Working in a MATLAB environment - a factor for the development of key competencies in students

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ABSTRACT: *Education tailored to the needs of the economy and changes in the labor market implies the application of an educational approach that aims to develop competent, dynamic and enterprising individuals, capable of coping in all conditions. The competence approach and the key competencies set out in the European Reference Framework impose the need for the theoretical knowledge and skills acquired by the learners to be applied in practice. The purpose of this article is to examine the opinion of students about their work in the MATLAB environment and the impact on their competencies.*
KEYWORDS: *key competencies, MATLAB environment, digital and mathematical competence*

I.   INTRODUCTION

In the information society we live in, technology is evolving at a rapid pace and this is affecting our overall lives. Higher education institutions strive to focus on improving the key competencies of teachers and students, so that they meet the requirements and challenges of the digital age. Applying appropriate strategies and tools used in training would improve the quality of education. The use of technology has become commonplace, but more importantly, the professional realization of future engineers depends largely on their skills for efficient and competent use in real environments. The approach to education and training of engineers has been changed, taking into account the changing socio-economic conditions. Above all, flexibility, adaptability and competitiveness are required.

II.   METHODOLOGY

The term "competence", according to the Dictionary of Foreign Words in the Bulgarian language, comes from the Latin competens and means "capable". [1] The skills that the learners demonstrate have a direct relationship with the competencies in the implementation of the specific activity. Competence is most often associated with the ability to understand something that can be done, ie. knowledge-based skills. According to Zwell, M., competencies are abilities, but not innate, but "those that are developed through quality learning, in an appropriate pedagogical environment and through the acquisition of serious practical experience." [11]

According to I. Zimnyaya, many studies have been conducted on "competence": "Competence - these are internal, potential, hidden psychological neoplasms: knowledge, performance, algorithms of action, system of values and attitudes, which are then identified in the competence of man. "[10]

For A. Bermus, "competence" is "a system of unity that integrates personal, essential and instrumental characteristics and components". J. Raven believes that: "... competence is a specific ability to effectively perform specific actions in a specific subject area, including highly specialized knowledge, special types of subject skills, ways of thinking." [8]

A. Markov examines in detail what is professional competence, believing that it is the interconnectedness of the mental qualities and conditions of a person, engaged in professional activities. In this way it is possible to show independence, responsibility ("effective competence"); as the ability to perform certain job functions. [4]

Other researchers in the field of competence approach in education (I. Winter, A. Kasprzhak, M. Choshanov, S. Shishov, B. Elkonin, etc.) note that the competent specialist not only has a certain level of knowledge, abilities, skills, but is able to apply them in practice [5]. According to A. Kuznetsov, the competence approach is oriented towards intellectual, social and practical skills. [3]

The European Reference Framework defines 8 key competences to be developed in the learning process (European Communities, 2007):

  ➢   Communication in native language;

> ➢ Communication in foreign languages;
> ➢ Mathematical competence and basic knowledge in the field of natural sciences and technologies;
> ➢ Digital competence;
> ➢ Learning skills;
> ➢ Public and civic competencies;
> ➢ Initiative and entrepreneurship;
> ➢ Cultural awareness and creative expressions. [6]

Of particular importance in the training of engineers are digital and mathematical competencies. Digital competence acquires special significance in the educational context, being one of the key competences. Work must be done at the level of its improvement, and teachers and students are expected to have a range of knowledge, skills, attitudes and attitudes. It is related to knowledge of the possibilities of digital technologies, their limitations, risks and consequences, understanding of the general principles and mechanisms underlying digital technologies, knowledge of the basic functions and uses of various devices, software and networks. [6] Mathematical competence includes the ability to use mathematical and logical methods of thinking and the rational use of formulas, models, constructions, graphs, diagrams.

MATLAB (MATrix LABoratory) software is used in the training and preparation of engineers. It is designed primarily for analysis of data from real measurements and experiments with various simulations. MATLAB is an interactive system for numerical calculations, analyzes and graphs and is used in industries such as: biotechnology, electrical engineering, medicine, automotive and others. This system is specially designed for matrix calculations: solving systems of linear equations, decomposition of matrices, processing of experimental data, two-dimensional and three-dimensional graphics, animation, etc. It has a wide variety of graphics capabilities and can be expanded with programs written in its own language. It is used in control systems, machine learning, signal processing, forecasting, statistical analysis, robotics, image processing, wireless communication and much more. One of the main advantages is the fast access to interactive applications, visualization of operations for mathematical calculation of matrices and linear algebra. Its graphical system (Simulink) includes commands for two-dimensional and three-dimensional data visualization, image processing, graphic presentation and animation, providing high-quality visualization of graphs and charts. Working in the Matlab environment is directly related to the digital and mathematical competencies of the learners. This makes it necessary in the training of students in the discipline "Computer Modeling of Electrical Systems". [7], [9]

III.   DISCUSSION

During the training in the discipline "Computer Modeling of Electrical Systems" from the master's program in "Electrical Systems" students gain scientific knowledge, which is the foundation on which to build a number of other general technical and special disciplines. In addition, it helps to build an engineering approach and habits in modeling processes and phenomena in electrical devices, electrical systems and networks. The aim of the course is to acquaint students with the methods, approaches and modern software products used for modeling processes and systems. The main approaches necessary for the acquisition of knowledge and skills related to solving problems in the field of numerical modeling of the electromagnetic-thermal field of electrical appliances and components of power systems are presented. In the process of training, variant multi-model modeling of electrical circuits of electrical appliances is realized. From Figure 1 to Figure 3 are presented examples of work on the discipline in MATLAB environment.
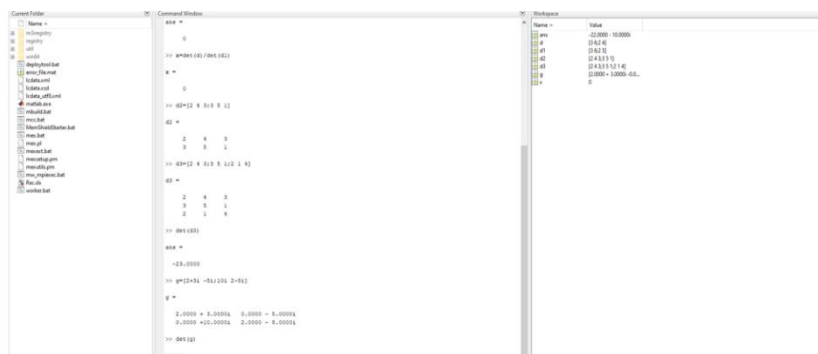

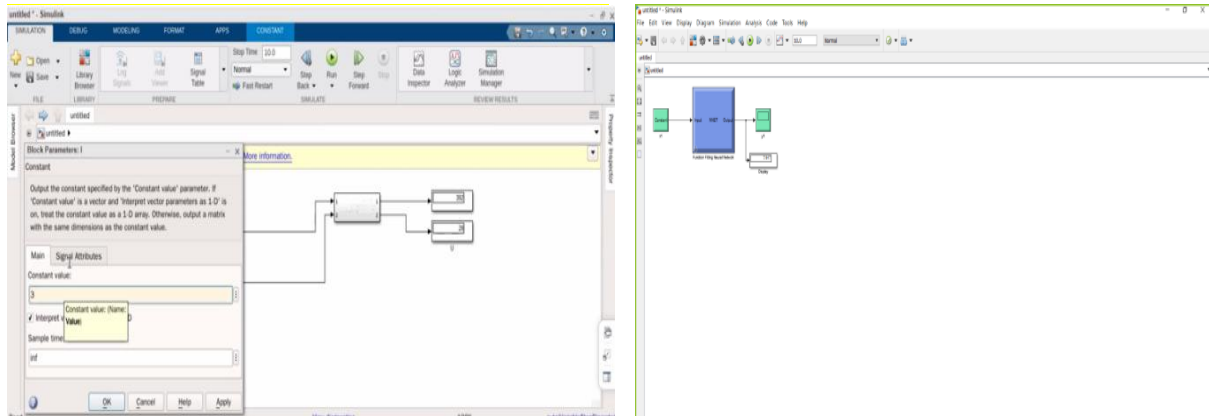
Figure 1. Matrix analysis in MATLAB environment

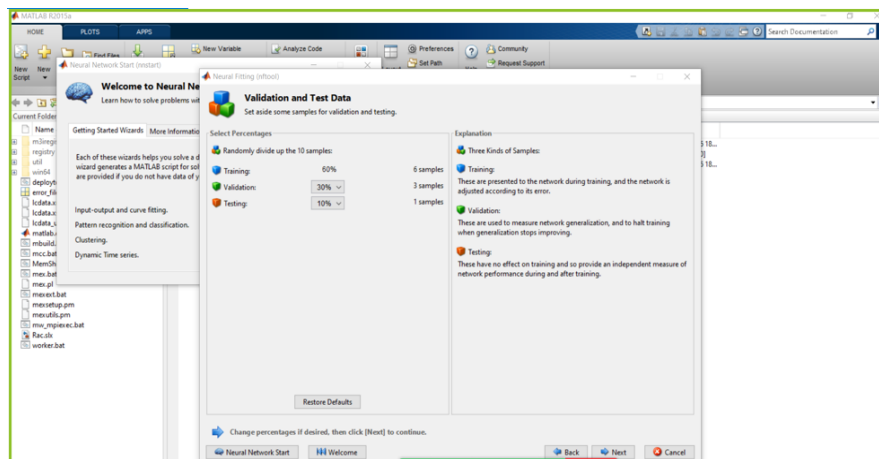**Figure 2. Working in MATLAB / Simulink environment**

Figure 3. Stage of neural network construction in MATLAB environment

In order to study the students' opinion on how working in a MATLAB environment affects the improvement of competencies, a short anonymous survey was conducted with respondents studying the discipline "Computer Modeling of Electrical Systems". The main advantages of working in MATLAB environment according to the surveyed students are: data visualization - 31.8%; modeling of simulation models - 18.2%; mathematical calculations - 13.6%; better understanding of the nature of the processes in the electrical circuits or devices - 36.4% /figure 4/. The results give us reason to say that students have realized the benefits of the MATLAB program.
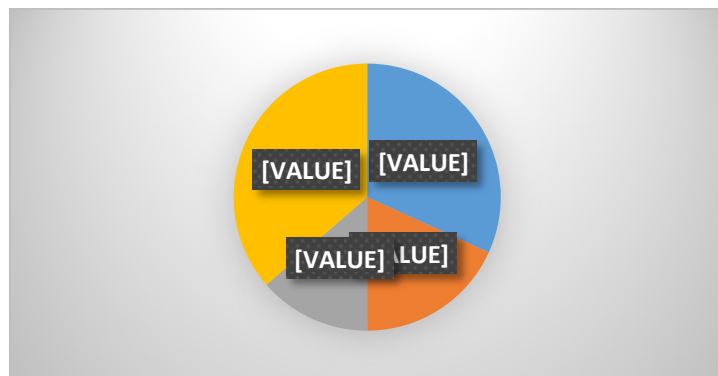

Figure 4. Advantages of working in MATLAB environment

To the question: "What are the most common difficulties when working in MATLAB environment?", The following results were obtained: 13.6% - creating a new file; 27.2% - creation of a function; 54.5% - work with matrices; 49.9% - Fourier transform. The percentages exceed 100 because students had the opportunity to indicate more than one answer. This result will direct our efforts in further clarification and dealing with the difficulties encountered by the trainees.

Interesting in terms of research are the results of a question related to the most important skills needed to conduct simulations. The highest result was answered: digital - 49.9%, followed by mathematical - 36.4%.

The study was finalized with a question concerning the students' opinion on whether working with MATLAB improves their competencies. 72.6% think: "Yes, for sure"; 4.5% - "No, I do not think so"; 13.8% - "hesitate" and 9.1% - "I can not judge" /figure 5/
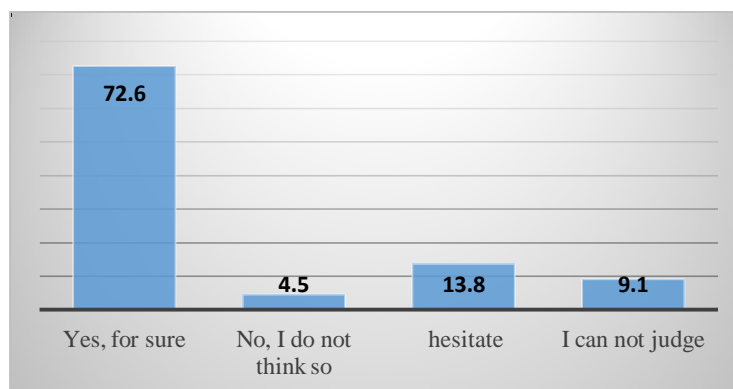

Figure 5. Has working with MATLAB improved your competencies?

IV. CONCLUSION

The course "Computer Modeling of Electrical Systems" is aimed at dealing with complex situations that require reflection and decision making. It is characterized by the following:

➢ It is oriented towards the achievement of digital and mathematical competencies;
➢ It is aimed at performing simulations in a virtual environment;
➢ Enables interdisciplinarity;
➢ Requires new forms of communication and cooperation;
➢ Development of solutions for complex problems and multi-creative modeling of electrical circuits and systems;
➢ Development of independence in the learning process.

The competence approach and the key competencies set out in the European Reference Framework impose the need for the theoretical knowledge and skills acquired by the learners to be applied in practice. Training integrates the competence approach with innovations in education and its theoretical and applied dimensions as basic pedagogical approaches.

Higher education requires a methodical system of work in order for future engineers to acquire the necessary competencies, which are a sure prerequisite for successful professional realization.

REFERENCES

[1]. Dictionary of foreign words in the Bulgarian language (1993). Ed. of BAS. S
[2]. European Communities, (2007)
[3]. Ivanova R. (2014). The competence approach in mathematics education, Scientific papers of the university of Ruse, volume 53, series 6.2 – 180
[4]. Markov A.K. (1996). The psychology of professionalism. M.: Intern. humanity. Knowledge Fund, 308 p.
[5]. Medintseva I.P. (2012). Competence Approach in Education // Teaching Skills: Materials II Intern. Scientific. Conf. M.: Buki- Vedi
[6]. MON, I-book - Competences and education https://mon.bg/bg/100770
[7]. Rodriges, H., (2013). Introduction to MATLAB
[8]. Romanovtseva O.V., (2016). The Competence Approach in Education, DOI 10.17922/2412-5466-2016-2-4-83-91
[9]. Trenchev, I., P Milanov, Introduction to Matlab, Southwestern University "Neofit Rilski" http://web.uni-plovdiv.bg/ikivanov/files/matlab%20rakovodstvo.pdf
[10]. Winter, I. Al. (2006). Key competencies - a new paradigm of educational outcomes // Internet - magazine "Eidos"
[11]. Zwell, M. (2000). Creating a Competence. New York