

**STEM-EDUCATION PRINCIPLES IN THE FOREIGN-LANGUAGE  
COMMUNICATIVE COMPETENCE BUILDING  
(ON THE DATA OF NON-LANGUAGE MAJOR STUDENTS)**

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**Summary**

As the title implies the article addresses the subject of *STEM*-education principles in foreign-language professional communicative competence building. Particular attention is given to the *STEM*-approach implementation at the non-language faculties, by psychology and physical rehabilitation students, in particular. The investigation summarizes some of the results already achieved in this field and present different researches' views on the given topic.

The paper is interdisciplinary in nature and written at the turn of various fields of science: humanities, social, natural, computer and information sciences. It is stressed that *STEM* is not a separate discipline but a kind of knowledge integration that allows synthesizing of multiple knowledge models into a common one. The articles attempts to reveal the key stages of *STEM*-education elements application. It is drawn the attention that *STEM*-oriented approach in language learning create innovation environment where students develop in equal measure hard- and soft skills, uncover their creative capacity and engage in collaboration and networking. The research distinguishes and analyzes the characteristic features and the role of the project method in *STEM*-oriented learning. Considerable attention is paid to the specific socio-psychological characteristic of Generation Z.

It is concluded that present-day education tends to look for the new methods, approaches, technologies and *STEM*-approach is one of the best ways out in modern educational process modernization and updating.

**Keywords:** *STEM*-education, non-language major students, Profession-Oriented English, Z-generation, e-learning, information-communications technology, hard- / soft skills.

DOI <https://doi.org/10.23856/5010>

## 1. Introduction

*Article's relevance* is predetermined by the *STEM*-principles effectiveness and its popularity in the education policy of many leading countries. *STEM*-oriented learning enables the possibility to strengthen the natural science component in the training curriculum and to combine science, technology, engineering, art, cultural and humanities on the base of cross-disciplinary collaboration. Professionally-Oriented English Teaching from the perspectives of *STEM*-education provides students not only with high level of foreign language communicative competence but with applied knowledge and skills in their professional domains, as well. That is why it is so essential while learning English at non-language faculties to form and develop students' professional competence within the *STEM* latest trends.

*Analysis of recent studied and publications.* Theoretical and practical issues of *STEM*-education are viewed both in Ukraine and abroad. The key *STEM*-principles and their use in secondary education are distinguished and described in the studies by

N. Morze (2016), T. Andrushchenko (2020), S. Buliha (2020), O. Barnoi (2020), S. Brevus (2020), V. Velychko (2020), N. Honcharova (2017), L. Hloba (2017), K. Huliaiev (2018), V. Kamyshyn (2020), H. Kikot (2019), E. Klimova (2017), O. Komov (2017), O. Lisovyi (2018), L. Nikolenko (2019), R. Norchevskyi (2017), O. Patrykeieva (2018), M. Popov (2016), M. Rybalko (2017), I. Stetsenko (2018), S. Tsinko (2018) O. Stryzhak (2020), I. Chernetskyi (2017), I. Vasylyshko (2018), M. Harrison (2017), D. Langdon (2011), B. Means (2015), E. Peters-Burton (2014), N. Morel (2016), J. Confrey (2016), A. House (2017) etc. Considerable attention to the *STEM*-principles utilization in language learning is paid by foreign researches, such as S. Shutler (2014), M. Dzhonatana (2016), V. Devida (2015), K. Dzhonsona (2014), M. Koelera (2015), Dzh. Mura (2014), F. Heesa (2016), A. Beyll (2015), S. Dzhozefa (2014). Nevertheless, in spite of enormous range of studies in this field the application of *STEM*-approach in Professionally-Oriented English teaching with non-language students is still underexplored and requires further research. **The subject matter** of the article is to trace the process of *STEM*-education development; to provide insight into the use of *STEM*-integrated approach in English teaching/learning at non-language faculties; to draw attention to the psychological and educational specificities of Generation Z; to examine the ways of *STEM*-technology implementation while teaching English.

## 2. What is *STEM*

*STEM* is considered a forward-looking approach in contemporary education. It is not a separate subject but a kind of framework for teaching and learning that implies knowledge integration of various domains of science. It is due to the *STEM*-principle the learning process can be performed on the verge of different subject areas that allows future professionals to become excellent in-demand experts in the most perspective spheres of human activity (science, education, medicine, economy, art), multitasking, more motivated and to extend their basic knowledge in programming, modelling, robotic technology etc.

*STEM*-integration predominantly coincides with natural and engineering sciences rather than with humanities. Although in fact, the *STEM*-capacity is enormous and its principles can be applied to any academic field, foreign language curricula and methodology is not an exception. Nowadays proficiency in a foreign language is viewed not only as a communication tool of information exchange but also as crucial factor of social, economic, scientific, technological and cultural progress. In the context of current realities, the prime objective of foreign language study is to develop the competence and skills, necessary for dealing in the professional areas. Because of increasing demands for specialists who are able to use appropriately their foreign language communicative potential to facilitate different types of activities, to ensure various modes of communication, to foster national cultures interaction etc. These requirements reflect the social priorities essence, directed at language education domain, determine the pedagogical objectives at social and economic standards.

To understand how *STEM*-oriented principles can upgrade the vocational educational system and train competent, flexible and adaptive professionals one should understand what *STEM* is and what potential benefits it has. The term *STEM* is an English abbreviation, which means: **S** – Science, **T** – Technology, **E** – Engineering, and **M** – Mathematics. Although recently the abbreviation has been extended by a new component: **A** – Art. It is worth noticing that on this point Art notion occupies a broad range of its varieties: music, painting, poetry, literature etc. Both approaches (*STEM* and *STEAM*) to education are characterized by interdisciplinarity, in other words it is not a single discipline, but an overall, integrated education system. One more

distinctive feature of *STEM*-oriented learning is its applied nature. It differs fundamentally from traditional learning parameters because it provides the conditions for simultaneous personal growth, professional and foreign language skills development, analytical and creative capability improvement, skills gaining of co-solving tasks, team working, learning in the course of independent and group work: “The human success in XXI century is completely dependent on their individual and professional abilities, but the most important and crucial among them are critical and creative thinking, stress resistance, the strong motivation to realize inner potential” (*Krasnovytskyi, Bielkina, 2003: 74*).

Having analyzed *STEM*-theoretical basis one can highlight its following characteristic features that distinguish it from the conventional educational principles:

1) **Firstly**, thanks to *STEM* students gain more time and possibilities for independent work, they learn to determine problem and find solutions in sustainable and independent manner (the concept of *life-long learning*).

2) **Secondly**, through teamwork participation, they share their experience, exchange ideas, solve problems and establish collaborative projects (principles of *project management*).

3) **Thirdly**, rote learning (memorizing technique, based on repetition) is increasingly replaced by meaningful learning – practical, active, long-lasting and fully engaged learning process. In the long run, it is the most productive way to encourage understanding and active learning techniques not by mechanical cramming but by focusing on the outcomes of the learning process that relates new teaching material to already acquired knowledge.

4) and **Fourthly**, there is a simultaneous relationship between hard- and soft skills development. *STEM*-technology deals with the interdisciplinarity, bringing together different academic disciplines into one activity. According to the famous Czech educational reformer J. Comenius: “All the knowledge grow from the same root – outer reality, they are interrelated and need to be learned in collaboration” (*Comenius, 1957: 26*).

It is for these reasons many leading European countries began work on the *STEM*-education implementation and development. Such strategic direction is aimed at establishing innovative educational environment that gets young generation interested in science, engineering, designing, and robotics. New education paradigm includes elements of blended and integrative learning, electronic / mobile learning, cloud technology, and elements of fundraising training, crowdfunding and facilitation techniques. As Russian philosopher, F. Granin claims: “Education – is a self-sufficient progress engine of the XXI humanity’s model. Knowledge society, where the main priorities are put on the investments in human capital – the most precious of the resources” (*Granin, 2004: 169*).

### 3. Generation Z and clip thinking

Generation Z (or Gen Z for short or colloquially zoomers), a term used to refer to people born between mid-to late 1990s and early 2012. Compared to their predecessors (Generation Y/ Millennials,) Z-youngsters are typically thought of being socially progressive, well behaved, abstemious, environmentally friendly, and risk-averse, more engaged in academic performance and future job prospects. However, at the same time, Gen Z youth is more exposed to intellectual disabilities, psychiatric disorders, addictive behavior, and low adaptability to the today’s world challenges. They spend much time on electronic devices and less time read books, developing shorter and shorter attention span, cognitive mental processes misbalance, which is a key feature of so-called “*clip thinking*” (fragmentary, collage, mosaic etc. perception) that leads to attention deficit disorders, reluctant attitude towards study, chaos in decision-making. Clip

consciousness means inability to concentrate for long, problems with complex, unsettling tasks solution, reduced ability to analyze, synthesize and summarize, absence of clear logic, rules and dogmas. Instead, they are living in reality, overflowing with short pictures, intense images, networks, fragmentary information.

The American futurologist E. Toffler was the first who spoke about the clip thinking phenomena in his book "*Future shock*". He was convinced that clip consciousness is a result of the information society mass impact on the individual who becomes an over-excited person with affected psyche (Toffler, 1970). In Europe, this notion was introduced by Russian scholar and philosopher F. Girenok. In his works, the researcher stressed that youth conceptual thinking stop playing a significant role in the contemporary world. Non-linear thinking replaces linear and binary one and is in opposition to the so-called book consciousness, which, in the information society with screen culture, loses its value, since screen greatly displaces a book. Even despite the fact that a book has collaborated in dialectic synthesis with a screen and resulted in electronic reader's appearance. Reading as a leisure activity type is predominantly a share of generations, growing up in the book culture but not in the screen one (Girenok, 2016).

Having analyzed a number of existing definitions it can be concluded that clip thinking is not a text but an image oriented and has the complex influence on human's consciousness by means of images and sounds. It does not presuppose long-lasting concentration on certain text; a person rapidly shifts the focus of attention and perception from one clip to another, from one fragment to another, from site to site. That leads to the mosaic, eclectic world picture formation that lacks coherence and systemacity. Clip thinking representative it is a digital epoch product who managed to adjust to data boom, paying for this by the lack of meaningfulness, deep world understanding and things understanding that are going on in the real world. As J. Baudrillard would say, it is a kind of anthropological reaction on the digital revolution.

It is hardwired into youth's brains to be an integral part of information society since they are closely interconnected in the single media environment by means of social nets, *Internet*, *You Tube*, messengers, e-mails, various podcasts etc. All these factors strongly influence engagement level and reduce work capacity and mental performance. It is for these reasons technical sciences (such as applied Mathematics, Physics, Chemistry, Engineering etc.) among youth are viewed as something complicated, dogmatic, little income-generating, boring, requiring significant time and financial consumption, compared with other human activities. Consequently, there is a sharp shortage of highly qualified specialist in the I. T. Technology domain to service state-of-the-art communications and production.

*STEM*-approach takes into account all these aspects and combines different methods, techniques, modes of information coding in order to provide modern educator with all necessary teaching tools to modernize the academic discipline content to meet present-day world demands.

#### **4. STEM-techniques Implementation in Professionally-Oriented English**

Development of foreign language professional communicative competence is an important element of *STEM*-concept in general. It presupposes skills of using major discipline professionally oriented vocabulary in appropriate combinability and context, including integrative, interdisciplinary and systematic approaches. Ukrainian researcher G. Kikot correctly emphasized: In the core of *STEM*-oriented approach should be the several academic disciplines integration to train the application of obtained knowledge in the professionally oriented situations, support interest in different subjects and develop critical and creative thinking (Kikot, 2019: 65).

From that perspective, an interesting challenge becomes the creation of *STEM* innovative educational and scientific environment at the Professionally-Oriented English classes at the non-language Faculties. Since foreign language proficiency is verified in communication, the main emphasis in the teaching methods choosing should be laid on the active teaching devices. Therefore, it is desirable to combine foreign language skills development with various communicative situations modelling, team working tasks, problems that need comprehensive solution and stimulate critical abilities analysis and creative thinking. It is important to foster equally hard- and soft skills. If the first one help to master profession the second are responsible for the heights reaching in the professional activity and potential realization. In this respect it would be advisable, at the Faculty of Physical Rehabilitation, Health and Sport, while learning issue-based module «*Sport and Health*», to consider latest trends in sport and fitness (Cycling, Functional training, Cross Fit, Proceodos etc.), novelties in healthy lifestyle industry through the lens of *STEM*-approach, using different wearable technology (devices). Choice spectrum is spectacular, from fitness-tracker, smart watches, heart rate sensors to GPS-navigators and smart glasses. The next point can be project activity process and its presentation that includes Information and Communications Technology implementation, team working, foreign language skills gaining in the process of communicative situation modelling that referred to professional environment.

An equally important issue in the concept of modern education is the relevance of studied academic disciplines. It often happens that students do not have a clear understanding of why they need this or that subject. In addition, it is thanks to interdisciplinary *STEM*-techniques nature that one can attract students' attention and show the applied character of certain knowledge and skills, its future career prospects. Active learning methods helps to understand how theoretical knowledge is converted into the practical experience. In this regard, a vivid example can be an introductory course learning of different psychology branches with psychology-students. Nowadays among a significant amount of graduating students Clinical psychology is in greater demand than Experimental, Human factor, Industrial psychology, psychophysiology etc. because of their interdisciplinary specificity, predominantly with technical knowledge domains, these fields still remain on the periphery. For instance, aircraft psychologist while studying the subtleties of flying activity should investigate not only psychological human's traits but also be competent in psychological regularities of flying techniques application, to take into account a number of factors of its exploitation, the peculiarities of flying tasks, flight conditions etc. All these demand additional professional awareness in this field. Today on the base of aircraft psychology is successfully developing the space-based one. Such innovation environment fosters students' interest in advanced areas of psychology and increases their motivation in foreign language learning, which gives access to the global scientific community, where English is an official language. Project activity with *STEM*-elements use can help in this situation again. As an option, students can form small groups and correlate project management tools with professional English vocabulary to make *SWOT*-analysis (Strengths, Weaknesses, Opportunities, and Threats) and discuss each psychology field separately. It helps to assess advantages and disadvantages, future career prospects, the possible ways of certain psychology field development.

## 5. Conclusions

*STEM*-education is one of the most striking XXI educative phenomena that combines innovative pedagogical elements, modern technology, science, humanities, art, engineering etc. The main aim of the given approach is to connect different knowledge fields in one

synergetic dimension in the course of teaching process. *STEM*-concept is multi-vector trend that comprises disciplines, methods, techniques correlation with creative skills fostering to mold a comprehensive personality.

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