper comes from the Regional Ukrainian project “STEM on the river Dnepr”, which involves 41 educational centers in Dnipropetrovsk Region (secondary schools, scientific and technological lyceums, gymnasiums), STEM educators and partner organizations, representing regional industry. The main task of this STEM



community is to build a unique regional innovative STEM education model, to develop young people's interest in STEM education and careers.

Purpose of the article is to summarize the results of conducted sociological research, determine the specificity and features of STEM introduction as a topical modern innovation in Ukraine (on the example of Dnipropetrovsk Region). Continuing the approaches proposed by European researchers [3] in the inGenius project, we expanded the scope of the study and involved groups of reference people who influence the choice of a profession by young people. These are parents, teachers and experts of the region, representing different communities. The results presented in this paper can be useful for educators who are trying to build their own new model of education and solve the problems of promoting professions among young people.

GENERAL CHARACTERISTICS OF CONDUCTED RESEARCH

Respondents	Number of respondents	Purpose of the poll	Method	Dates
Principals, coordinators and teachers of experimental schools	230	Purpose of the study was to identify the level of motivation and technological readiness of pedagogical workers for experimental work on the introduction of STEM education innovative model in regional secondary education institutions	On-line poll with google-form service (author's questionnaire)	April 2017
10th grade pupils of Dnipropetrovsk region secondary schools	670	Purpose of the research was to investigate students' public opinion about studying subjects and selecting STEM-professions	On-line poll with google-form service (author's questionnaire)	October 2017
Expert Group: Management of leading enterprises of Ukraine; Employees of higher educational institutions of Ukraine; The heads of local education authorities; Representatives of employment centers	40	Purpose of the survey is to study the experts' opinions of different categories on the main problems and perspectives of introducing STEM-education at the regional level (on the example of Dnipropetrovsk region).	On-line poll with google-form service (author's questionnaire)	April 2018
Parents of high school students	486	Purpose of the survey is to study the level of parents' influence on the professional orientation of senior students.	On-line poll with google-form service (author's questionnaire)	October 2018

Analysis of the results

I. 'Pedagogical workers' motivational and technological readiness for experimental work on introduction of the stem-education innovative model in dnipropetrovsk region'



It should be noted that the study of teachers' opinion was very important because STEM as a direction came to Ukraine first of all through the education system, the most massive - through the school, and teachers, in this case act as agents of change, from whose thoughts and guidelines further development of STEM-innovations in Ukraine is largely dependent.

Conducted questionnaire allows assuming the following. Interviewed representatives of experimental educational institutions generally have a positive attitude towards innovation, but provided that it will be aimed at working with students, introduction of new forms and methods of work. In general, it can be stated that surveyed educators are ready to implement changes related to the implementation of innovations. Innovations implementation in any sphere of human life is always associated with a variety of difficulties. Among the reasons that may slow the introduction of new pedagogical ideas and technologies, the respondents highlight, first of all, insufficient material provision - (33%), conservatism in education - (16%), excessive saturation of educational material - (14%), hasty introduction of new in the process of training - (12%), lack of personal time for the implementation of innovations - (13%). Also, attention is drawn to the fact that only 6% of the respondents identified among the reasons that hinder innovation activity, students' psychological unwillingness to perceive innovations.

Respondents were given an opportunity to define their vision of what factors could affect the successful implementation of STEM education in their institution. (Chart № 1)

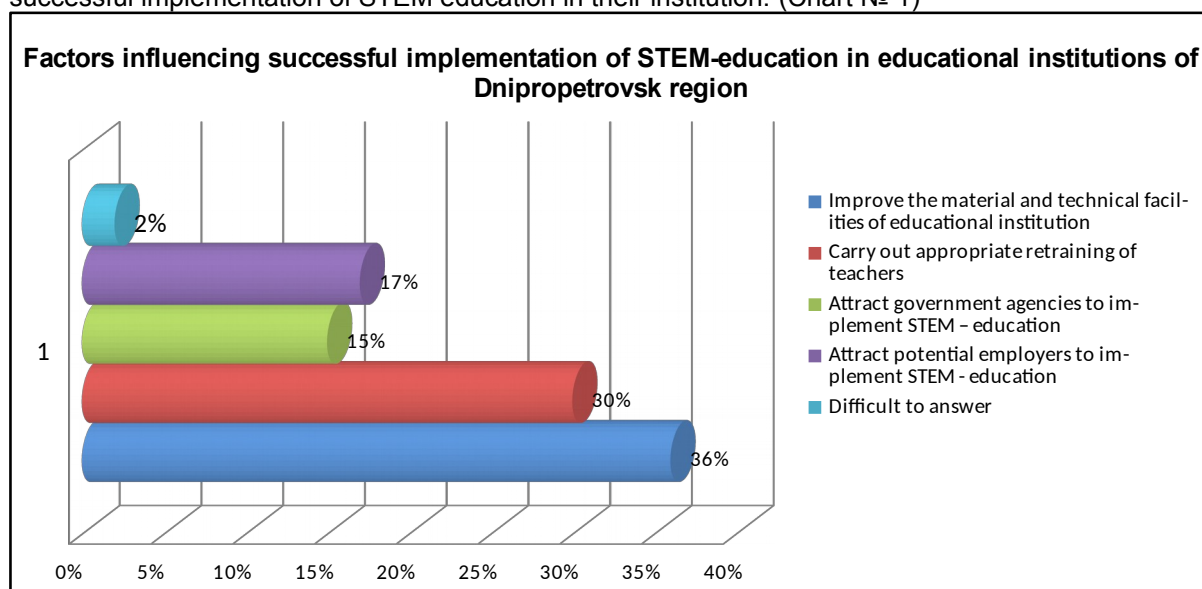


Chart № 1 'Factors influencing successful implementation of STEM-education in educational institutions of Dnipropetrovsk region

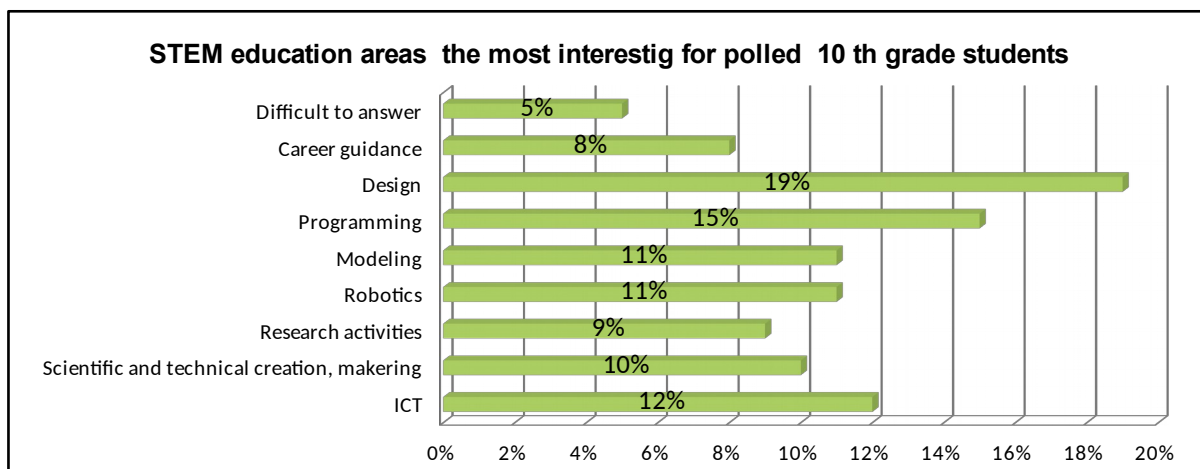
Such respondents' position may indicate a lack of understanding of potential employers and government bodies' role in the STEM education implementing process.

The vast majority of surveyed educators (85%) are convinced that introduction of STEM education will improve the quality of education at their institution. It is clear that STEM-education in educational institutions can be realized only in specific areas of study, since this concept includes application of science, technology, engineering, mathematics in the educational process. In this study, respondents were asked to decide on exactly which areas STEM education could be carried out at their institution. Most respondents noted that in their educational institution STEM education can be carried out in the following areas: computer technologies (28%), natural sciences (27%) and mathematics (26%). A much smaller number of respondents noted that in their educational institution STEM education could be applied in areas such as biology and compatible sciences (12%) and traditional engineering (5%). It should be noted that traditional engineering is one of the STEM education key areas but as we see from the survey results, educational institutions are not ready for this direction development today because they do not have appropriate material base.

Conducted research makes it possible to state the following. Educators of experimental educational institutions have a sufficiently high level of motivation to innovate, open to cooperation and understand the importance of innovations in the modern Ukrainian school.



II. 'Studying the attitude of 10th grade students to the study of subjects and selection of stem professions'



Survey results make it assumable that the polled 10th grade students are interested in different directions of STEM – education. (Chart № 2)

Chart № 2 'STEM education areas the most interesting for polled 10th grade students'

As shown by the research results, natural, mathematical disciplines and technological education are not very interesting for the questioned children. So, only the third of respondents (25%) noted that these are the most beloved subjects. Most respondents (almost 38%) are interested in these particular directions of education not more than other. At the same time 14% state that there would be a greater interest in natural and mathematical disciplines, but everything depends on the teacher's level of training. It was categorically noted that these subjects are remarkably difficult and they do not want to study by 14% of those polled. Absolutely do not want to learn 5% of those polled. 4% of the respondents are not determined on the question.

However, the questionnaire showed that only 25% of respondents indicated they could choose STEM-professions like industries related to natural sciences, technologies and mathematics. At the same time, respondents (29%) said that they would like to choose a profession in the industry, but do not know where they would be able to work in the future. One-fourth of respondents (25%) noted that they lacked sufficient knowledge of natural sciences and mathematics and could not choose a profession in the field of STEM. Also 10% of respondents noted that in their opinion this direction is not promising.

Conducted research gives the ability to establish the following. STEM topics of interest to students are clearly outlined. Therefore, the majority of polled GEI students support the STEM direction and understand its prospects but do not understand in what sphere and where they will work in the future, even choosing the STEM profession.

III. 'Problems And Prospects Of Stem-Education Implementation In Dnipropetrovsk Region' (Expert Survey)

Monitoring of expert opinions was seen relevant not only to examine the opinions of various specialists regarding the complexity of STEM education implementation, but also to attract their attention to these innovations, determine the level of readiness of different society layers and their representatives to solve professional orientation problems. The study of expert opinion on problems and means of overcoming STEM personnel deficit in various areas of professional activity, identifying the most in-demand STEM specialty, suggests the following. Today there is a shortage of STEM personnel. Experts believe that the most promising ways to overcome this deficit are: establishment of cooperation between school, university and enterprises (21% of respondents supported this position); introduction of joint projects with employers (17% of respondents supported this position), updating of school and university curricula (16% of respondents supported this position). That, in turn, confirms the prospect of certain directions of reforms in education. At the same time, insufficient methods of solving qualified employees lack problem according to experts are the following: support of the



promising youth by employers (12% of respondents supported this position) and introduction of dual education (13% of respondents supported this position). It can be assumed that such percentage rate is related with regulatory norms of this work, insufficient distribution of these support forms and lack of awareness in employers about such involvement of young people to work in their companies / enterprises.

The study of supporting mechanisms for promising pupils and students by potential employers demonstrated the following. 40% of respondents believe that young people may be determined on the choice of profession while studying in grades 10 –11. Respondents believe that one of the most important criteria for choosing the future specialty is the level of wages (35% of respondents supported the position), inclinations and interests of youth (26% of respondents supported the position), demand for the future specialty (17% of respondents supported the position). Interestingly in previous studies youth's (pupils) responses to this question were distributed as follows: more important for young people in choosing the future profession is the level of wages (46%) and the demand for future specialty (43%). Accordingly, it can be assumed that the selected expert group as a whole has its own vision of how to promote the STEM education brand in the Ukrainian society.

IV. 'The influence of parents on professional orientation of high school students'

STEM - innovations is an area of activity that is directly related to the professional orientation of modern youth, which is why, in the context of the development of dialogue in the modern Ukrainian educational space, it is important to focus on the opinion of the parents of students of experimental educational institutions.

The survey showed that the vast majority of questioned parents (92%) discussed the problem of choosing a future profession with their children; only (4%) of respondents indicated that they did not discuss this problem with their children and (4%) of respondents are not determined on the given question. The research also demonstrated that parents' thoughts about choosing a future profession often coincide with the child's view. Thus, this was indicated by (42%) of the interviewed respondents. While 40% of parents surveyed said their opinion on the choice of future occupation was only partially equivalent to their child's opinion. Along with this 14% of respondents noted that their opinion does not completely coincide with the opinion of their own child. 4% of respondents are not determined on the given question, respectively.

Among the areas of professional activity in which respondents advise to apply the skills of high school students, it is possible to single out, first of all, information technologies (27%), medicine (11%), administrative activities (10%), production (9%), science (9%), art (7%), pedagogy (7%), sphere of service (7%), sports (5%), military affair (3%).

Thus, the results of the study showed that modern parents are motivated to influence the choice of the future profession of their own children. However, the direct influence of parents on the process of choosing the future profession of their children is limited because a significant number of high school students have their own opinion on this issue, which is in part, or does not coincide, with parents.

Conclusions

Consequently, the study made it possible to form a general conceptual vision of prospects for introduction of various STEM areas in Ukraine on the example of Dnipropetrovsk region.-

STEM innovations create a new space for a steady dialogue between educators, parents and employers for the development of the economies of the states and engage youth in STEM industry.

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