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PROFESSIONAL TRAINING OF SOFTWARE TECHNICIANS: THE CHALLENGES OF SOCIETY DIGITALIZATION

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Abstract.

Relevance: the digitization of all sectors of the economy, the ever-increasing demands of the modern labor market for IT specialists, the transformation of the system of IT company assessments contribute to the search for ways to ensure the training of competitive technicians, college programmers, modernization of content, forms, methods and ways of teaching and learning of students.

Aim: to define the main indicators and qualitative characteristics of the modern techno-programmer and to analyze the content of relevant training in the light of the challenges of the "digital" society.

Methods: analysis of psychological, pedagogical and methodical literature on the problem to identify the state of the problem under observation in the theory of professional pedagogy; research of methodological documentation – orders, regulations, recommendations, curriculum; systematization, comparing, questionnaires; evaluation rating, and summary.

Results. The problem of professional training of technicians-programmers in colleges on the basis of analysis of works of the international and national scientists is investigated. Factors of influence on quality of their training are considered, the basic requirements and qualitative characteristics are allocated. The opinion of students about the most demanded in the labor market personal and professional qualities of software engineers is studied and their rating is carried out. By results of the analysis of the curriculum, educational and professional program and their comparison with modern requirements of the labor market to a competitive specialist (junior specialist) a number of problems are formulated, the solution of which requires interaction of scientific, pedagogical collectives and employers.

Conclusions. The fleeting processes of digitalization of society and the national economy actualize the need to modernize the standards of professional training of technicians-programmers in colleges. They should be oriented to the development of basic parameters of competitiveness of these specialists in the employment market. The qualitative characteristics of a competitive programmer technician have been revealed: integration of high level of education, creative potential and professionalism.

Keywords: *programmer technician, professional training, college, competitiveness, digitalization, information technology, cloud services.*

Introduction. The era of modern "digital" society is characterized by a rapid change in the principles, forms, approaches, methods and ways of organizing production. The term "workplace" is now replaced by the term "digital workplace". According to the Concept of development of digital economy and society of Ukraine for 2018-2020, approved by the Resolution of the Cabinet Ministers of Ukraine dated January 17, 2018, the main purpose of development of modern Ukrainian society is to implement an accelerated scenario of digital development, which, in terms of challenges, needs and opportunities, is the most relevant for Ukraine (Cabinet Ministers of Ukraine. Legislation of Ukraine. 2018). That is, we are entering a new era, requires a person's ability for continuous learning, development, continuous self-improvement.

The accelerated scenario of digital development, among other things, also provides for the creation and development of digital infrastructures, help to take advantage of the digital world in everyday life and contribute to the effectiveness of the economy as a whole. Therefore, digitalization is designed to help: improve the quality of education services, create new jobs, develop entrepreneurship, and so on. Digitalization also contributes to economic growth by improving the efficiency, productivity and competitiveness of digital technologies used. This involves achieving digital transformation in various economic sectors and activities and acquiring new competitive qualities and properties. Integrated digitalization is aimed at a comprehensive and profound value rethinking and transformation of the existing analogue economic, social systems and spheres to increase their quality and efficiency. With this in mind, the digital society puts new demands on professionals, forcing them to master the latest technologies and techniques on the move. The professional qualities that contribute to the success of this work are also changing rapidly.

It is obvious that a digital society needs qualified mid-level professionals who are able to independently master new information technologies, work with information in a certain area, and penetrate into the technological processes of labor organization, capable of creative search, able to independently and continuously update their knowledge, improve their skills and professional skills (Varavva, 2017, p.5-10). Formation of such abilities in the future technicians-programmers today is a serious challenge for pedagogical teams of colleges. Its solution will allow the requirements of the labor market and ensure the competitiveness of college graduates. After all, the development and implementation of technological innovations will lead to their integration into all sectors of the economy, and this, in turn, will lead to the reorganization of production facilities, companies, the use of new opportunities in each workplace, and, consequently, a change in priorities in training specialists for the IT industry. For the modern professional training of IT specialists the tasks of ensuring compliance of the content and methods of educational activity of students with the changing features of professional activity, which are typical for the modern social and economic conditions, remain unsolved.

Sources. To studying of problems of specificity of professional activity of programmers are devoted works of foreign and domestic scientists, among which: Smulson (1996), Babaeva (2001), Voiskunsky (2003), Grishko (2009), Shchedrolosyev (2011). The intellectual features of programmers were studied by Litvinova (2019), Trius (2012), and Shishkina (2019). Grishko (2009) describes the qualities inherent in a programmer as a subject of activity. The model of professional competence in the structure of personality of an engineer-programmer was developed by Shchedrolosyev (2011). The general professional competencies of modern software engineers were studied by Semerikov and Striuk (2020).

Actual and sufficiently developed is the subject of research by Western scientists, related to the training of software professionals. In particular, many works are devoted to the professional identity of programmers and are considered as an indicator of professional success (Schneiderman, 1984; Bill Curtis, 1990; J. Bowman, 1995, S. Soda, 2007; John Lawnsbury, 2008; Luis Fernando Carpez, 2010; F. Ahmed, Bandar Begovin, etc.), as well as the impact of motivation on professional success (N. Badu, T. Hall, G. Sharp, etc.).

The paper aim is to identify and summarize the main indicators of competitiveness and qualitative characteristics of modern technician-programmer.

Methods: analysis of scientific and methodical literature to identify the state of the problem under study in the theory of professional pedagogy; study of pedagogical documentation – orders, regulations, recommendations, curriculum; systematization, comparison, questionnaires; rating assessment, generalizations.

Results and discussion. Humanity is developing rapidly, each year modernizing the era in which it lives. Postindustrial society, information society, service society, network society, etc. – All these are characteristics of the new epoch (Batyshev, 2010). Any society is always interested in creative, independent, proactive professionals capable of perceiving and generating new ideas, and especially need such professionals for the society of the future (Zobkov, 2015, p.91-94).

Given the above, it is clear why the request for a programmer's profession is at the top positions of the leading labor market rankings. It is important to consider and study the professional competence and individual psychological features of a programmer, which determine the success of the work functions. After all, a human programmer becomes a key figure in the "digital society". The efficiency of functioning of not only a concrete enterprise, but also the development of the country's economy in the future depends on the quality of programmers' work. That is why we consider it expedient to study the main indicators of young specialists' competitiveness in the modern labor market. Among them, in our opinion, we should pay attention to:

– educational and professional level, intellectual and creative potential, covers the level and quality of

received professional education, its compliance with the needs of modern economy, professionalism, acquired intellectual potential, creative attitude to work;

– professional mobility of an employee, his or her ability and readiness to acquire modern professional knowledge, to improve his or her qualifications, to find attractive jobs in the national and international labor markets;

– health level, the ability to withstand the modern rhythm and intensity of work, the ability to adapt physically and mentally to dynamic working conditions;

– economic status, a standard of living that provides access to quality education and allows for a longer period of time to find a suitable job;

– social and moral traits such as activity, initiative, responsibility, willingness to cooperate, teamwork, etc. (Legan, 2015).

Modern researchers S.O.Semerikov and A.M.Striuk created and justified a system of general professional competencies designed to build a stable professional competence of a software specialist, uniting 15 competencies – professional and social (Semerikov and Striuk, 2020). In our opinion, it is this system that should be used for the professional training of programmer technicians in the college.

Based on the results of the study of scientific literature, we found that researchers distinguish three components of the competitive characteristics of workers – education, creativity and professionalism, which are quite closely related to each other. At the same time, it should be taken into account that the level of education affects both creative potential and professionalism. And if education is more or less open and accessible to every young person, and its level may depend mainly on an individual, then the creative potential should be developed, that is, work on self-improvement, and throughout life (Bondarevskaya, 2015, pp. 106 -109.).

The level of general and vocational education of young people determines the possibility of its effective use in the economy and the ability to perform certain types of activities. The mismatch between the structure and level of vocational education of young people and the needs of the labour market makes it impossible to use part of the workforce of young people in production, leading to youth unemployment and unreasonable time and money spent on the re-training. According to the State Statistics Service of Ukraine in 2018, the employment rate among persons aged 25-29 years exceeded the average level in Ukraine (60.3%) and amounted to 73.8%. As for persons aged 15-24 years, this indicator was only 32.5%. (State Statistics Service of Ukraine, 2018). The low employment rate

can be explained by the fact that young people at this age are studying and do not have outstanding competitive advantages in the labour market.

According to the problem of our study should be specified that the training of junior specialists "technician-programmer" (qualification) in colleges at the specialty 121 "Software Engineering" of the knowledge industry 12 "Information Technology" at the specialty "Software Development" is realized for the formation of skills of designing software development, in particular – in the field of Internet technologies. The graduates of the speciality (software engineers) are prepared to perform the main professional function – software support and testing of software in a wide range of production areas. Thus, software engineers must master the skills of providing automatic data input to the computer, developing databases for data storage, tracking software systems and timely detection and correction of defects.

The main special disciplines that future programmers will master are: basic programming and algorithmic languages; algorithms and data structures; office software; object-oriented programming; computer architecture; computer circuitry; databases; operating systems; software and data security; visual programming tools; group dynamics and communication; computer networking; fundamentals of software engineering; software design; computer graphics; WEB programming; WEB design; database management systems; statistical modelling and forecasting.

Students, having chosen this specialty, can receive: a profession of the operator of a computer set; the diploma of the younger expert (qualification of the technician-programmer) thorough knowledge in architecture of the computer and programming in different languages; practical training on software development; experience of work with computer databases; experience and practice of work on development of software applications; possibility of the further development and improvement of professional skills.

At the same time, it should be noted that the professional components of technology programmers are described in the corresponding educational programs developed by individual professional institutions before graduating. Analyzing them, it should be noted that the technician-programmer should have certain scientific, instrumental, social, personal and professional competencies that will ensure the performance of his work on: the implementation of mechanized and automated information processing; development of technology for solving economic and other problems of a production and research nature; systems design and data processing; preparation of

operations related to the implementation of the computing process; monitoring the operation of machines; drawing up simple schemes of the technological process of information processing, algorithms for solving problems, switching schemes, layouts, work instructions and the necessary explanations for them; program development and solution of simple problems, their adjustment and experimental verification of individual stages of work; preparation of technical information carriers that provide automatic data entry into a computer, development of forms and output documents, input of necessary information and timely setup of work programs, etc.

According to the educational and professional program, the technician-programmer needs to know: design methods for mechanized and automated information processing; computer facilities, collection, transmission and processing of information, the rules for their operation; technology of mechanized and automated information processing; work programs, instructions, layouts, and other guidelines that determine the sequence and technique of performing settlement operations; types of technical storage media, the rules for their storage and operation; existing number systems, ciphers and codes; basic formalized programming languages; basics of programming; methods of calculations and computational work; methods for calculating the work performed; fundamentals of economics, organization of labor and production; the basics of labor law.

Nevertheless, there are a number of problems in the education system related to information technology education. First of all, it should be noted that since 2018, vocational higher education institutions have been training specialists for the IT industry through temporary educational programmes created in colleges (each institution develops its own programme). Therefore, professional training is not coordinated, without a joint action program to achieve the goals and objectives of vocational education in modern Ukrainian society. Another problem is the constant updating of information technologies, which entails the aging of knowledge acquired by students during their studies.

In response to these challenges, the college's teaching staff is challenged to develop the skills of IT students to adapt to self-learning and self-development; to work in a team; to cooperate, think analytically, identify problems and find optimal solutions. In addition, a graduate's suitability for the profession can be determined by the college's qualification certification system. Professional higher education institutions independently develop certification practices by involving students in various subject competitions, contests and exhibitions.

Based on the pedagogical experience of the college, we cannot ignore their lack of integration with higher education institutions in shaping key and subject competencies. This has a negative impact on the training of applicants for professional higher education. We are talking about the need to involve students in university competitions, because the sooner they start participating in them, the sooner they will master the skills of research, planning, project development and implementation, and self-actualization. In their professional activity they should be able to think rationally, solve problems, look for optimal (alternative) approaches to solving problems.

Therefore, today's vocational education faces an important task: training IT-specialists, in particular, software specialists, at a high level, taking into account the needs of the labor market. The educational process should be reasonably adjusted to the needs of society in the field of information and digital technologies. It is important not only to give students the opportunity to get acquainted with the latest scientific developments and obtain professional knowledge, skills and abilities, but also to get acquainted with the experience of practitioners in various fields related to the specialty.

It is necessary to consider that training of program experts is carried out in vocational training institutions in the conditions of active development of mobile technologies, creation of an open electronic content, occurrence of new cloud services, social networks, mobile appendices etc. for training. In this regard, a modern teacher is called upon to create favorable pedagogical conditions for the active work of students, which include: the ability to find the necessary information, structure, systematize and present the result to end users in the right form, working together to solve professional problems, while demonstrating communication skills and using a modern arsenal of interactive methods of learning.

Scientists and IT practitioners say in unison that Ukraine is the most successful country in Europe in terms of developing and adapting mobile technologies. This opinion is based, in particular, on the performance of powerful companies: Google (chief regional manager Dmitry Sholomko), Google Marketing Solutions of Central and Eastern Europe (headed by Nina Levchuk) and others. They name three main points that make their employees more productive: they trust people, give them the opportunity to realize themselves and make people create what they are interested in. In other words, trust, delegation and the need to make these people like what they do (Jovanovskaya, 2016). It is these principles that have been proclaimed by leaders in the development of the European Higher Education Area. In this regard, the cooperation of colleges with employers –

representatives of business on the basis of public-private partnership in addressing current issues of the training of IT specialists.

Based on the results of internships of college students in the workplace, we can say that the demand for specialists in the profession of software specialist in companies is constantly growing. This fact convinces him of his prospects and at the same time testifies to the need to improve the quality of professional training of graduates, which provides not only a high level of professional competence, but also the formation of creative abilities, the appropriate structure of personal qualities, responsibility and independence in decision-making. After all, they have to work in difficult market conditions, and therefore, in conditions of competition and risk.

Having studied the requirements of the labour market for IT specialists, we also studied the opinion of future software specialists on the most important personal and professional qualities that contribute to competitiveness in the labour market. The survey was attended by 361 students at the speciality 121

"Software Engineering" in the field of knowledge 12 "Information Technologies". The respondents were third and fourth year students of three colleges representing the regions of Ukraine: Lviv College of Information Technologies, Lviv Polytechnic University, Zaporizhzhya College of Information Technologies, Polytechnic University and the College of Information Technologies and Land Management of the National Aviation University of Kyiv. The question was asked to the respondents: "Who, in your opinion, should be a qualified and modern programmer technician?". The answers were distributed as follows:

A rating method was used to obtain the survey results that we graphically represent in *Figure 1*.

The data presented on the graph show that the main characteristics that a modern technician-programmer should have are: stress, high intelligence, creativity, analytical thinking, responsibility, organization, sociability, farsightedness, purposefulness, diligence, readiness for self-improvement. The least popular, in their opinion, are: adaptability and business qualities, self-criticism, willpower.

№	Features of a modern programmer technician	Number the students who chose this answer	%
1	Stress resistance, endurance.	30	8,31
2	High level of intellect, developed logical thinking.	27	7,48
3	Creativity, ingenuity, ingenuity.	26	7,20
4	Analytical thinking, the ability to understand a problem, make optimal decisions, constructiveness.	22	6,09
5	Responsibility .	20	5,54
6	Organisation, self-discipline.	19	5,26
7	Social responsibility, teamwork skills	17	4,71
8	Prediction, large-scale thinking, the ability to predict the outcome.	17	4,71
9	Perseverance, attentiveness.	16	4,43
10	Hard work.	15	4,16
11	Preparedness for self-improvement, willingness to develop.	15	4,16
12	Motivation, interest in innovation.	14	3,88
13	nitiative, creativity.	13	3,60
14	Dedication.	12	3,32
15	Ability to respond flexibly to the challenges of time.	12	3,32
16	Scrupulousness.	12	3,32
17	Perseverance.	11	3,05
18	Efficiency.	11	3,05
19	Curiosity.	10	2,77
20	English skills.	10	2,77
21	Punctuality and ability to organize time.	9	2,49
22	Willpower.	7	1,94
23	Self-Criticism.	7	1,94
24	Flexibility.	5	1,39
25	Businesslike.	4	1,11

Comparing the results of the research with the requirements set by the modern labor market to the professional qualities of software specialists, it is necessary to state some discrepancies. This discrepancy, in our opinion, can be explained by studying the results of work of representatives of different specialties in the field of knowledge 12 "Information technologies": 121 "Software Engineering", 122 "Computer Engineering", 123 "Computer Engineering", 124 "System Analysis", as well as the fact that business is more demanding towards bachelors and masters.

Conclusions. In the digital society there are rapid processes of modernization of devices, gadgets, software, development of digital technologies and cloud services, transformation of job evaluation systems, which emphasizes the need for continuous updating of standards for training software specialists in colleges. The research has shown that the main indicators of competitiveness of these specialists in the labor market are: educational and professional level; intellectual and creative potential, which meets the needs of the economy; professional mobility of an employee, his ability and willingness to learn new professional knowledge; ability to withstand the modern rhythm and intensity of work, to adapt to the rapid changes in working conditions; formation of socio-psychological qualities (activity, initiative, responsibility, willingness to work in a team, etc.).

In accordance with the purpose research revealed qualitative characteristics of a competitive technician-programmer, which can be summarized as a complex of three complex components – education, creativity and professionalism. In this Trio, educational level affects both the creative potential and the professionalism of the future specialist.

The study of regulations and the analysis of the content of professional training of technicians-programmers in college testify to the presence of a number of problems: firstly, the teaching staff works under temporarily created educational programs (each educational institution develops its own program); secondly, constant updating of information and cloud technologies leads to the aging of competencies acquired by students before graduation; thirdly, there are no mechanisms of interaction with large IT-companies in deciding on the development of a training standard for these professionals (junior professionals).

We see the prospects for further research to identify and substantiate the pedagogical conditions for training technical programmers in colleges.
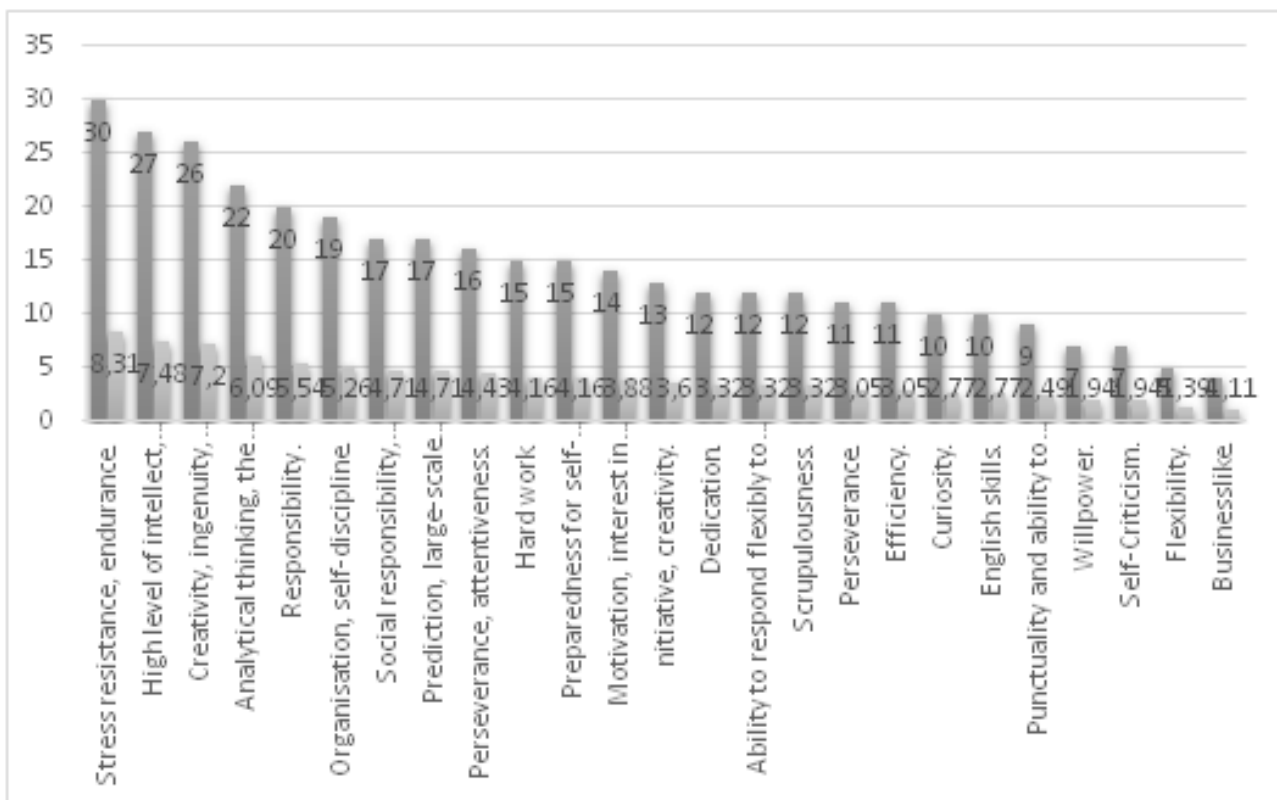

Fig. 1. Results of the analysis of rating estimation by students of the higher institutions of professional education in the most demanded personal and professional qualities of programmer technicians on the labor market.

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ПРОФЕСІЙНА ПІДГОТОВКА ТЕХНІКІВ-ПРОГРАМІСТІВ: ВИКЛИКИ ЦИФРОВІЗАЦІЇ СУСПІЛЬСТВА

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Реферат.

Актуальність: цифровізація усіх галузей економіки, постійно зростаючі вимоги сучасного ринку праці до ІТ-фахівців, трансформація системи грейдів ІТ-компаній зумовлюють пошук шляхів забезпечення професійної підготовки конкурентоспроможних техніків-програмістів в коледжах, модернізацію змісту, форм, методів і способів навчально-пізнавальної діяльності студентів.

Мета: виявити основні показники і якісні характеристики сучасного техніка-програміста та проаналізувати зміст відповідної професійної підготовки в світлі викликів "цифрового" суспільства.

Методи: аналіз психолого-педагогічної та методичної літератури з проблеми для виявлення стану досліджуваної проблеми в теорії професійної педагогіки; вивчення педагогічної документації – наказів, положень, рекомендацій, навчального плану; систематизація, порівняння, анкетування; рейтингового оцінювання, узагальнення.

Результати: Досліджено проблему професійної підготовки техніків-програмістів у коледжах на основі аналізу робіт зарубіжних та вітчизняних науковців. Розглянуто чинники впливу на якість їхньої підготовки, виокремлено основні вимоги та якісні характеристики. Вивчено думку студентів щодо найбільш затребуваних на ринку праці особистісних і професійних якостей техніків-програмістів та здійснено їх рейтингування. За результатами аналізу навчального плану, освітньо-професійної програми та співставлення їх із сучасними вимогами ринку праці до конкурентоспроможного фахівця (молодшого спеціаліста) сформульовано низку проблем, розв'язання яких потребує взаємодії науковців, педагогічних колективів і роботодавців.

Висновки: швидкоплинні процеси цифровізації суспільства і вітчизняної економіки актуалізують необхідність модернізації стандартів професійної підготовки техніків-програмістів у коледжах. Вони мають спрямовуватись на формування основних параметрів конкурентоспроможності цих фахівців на ринку праці. Виявлено якісні характеристики конкурентоспроможного техніка-програміста: інтеграція високого рівня освіти, творчого потенціалу і професіоналізму.

Ключові слова: *техніk-програміст, професійна підготовка, коледж, конкурентоспроможність, цифровізація, інформаційні технології, хмарні сервіси.*