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GENDER DISPARITIES IN STEM

The article deals with the contemporary situation in STEM as interdisciplinary system of education, the main emphasis is given to both education and employment spheres. The article highlights the main spheres of STEM application, mainly in science, technology, engineering and mathematics educational spheres. The article points out the necessity of helping students to prepare for these areas of learning and create practical applications in the aspect of application these lessons to the real world. Much attention has been paid to gender correlation in STEM, focusing attention on the problematic issues in this area people are faced with nowadays such as unequal ratio, situation de jure and de facto. Also, statistical data was presented that shows great gender gap in educational and scientific areas. It is also noted that over the past decades, gender relations in education and the workforce have changed: women have won the right to work in "male" jobs, receive fair pay and recognition through awards, grants and publications. In the course of the study, it has been discovered that despite general changes, differences persist in the fields of science, technology, engineering, and mathematics (STEM). The article analyzes the problem of gender, researches its origins and offers its own vision of its solution. In addition to the moral issues associated with equal access to professions, understanding and addressing the complex issues surrounding gender in STEM is very important. Modern STEM education promotes not only skills such as critical thinking, problem solving, higher-order thinking, design but also behavioral competencies such as perseverance, adaptability, cooperation, organization, and responsibility and should provide the equal possibilities for every member of the society.

The benefits to STEM and society will only be realized when the full participation of all able and qualified people, men and women, is guaranteed.

Key words: Science, Technology, Engineering and Mathematics; gender; professional development; STEM, disparities.

Introduction. Nowadays the issue of gender itself as well as gender gap or discrimination is widely spoken about. This situation may be seen and often bumped with not only in employment but also in educational, medical, environmental, political and other spheres. The problem facing everyone now is really burning. The necessity of support of the rights equality was manifested firstly in the Universal Declaration of Human Rights adopted by UN General Assembly as early as in 1948. The main attention was paid to the problem of overcoming of all forms of inequality (such as race, colour of skin, sex, language, religion, political or other opinions, national or social origin, property, birth or other position) that at that time seemed to be the basis for a just and fair society. Nowadays we face the problems of gender inequality that is of utmost importance. Some factors of gender inequality seem to have risen from traditional attitudes to the male and female roles in a society. On the one hand it is important to keep alive the traditional gender values, but on the other one should have equal rights and possibilities in the any sphere of the world.

Gender inequality can be found practically everywhere, starting from education (both while applying to and teaching at the universities) and then moving to social, cultural, political, religious and other spheres. One of the most burning problems in gender disproportions and disparities lies in educational sphere, namely in higher education.

Awareness of the problem of gender inequality in all main spheres of our life lay the groundwork for finding ways for its overcoming.

Analysis of recent research and publications.

The issue of gender disproportion still continues to be of great importance. Nowadays much attention has been already paid to the problem of necessity and perspectives of STEM education system. Much has been studied by mainly American and European researchers such as Fareed Zakaria, John Maeda, Sandy Buczynski, Justin Brady and others. In our country main attention to this issue was paid by E. Skibae, S. Storozhuk and others. However, the issue needs further studies.

The purpose of the article. The article discloses the problematic issues of gender disparities in STEM

sphere. So, the main purposes of the study are to point out the main aspects of the existing STEM system, to highlight the reasons and factors for gender asymmetry and discrimination both in education and employment, and finally offer the possible solutions to the problematic issue.

Main research material. STEM education (science, technology, engineering, and mathematics) is quite experiential learning strategy which provides students mainly with an interdisciplinary approach to learning and allows the application of knowledge and skills to be integrated through in-context projects or problems. There are a few advantageous of this approach as compared to the already existed one. Firstly, STEM education makes learning “real”. Secondly, it gives students the opportunities to see the connection between the subject content they are studying. And finally, it provides with the application of that content irrelevant ways. STEM education is designed to encourage students to pursue these subjects as well as innovation and research in their education and career paths [1, c.99-104].

“Only 17 women have won a Nobel Prize in physics, chemistry or medicine since Marie Curie in 1903, compared to 572 men. Today, only 28% of all of the world’s researchers are women. Such huge disparities, such deep inequality, do not happen by chance. Too many girls are held back by discrimination, biases, social norms and expectations that influence the quality of education they receive and the subjects they study”. This is the beginning of the report which was commissioned by the United Nations Educational, Scientific and Cultural Organization (UNESCO) [2]. The changes taking place in the social and professional role of women in modern society are influencing the strengthening of gender asymmetry. Gender asymmetry is a disproportionate representation of the social and cultural roles of both sexes (as well as ideas about them) in various areas of life. In the system of higher education, gender asymmetry is manifested in the unequal ratio of men and women employed in this area. Formally, there are several times more women in education than men, but at the same time, there are much more men in management.

Such discrimination also exists in other areas, such as the arts and culture, where the majority of workers are women, mostly in low-paid positions. The percentage of women engineers who leave the profession is much higher than that of male colleagues. On top of that, another problem is the high proportion of female STEM students who drop out of college or change careers when entering the labor market and even at some point in their STEM career. For example, in the European Union, only 20 percent of women aged 30 and over with technical degrees choose to stay in the tech industry. This also happens because of the lack of sense of adaptation

to the role of the engineer in the workplace. Hundreds of studies have underlined the existence of the so-called “stereotypical threat”, i.e., the psychological situation during which women would feel at risk of being categorized as belonging to a social group on which negative stereotypes are concerned.

When we talk about discrimination, we mean *de jure* and *de facto* discrimination. There is no *de jure* discrimination in Europe, because the legislation is more focused on women. As far as *de facto* discrimination is concerned, we do have cases where a woman is denied employment or is offered lower wages due to circumstances, because a woman is more family-oriented and family-related.

A study by the European Trade Union Confederation, the results of which were published by Euronews, indicates that this gender gap will not be overcome in European countries until the beginning of the 22nd century, and, for example, in Germany until 2121, in Romania - until 2022, and in Belgium - until 2028. According to analysts, the main reason for this gap is the stereotypes that lie in the field of psychology and discrimination against women.

Gender inequity in STEM higher education is not only a national issue; it is a global phenomenon. It is already evident at school. Most of the current research links gender divisions in STEM to the social roles children learn through family upbringing and socialization in kindergartens and schools. Studies have repeatedly reported that math and science are perceived as male domains, and scientists as predominantly male [3].

According to the UNESCO groundbreaking report *Cracking the code: Girls’ and women’s education in STEM*, only 35% of STEM students in higher education globally are women, and differences are observed within STEM disciplines. For example, only 3% of female students in higher education choose information and communication technologies (ICT) studies [4].

A 2019 Harvard Scholars study found that the gender gap in STEM starts at school. By high school in the US, there are twice as many boys as girls who dream of becoming mathematicians and engineers. The same trend can be seen in high school: girls make up 61% in biology, 52% in statistics and 50% in chemistry, but only 23% in computer science and 29% in physics. In college, the gap widens: men are five times more likely to study engineering and IT [4].

At first glance, it seems that the statistics of men and women earning a bachelor’s degree are leveling off: 50% of bachelors in science and technology are women. But if you exclude all social and behavioral sciences from this broad spectrum, it turns out that in classical STEM disciplines, women bachelors make up only 38%.

Statistics generally showed an increase in the share of female researchers: 35% in 2005 versus

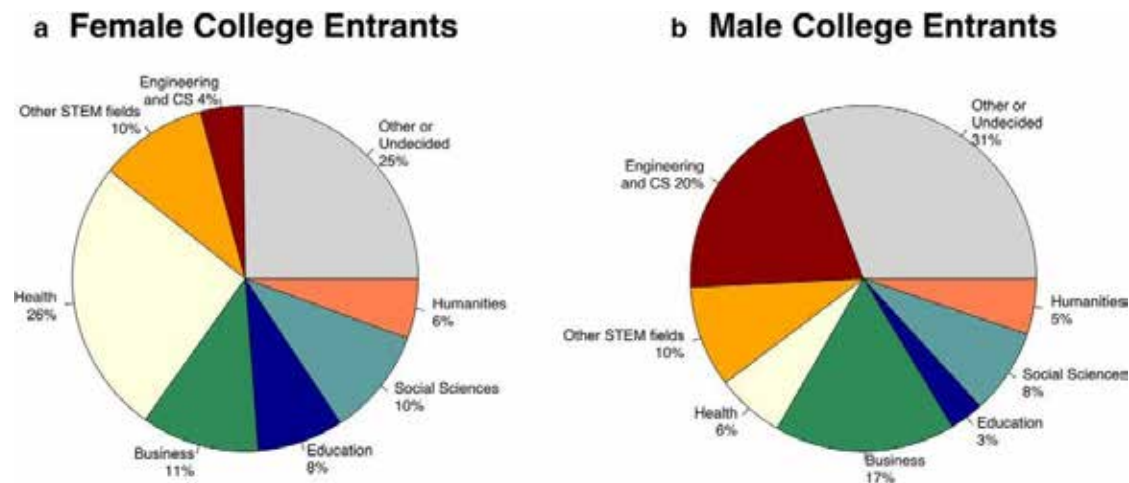


Fig. 1. Gender gap among US college applicants [4]

12% in 1955 among all disciplines. But the percentage of women varies significantly depending on the field of research (15% in STEM and 33% in psychology) and country (28% in Germany and 50% in Russia). Harvard scientists conducted an experiment - they compared men and women of the same age with the same experience, occupying similar positions. It turned out that even in this case, women in the field of STEM receive 9% less than men.

What causes gender inequality? Why do girls lose interest in math in high school?

Scientists have tried to explain this trend by analyzing children's math abilities using standardized tests. Modern research has proven that the gender difference in cognitive (including mathematical) abilities is so small that it can be considered an error. Maybe it's not about mathematical ability, but about performance? Tests show that kindergarten boys are more productive than girls in exact sciences. However, among highly skilled workers, this gap has narrowed rapidly over the past decades, currently it is - 2:1. In addition, scientists have noticed that women perform worse if they know that the test is aimed at revealing gender differences.

Thus, higher productivity is not an innate male trait.

Most of the current research links the gender division in STEM to the social roles that children learn through family upbringing and socialization in kindergartens and schools.

First, mathematics is considered a science "for boys". Mathematics is a complex and highly paid field of science. The stereotype that girls are more drawn to the humanities was explained by maternal instinct, physiology and hormones that supposedly interfere with a career as a programmer or engineer.

Scientists have found that the interest of girls in the exact sciences is strongly influenced by the family: in families where parents or close relatives are engaged in the exact sciences, the tendency of schoolgirls

to mathematics is noticed faster and more often contributes to the development of the child in this area.

Another reason for the predominance of men in STEM is the high competition in this environment. The traditional upbringing of a girl involves the promotion of such qualities as diligence, perseverance, obedience. In boys, as a rule, the opposite is true - they are encouraged to be active and strong-willed. A child, who is ready for competition and struggle from childhood, copes with stress more successfully in the future and, as a result, more easily endures competition at work.

Despite the fact that gender inequality in science today is much less pronounced than half a century ago, women in STEM are still in the minority due to popular misconceptions and the peculiarities of female gender socialization.

Increasing the number of women in engineering requires a collaborative effort between educational institutions and work environments that contribute to the elimination of prejudice against men and women. Engineering and computer science, for example, differ from the broadest STEM category in that they account for over 80% of the workforce, offering a wide range of high-quality opportunities. The experience of women, together with the experience of men, contributes to creativity, productivity and innovation.

Tessa Charlesworth in her investigation "Gender in Science, Technology, Engineering, and Mathematics: Issues, Causes, Solutions" proposed the following solutions to gender disparities:

- Changes in gender bias at the individual level in "perceivers" (who make decisions about a person at the time of hiring or promotion) and in "goals" themselves (for example, women's and men's own perceptions of themselves in STEM).

- Changing gender bias at the organizational level. The STEM environment exhibits biases that have implications for women's safety, productivity,

and perceptions of belonging. Providing flexible working conditions in STEM can have a beneficial effect on the conversion and advancement of women (especially mothers), as such arrangements uphold and support community and family values [4].

“Gender equality is a sensitive indicator that shows how developed and democratic a state is,” noted the prominent American political scientist Ronald Inglehart. Minister of Education and Science of Ukraine Sergiy Shkarlet continues: “Stereotypes about the role of women and men must change, starting with education. That is why the MON is one of the subjects of the international initiative “Partnership Biarritz” and fulfills its obligations to promote gender equality.” The world is equal: half the population, half the talents of the world are women. Therefore, equal representation of women and men with equal votes, equal pay and equal respect should be the norm. It would be a mistake for any organization to let go of a talented employee - male or female - and not develop them for better business results [5].

Conclusions and prospects for further research.

The article deals with one of the most acute problems of contemporary society, namely gender disparity in education as well as others spheres of our life. STEM is a quite new and experimental learning strategy, the main purpose of which lies in interdisciplinary approach to learning. The article points out the positive sides of existing STEM system in education. The paper reveals the complicated issue with gender disparities both in modern higher education and ensuing research work. It also focuses on unequal gender ratio in other areas such as art and culture presenting statistical data that reveals catastrophic situation nowadays as well as places emphasis on the problematic situation that might happen in the nearest

future in EU countries (such as Germany, Romania and Belgium) not only in education, science but also in other areas. Furthermore, the present article calls our attention to the difference between de jure and de facto discrimination facts based on UNESCO data and studies made by European researches. The article also spotlights the reasons that led to the present situation, namely social, cultural and national are among the most acute. Finally, the authors of the article show their own viewpoints on the problem and offer some solutions to deal with gender disparities in educational sphere.

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Нікітіна І. П., Іщенко Т. В. Гендерна нерівність в STEM освіті

У статті розглядається сучасний стан STEM як міждисциплінарна система освіти, основний акцент зроблено як на освітній, так і на працевлаштувальній сферах. У статті висвітлено основні сфери застосування STEM, переважно в науково-технічній, інженерно-математичній освітній сфері. У статті вказується на необхідність допомоги учням у підготовці до цих напрямків навчання та створення практичних застосувань в аспекті застосування цих уроків у реальному світі. Велику увагу було приділено гендерній кореляції в STEM, зосередивши увагу на проблемних питаннях у цій сфері, з якими люди стикаються сьогодні, таких як нерівне співвідношення, ситуація де-юре та де-факто. Також були представлені статистичні дані, які свідчать про великий гендерний розрив в освітній та науковій сферах. Також зазначається, що за останні десятиліття змінилися гендерні відносини в освіті та робочій силі: жінки вибороли право працювати на «чоловічих» роботах, отримувати справедливу оплату праці та визнання через нагороди, гранти та публікації. У ході дослідження було виявлено, що незважаючи на загальні зміни, відмінності зберігаються в сферах науки, технологій, інженерії та математики (STEM). У статті аналізується проблема гендеру, досліджуються її витoki та пропонується власне бачення її вирішення. Окрім моральних питань, пов'язаних із рівним доступом до професій, дуже важливим є розуміння та вирішення складних проблем, пов'язаних із гендером у STEM. Переваги для STEM і суспільства будуть реалізовані лише тоді, коли буде гарантована повна участь усіх здатних і кваліфікованих людей, чоловіків і жінок.

Ключові слова: наука, технології, інженерія та математика, гендер, професійний розвиток; STEM, диспропорції.