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PEDAGOGICAL CONDITIONS OF DIGITAL COMPETENCIES FORMATION OF SPECIALISTS IN THE INFORMATION AND EDUCATIONAL ENVIRONMENT

Abstract. *The new millennium clearly demonstrates the rapid development of new technologies. Its beginning is connected with the peculiarity of the development of society, which is influenced by the tendencies of digitalization of all spheres of human life, including education. Against the background of the penetration of digital technologies into all spheres of people's lives, the problem of forming the digital competence of citizens becomes especially relevant. Under the current conditions of education development, there are increased requirements for the formation of digital competencies of applicants. The article reveals the pedagogical conditions for the formation of digital competencies of specialists in the information and educational environment of higher education establishments of Ukraine in connection with the active implementation of the concept of "Industry 4.0" worldwide. The education as a determining factor in the humanity development in the context of digitalization should ensure the personal growth of higher education, the formation of all necessary professional competencies and competitiveness in the world labor market. The relevance of the study of the phenomenon of "pedagogical conditions" (interpreted as a set of teaching methods and tools implemented by educational institutions in the process of training and aimed at the formation of digital competence in the study of professional disciplines), identified 10 basic pedagogical conditions. The importance of digital educational environment, information security, innovative technologies, educational and methodological support, various forms of digital learning, cloud technologies, increasing the level of digital competence of teachers in the formation of digital competencies of specialists is revealed. The implementation of the research results was carried out at the National Pedagogical Dragomanov University and Poltava V. G. Korolenko National Pedagogical University by conducting a pedagogical experiment.*

Keywords: *pedagogical conditions, competence approach, specialists' digital competence, digitalization, digital educational learning environment.*

Statement of the problem and its relation to essential scientific and practical tasks. Ukraine's entry into the world educational space is accompanied by significant changes in pedagogical theory and educational practice. The transformation of modern society requires the modernization of education and educational activities, which must work ahead, for the future.

Today, the global trend of the digital world economy is entering an active phase of its development. Ukraine is becoming an active participant in the implementation of the concept of "Industry 4.0". Education is one of the most important areas of human activity and a determining factor in human development, still professes Formula 2.0. The challenge is to close this huge gap as soon as possible. Enterprises that intend to meet the requirements of the fourth industrial revolution will have

to help production staff adapt to new conditions, and the digitalization of the education sector harmonizes it with other spheres of social life.

The challenges that today motivate the rapid development of the education system and its digitalization can be divided into external and internal. The external ones include the global transition of education to an online format and the development of an education quality system that defines the essence of specialist's professional growth. The internal system includes the rapid digital modernization of the content of education and the mastery of the subjects of the educational process with new forms, methods of educational online interaction.

The modern labor market requires not only deep theoretical knowledge from the graduate, but also the ability to apply them independently in non-standard, constantly changing life situations, be sure to be in the trend of the products of the technological revolution [1]. The vast majority of young people and teachers believe that they use modern digital technologies quite competently. However, they generally do not have the full digital knowledge and skills necessary for successful learning and employment, especially with regard to the security and protection of personal information on the Internet. Modern education does not fully prepare future professionals for work and life in the information society.

Under the current conditions of education development, there are increased requirements for the formation of digital competencies of applicants. The European Commission in its definition of digital competence, prepared in the framework of the Digital Education Action Plan (DEAP), emphasizes the importance of conscious and responsible use of digital technologies in education, at work and in public life.

An analysis of recent research projects that initiate a problem solution. Updating the legislation in the field of education in Ukraine stimulated a number of processes aimed at ensuring the quality of educational services provided by educational institutions, as well as the further development of the main provisions of the competency approach as a methodology of professional training.

The community of scholars widely discusses and explores the formation of digital competence in education. In determining the pedagogical conditions, we rely on the approaches disclosed in the works of O. Barlit [2], V. Bykov [3], O. Burov [3], I. Vorotnykova [4], R. Hurevych [5], A. Hurzhii [3], M. Zhaldak [3], O. Zhernovnykova [6], M. Kademiia [5], L. Kartashova [7], S. Lytvynova [3], V. Mohilevska [2], N. Morze [8], O. Nalyvaiko [9], V. Oliinyk [3], V. Palii [10], I. Plish [7], O. Sakhno [11], O. Spirin [3], M. Shyshkina [3] and others. Findings illustrated that there has been a growing increase in the number of studies focusing on digital competence. This increase is more evident in the Covid-19 pandemic period, particularly in the last two years [12].

However, despite the importance of research on the problem of clarifying the pedagogical conditions for the formation of digital competence of vocational education professionals, scientists do not pay attention to aspects of the impact of innovative educational environment of educational institutions to solve this problem.

Based on the data of theoretical and methodological analysis of legislative, scientific, pedagogical and methodological literature and the experience of modern learning strategies in the digital educational environment, the study substantiates certain conditions that will maximize the formation of digital competence of educational processes acquired knowledge, skills, abilities.

The formation of digital competence of future professionals is an integral part of their training and becomes especially relevant in todays rapid development of the digital society.

The aim of our research article. The purpose of the study is to determine the pedagogical conditions for the formation of digital competencies of specialists in the information and educational environment in terms of distance education. The future specialist of any profession today cannot be competitive without digital competencies to carry out professional activities in a specific and previously unfamiliar to humanity digital educational environment.

Methods and techniques. Among the research methods used: theoretical (analysis, synthesis, generalization), pedagogical (pedagogical experiment, pedagogical observation), sociological (questionnaire), mathematical (calculation, ranking, regression analysis).

The sample of students was made up of VI course-undergraduates of full-time and part-time educational programs "Secondary Education (Mathematics)", "Secondary Education (Computer Science)", "Secondary Education (Physics)", "Secondary Education (Labor Training and Technology)", "Professional Education (Technology of Light Industry

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Products)", "Educational, Pedagogical Sciences" from National Dragomanov Pedagogical University and VI course-undergraduates of full-time and part-time educational programs "Secondary Education (Mathematics)", "Theory and Methods of Teaching Mathematics", "Financial and Actuarial Mathematics", "Secondary Education (Physics)", "Computer Physics", "Secondary Education (Informatics)", "Theory and Methods of Teaching Computer Science", "Secondary Education (Labor Training and Technology)", "Labor Training and Technology and Extracurricular Education", "Labor Training and Technology with Computer Graphics", "Educational, Pedagogical Sciences", "Pedagogy Higher School", "Pedagogical Counseling", "Leisure Pedagogy", "Andragogy", "Adult Education", "Educational Policy, Public Administration in the Field of Education", "International Education", "Extracurricular Education" from Poltava V. G. Korolenko National Pedagogical University.

The study covered the entire period of master's studies and was conducted in two stages: the first (2021) — at the beginning of the experiment, before the introduction of pedagogical conditions for the formation of digital competencies in the educational process; the second (2022) — at the end of the experiment, after the introduction of pedagogical conditions. Quantitatively, 204 people were involved in the pedagogical experiment (control group (CG)), and 198 people were involved in the experimental group (EG).

To implement 10 pedagogical conditions for the formation of digital competencies of specialists in the information and educational environment of higher education institutions, teachers of disciplines in these educational programs developed guidelines that contained an algorithm for organizing educational activities using pedagogical conditions for the formation of digital competencies. During the experiment the approbation of the developed methodical recommendations was carried out, the change of levels of formation of digital competence at applicants of higher education of EG and CG was established, the dynamics of formation of digital competence of future specialists in information-educational environment was revealed.

Classes with students in CG were carried out with the introduction of pedagogical conditions for the formation of digital competence in the information and educational environment, in EG — traditionally.

The result of the pedagogical experiment was a final check of the levels of digital competence of higher education CG and EG. The obtained data testified to the effectiveness of the selected pedagogical conditions for the formation of digital competence of future professionals in the information and educational environment.

In the process of scientific research, I. Todorova's method [13] was used, adapted by the authors to the specifics of the study. The method of identifying the effectiveness of pedagogical conditions for the formation of digital competence of future professionals in the information and educational environment is offered to respondents in the form of a questionnaire (*table 1*). The survey was conducted anonymously, in compliance with the principles of democracy and voluntary participation.

The level of effectiveness of pedagogical conditions for the formation of digital competence (before the introduction of pedagogical conditions in the educational process) is presented in table 2 of the study, the results of diagnostics of the effectiveness of pedagogical conditions for the formation of digital competence in the information and educational environment are shown in table 3. With the help of regression analysis, a trend line was constructed (*figure 2*), which confirms the reliability of the study.

Presentation and justification of research material and findings. Competence approach to the training of future professionals implies that a student studying in any specialty and in various educational programs, after graduation must have not only a certain amount of knowledge, skills and abilities, professional competence, but also have formed digital competence as one of its important components for the successful implementation of professional activities in today's digital society. Digital competence should include the ability to digital collaboration, security and problem solving.

Effective formation of digital competence is ensured by the systematic nature of this process and is possible only under certain pedagogical conditions.

Creating these pedagogical conditions in the educational process will give each applicant the opportunity to form their own personal model on the way to improving professional skills.

The category of "condition" is one of the keys in philosophy and is understood as something that makes possible the presence of an object, phenomenon, process. Conditions reveal the relationship

of the subject to processes and phenomena, create an environment for its existence, functioning and development.

The study of philosophical and psychological-pedagogical literature has shown that there is still no terminological unity regarding the concepts of "condition", "pedagogical condition". In pedagogy, the term "conditions" means the factors on which the effectiveness of the learning process depends [14]. The concept of "condition" in our study is understood as a set of certain facts, circumstances, influences, processes that allow to organize the educational process as a result of which a person with a set of digital competencies is formed.

The dictionary of professional pedagogy defines "pedagogical conditions" as circumstances on which the integral productive pedagogical process of professional training of experts which is mediated by activity of the person depends and occurs [15].

The concept of "pedagogical conditions" extends to various aspects of all components of the educational process: goals, content, principles, methods, forms, means and so on.

Many scientific papers, dissertations and publications are devoted to clarifying the essence of the term "didactic conditions". Modern researchers have formulated a number of typical features and provisions for the concept of "pedagogical conditions", fundamental to understanding this phenomenon. In particular, it is noted in their scientific works that "pedagogical conditions": the subject of research of methodology of pedagogy; the relation of the educational system to the surrounding phenomena, without which it cannot exist; aimed at solving educational problems; necessary to achieve a specific pedagogical goal; ensure the functioning of the educational system [7]. So, under this term scientists understand a set of purposefully developed components of the educational process, the interaction of which contributes to the achievement of the appropriate level of competence. Their main function is to ensure the effective solution of educational problems due to the optimal choice and implementation of content, forms, methods, teaching aids, procedures, pedagogical technologies and more. These conditions provide for changes and improvements in the leading components of the learning process.

In our study, the term "pedagogical conditions" we mean a set of methods and teaching aids implemented by educational institutions in the process of professional training and aimed at the formation of digital competence in the study of professional disciplines. This will help to build the educational process taking into account the needs, interests and capabilities of the individual and to help to unleash their potential in a professional and social sense.

The diversity and large number of studies on the problem of determining the pedagogical conditions for the formation of digital competence in the training of future professionals is transformed too slowly into a high quality of their professional activities.

Taking into account the didactic principles, the structure of digital competence and different approaches of scientists to determine the pedagogical conditions, we have identified the pedagogical conditions necessary for the formation of digital competence of vocational education professionals that will help solve the problems outlined in the study.

1. Formation of an open, safe digital educational environment in educational institutions and information support in it of the proper process of training future specialists for professional activity.

2. A combination of different forms of organization of the educational process.

3. Creation of high-quality educational and methodical support of the educational process

4. Integration and updating of the content of education, direction of programs of disciplines on formation of digital competences.

5. Mastering digital tools in the process of preparation for professional activity.

6. The use of interactive learning technologies aimed at the formation of digital competencies and ensuring effective interaction between all participants in the educational process.

7. Formation of positive motivation of applicants for the introduction of innovative learning technologies.

8. Pedagogical support of manifestations of initiative, promotion of self-development, self-realization, stimulation of self-educational activity at all stages of digital competences formation.

9. Readiness of pedagogical workers to ensure the formation of digital competencies in the teaching of academic disciplines in educational institutions.

10. Ensuring compliance with ergonomic standards for the use of digital technologies in the educational process.

In order to determine the effectiveness of the application of selected pedagogical conditions for the formation of digital competence of future professionals

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in the information and educational environment developed a questionnaire for higher education in accordance with I. Todorova's method [13].

Methods for identifying the effectiveness of pedagogical conditions for the formation of digital competence of future professionals in the information and educational environment

Students are offered a questionnaire (*table 1*): Read the statements in the table. You need to read both the left and right statements. Determine which of them more accurately characterizes your opinion on the effectiveness of pedagogical conditions for the formation of digital competence of future professionals in the information and educational environment. Circle only one number (score), which shows the degree of certainty of this characteristic. The closer the figure is to the statement, the more defined this characteristic is.

Table 1

Questionnaire for students

"+" Characteristic	Circle the desired number	"–" Characteristic
1. My higher education institution has an open, secure digital educational environment	+3 + 2 +1 **0** –1 –2 –3	1. The digital education environment created in my higher education institution is not open and safe
2. Information support of the digital educational environment of the educational institution of proper quality for preparation of future specialists for professional activity	+3 +2 +1 **0** –1 –2 –3	2. Information support of the digital educational environment of the educational institution is missing or of inadequate quality for preparation of future specialists for professional activity
3. The educational process combines different forms of learning	+3 +2 +1 **0** –1 –2 –3	3. In the educational process there is no variety of forms of organization of education
4. I consider blended learning to be effective in my higher education institution	+3 +2 +1 **0** –1 –2 –3	4. I find blended learning, which is taught in my higher education institution, ineffective
5. As a student of higher education, I am provided with high-quality educational and methodological support of the educational process	+3 +2 +1 **0** –1 –2 –3	5. As a student of higher education, I am not provided with high-quality educational and methodological support of the educational process
6. The educational and methodological support of the educational components of my educational program is clear to me and contributes to my development as a professional.	+3 +2 +1 **0** –1 –2 –3	6. The educational and methodological support of the educational components of my educational program is incomprehensible to me and does not contribute to my formation as a professional.
7. The content of education of disciplines of my educational program is updated, I observe clearly expressed interdisciplinary connections	+3 +2 +1 **0** –1 –2 –3	7. The content of education in the disciplines of my educational program is outdated, I do not observe interdisciplinary connections
8. Programs of disciplines are aimed at the formation of digital competencies	+3 +2 +1 **0** –1 –2 –3	8. Programs of disciplines are not aimed at the formation of digital competencies
9. I master digital tools in the process of preparation for professional activity	+ 3 +2 +1 **0** –1 –2 –3	9. I do not master digital tools in the process of preparation for professional activity
10. I consider the digital tools which I master in the course of studying of disciplines, expedient for my specialty	+3 + 2 +1 **0** –1 –2 –3	10. I consider the digital tools which I master in the course of studying of disciplines, inexpedient for my specialty
11. Interactive learning technologies used by teachers in my educational program are aimed at the formation of digital competencies	+3 + 2 +1 **0** –1 –2 –3	11. Interactive learning technologies used by teachers in my educational program are not aimed at the formation of digital competencies

Continue of Table 1

12. Interactive learning technologies used by teachers in my educational program are focused on ensuring effective interaction between all participants in the educational process	+3 +2 +1 **0** –1 –2 –3	12. Interactive learning technologies used by teachers in my educational program are not focused on ensuring effective interaction between all participants in the educational process
13. I observe the interest of teachers of their educational program in the introduction of innovative learning technologies	+3 + 2 +1 **0** –1 –2 –3	13. I observe the lack of interest of teachers of their educational program in the introduction of innovative learning technologies
14. During training I feel the formation of positive motivation to implement innovative learning technologies	+3 +2 +1 **0** –1 –2 –3	14. During training I do not feel the formation of positive motivation to implement innovative learning technologies
15. I feel pedagogical support of manifestations of initiative at all stages of formation of digital competences	+3 +2 +1 **0** –1 –2 –3	15. I do not feel the pedagogical support of manifestations of initiative at all stages of formation of digital competencies
16. During the educational process there are promotions of self-development, self-realization, stimulation of self-educational activity	+3+ 2 +1 **0** –1 –2 –3	16. During the educational process there are promotions of self-development, self-realization, stimulation of self-educational activity
17. Teachers are competent to ensure the formation of digital competencies in the teaching of academic disciplines in my institution of higher education	+3 +2 +1 **0** –1 –2 –3	17. Teachers are not competent to ensure the formation of digital competencies in the teaching of academic disciplines in my institution of higher education
18. Teachers of my educational program are constantly engaged in self-improvement through training, internships, participation in various trainings, workshops, webinars, etc.	+3 +2 +1 **0** –1 –2 –3	18. Teachers of my educational program do not engage in self-improvement through training, internships, participation in various trainings, workshops, webinars, etc.
19. I note the observance of ergonomic standards for the use of digital technologies in the educational process	+3 +2 +1 **0** –1 –2 –3	19. I note non-compliance with ergonomic standards for the use of digital technologies in the educational process
20. Health education requirements are observed in the educational process	+3 +2 +1 **0** –1 –2 –3	20. There are no health requirements in the educational process

Scale for assessing the level of effectiveness of the pedagogical conditions for the formation of digital competence of future professionals in the information and educational environment

The value of the coefficient	*From +3 till +1,9*	*From +1,8 till +0,6*	*From +0,5 till – 0,5*	*From –0,6 till – 1,8*	*From –1,9 till –3*
Level of efficiency	Very high	High	Medium	Low	Very low

Focus on the following scale: 1 — this characteristic prevails rather than the opposite; 2 — the characteristic is clearly defined; 3 — the characteristic is defined very strongly; 0 — hard to say. Negative values are the opposite of positive ones.

Processing of results. In order to calculate the coefficient of the overall effectiveness of educational activities, the total amount of points (with their signs) is divided by 20 (the number of statements in the form).

Prior to the introduction of pedagogical conditions in the educational process, the effectiveness of the existing pedagogical conditions for the formation of digital competence was determined according to the method of I. Todorova [13]. The results are shown in table 2.

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Table 2

The effectiveness of the existing pedagogical conditions for the formation of digital competence (before the introduction of pedagogical conditions in the educational process)

Level of efficiency, %	Very high	High	Medium	Low	Very low
CG (204)	0	14.71	52.94	27.45	4.90
EG (198)	0	14.14	53.54	26.26	6.06

Table 3

The effectiveness of pedagogical conditions for the formation of digital competence in the information and educational environment (before and after the introduction of pedagogical conditions in the educational process)

Level of efficiency, %	Very high		High		Medium		Low		Very low	
	Before	After	Before	After	Before	After	Before	After	Before	After
CG (204)	0	0	14.71	19.12	52.94	53.92	27.45	23.04	4.90	3.92
EG (198)	0	7.07	14.14	20.71	53.54	63.13	27.78	9.09	4.54	0

As can be seen from table 2, the level of effectiveness of the existing pedagogical conditions for the formation of digital competence ranges from very low (CG — 4.90%, EG — 6.06%) to high (CG — 14.71%, EG — 14.14%). We have a legitimate result, because many disciplines of higher education at the second (master's) level of higher education in their content implement certain pedagogical conditions for the formation of digital competence.

The results of diagnostics of the effectiveness of pedagogical conditions for the formation of digital competence in the information and educational environment are shown in table 3.

From table 3 we see that the levels of effectiveness of pedagogical conditions for the formation of digital competence in the information and educational environment are distributed as follows.

Very high: in EG — 7.07%, in CG — 0% (at the ascertaining stage in EG and CG — 0%).

High: in EG — 20.71%, in CG — 19.12% (at the ascertaining stage in EG — 14.14%, in CG — 14.71%).

Medium: in EG — 63.13%, in CG — 53.92% (at the ascertaining stage in EG — 53.54%, in CG — 52.94%).

Low: in EG — 9.09%, in CG — 23.04% (at the ascertaining stage in EG — 27.78%, in CG — 27.45%).

Very low: in EG — 0%, in CG — 3.92% (at the ascertaining stage in EG — 4.54%, in CG — 4.90%).

The dynamics of changes in the levels of efficiency of students' learning activities during the implementation of the resource-based learning (RBL) system is visualized in fig. 1.

The reliability of the results of the pedagogical experiment is confirmed by regression analysis and a polynomial trend line constructed by means of a spreadsheet.

Positive results of experimental work were discussed and analyzed by teachers of departments theory and methods of technological education, drawing and computer graphics of the National Pedagogical Dragomanov University and departments of of general pedagogy and andragogy, information systems and technologies, theory and methods of training, of Industrial Engineering and Service of Poltava National Pedagogical University named after V. G. Korolenko at a joint meeting of the scientific round table "Pedagogical conditions for the formation of digital competence in the information and educational environment". The meeting noted the positive dynamics of changes in the levels of effectiveness of pedagogical conditions for the formation of digital competence, discussed ways to implement pedagogical conditions in the educational process of higher education institutions, agreed on a schedule for developing joint courses in the form of distance learning. and beyond.

Conclusions and prospects for further explorations in this direction. Proper organization of the

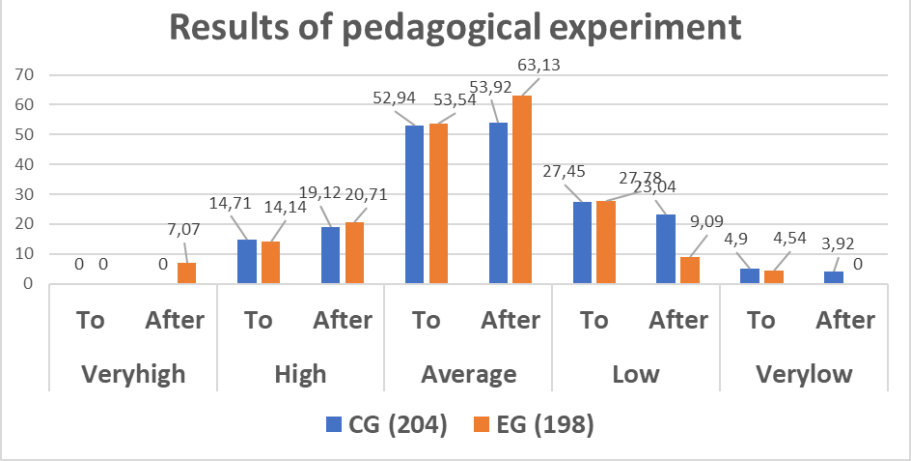

Fig. 1. The results of the pedagogical experiment — the dynamics of changes in the levels of effectiveness of pedagogical conditions for the formation of digital competence

educational process, effective interaction of all its participants and taking into account such pedagogical conditions as: formation of an open, safe digital educational environment in educational institutions become especially important in the formation of digital competencies in the training of specialists in the information and educational environment; organic combination of different forms of organization of the educational process in order to form digital competencies; use of creative teaching methods in the process of studying disciplines of professional training; directing the content of disciplines to the formation of digital competencies in accordance with the latest technologies.

The formation of digital competencies in the process of professional training of students becomes part of a well-modeled pedagogical process aimed at effective training of teachers. Therefore, there is a need to develop and improve the level of digital competence of teachers, the formation of which allows the use of electronic educational resources, online tools for search, logical selection, systematization, use of educational material and organization of effective educational process.

The introduction of digital technologies in education is not only the use of new online tools, it is lifelong learning, design of individual educational routes, development and distribution of their own educational products by teachers.

The data presented in this study are available on request from the corresponding author.

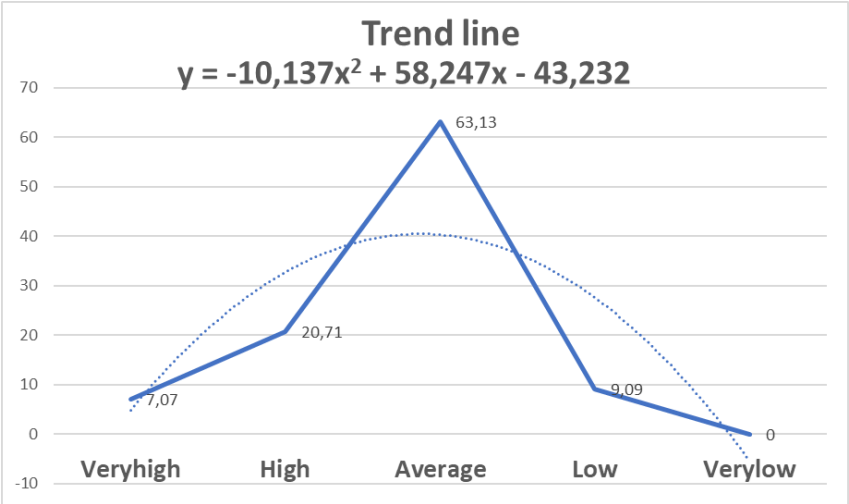

Fig. 2. The results of regression analysis using a polynomial trend line

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ПЕДАГОГІЧНІ УМОВИ ФОРМУВАННЯ ЦИФРОВИХ КОМПЕТЕНТНОСТЕЙ ФАХІВЦІВ В ІНФОРМАЦІЙНО-ОСВІТНЬОМУ СЕРЕДОВИЩІ

Анотація. *Нове тисячоліття яскраво демонструє швидкий розвиток цифрових технологій. Його початок пов'язаний з особливістю розвитку суспільства, на яке впливають тенденції цифровізації всіх сфер життя людей, зокрема й освіти. За нинішніх умов розвитку освіти висуваються підвищені вимоги щодо формування цифрових компетентностей здобувачів. У статті розкрито педагогічні умови формування цифрових компетентностей фахівців в інформаційно-освітньому середовищі закладів вищої освіти України в зв'язку з активною реалізацією в усьому світі концепції «Індустрія 4.0». Саме освіта як визначальний чинник розвитку людства в умовах цифровізації має забезпечити особистісне зростання здобувачів вищої освіти, формування всіх необхідних професійних компетентностей, конкурентоздатність на світовому ринку праці. Доведено актуальність дослідження феномена «педагогічні умови» (що потрактований як сукупність методів і засобів навчання, що реалізуються закладами освіти в процесі професійної підготовки фахівців та спрямовані на формування цифрової компетентності в процесі вивчення фахових дисциплін), виокремлено десять основних педагогічних умов. Досліджено важливість цифрового освітнього навчального середовища, інформаційної безпеки, інноваційних технологій, навчально-методичного забезпечення, різних форм цифрового навчання, хмарних технологій, підвищення рівня цифрової компетентності викладачів у формуванні цифрових компетентностей фахівців. Упровадження результатів дослідження здійснено в Національному педагогічному університеті імені М. П. Драгоманова і Полтавському національному педагогічному університеті імені В. Г. Короленка шляхом проведення педагогічного експерименту.*

Ключові слова: *педагогічні умови, компетентнісний підхід, цифрова компетентність фахівців, цифровізація, цифрове освітнє навчальне середовище.*

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