Formation and Self-Development of the Students' Digital Competencies Within the Lifelong Learning System

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Abstract

The impetuous development of digital technologies is changing the requirements for specialists. In the modern world, a competitive analyst working in the field of economics must have not only professional competence, but also digital competence, which includes not only digital skills, but also a set of knowledge and views on the nature and role of information technologies and opportunities, as well as relevant legal and ethical principles.

The article deals with the analyzes of the modern theoretical foundations and approaches to the development of digital literacy within the lifelong learning processes: namely, one of the tools for determining the level of formation of digital competence using Tsifrogram test (which is based on the conceptual model of digital competence of citizens DigComp - The Digital Competence Framework for Citizens) is described and analyzed in detail.

The research was carried out in line with the competence-based, personality-activity and communicative approaches. The training program for economic analysts used active and interactive teaching methods and practices.

The results of the level of digital competence formation among students of economic specialties of the university are presented. The main recommendations for increasing the level of the students' digital competence are analyzed, identified, and highlighted. In the future, it is planned to develop a roadmap for increasing the level of students' digital competence during their studies at the university.

Keywords

Digital competence, DigComp, constituents of digital competence, self-diagnosis test, digital profile results

1. Introduction

The rapid pace of development of information technologies, the emergence of new devices, the growth in the number of Internet users are markers of the modern information society. Scientists [1] note that the key technologies that will influence the development of society are: robotics, artificial intelligence, the Internet of Things, cloud computing, Big data, 3D printing, digital payment systems, interoperable technological systems and platforms.

The European Commission has for several years expressed concern about the slow adoption of digitalization processes in education and training. In order to study the state of the current level of implementation of e-learning in educational institutions of the EU, the European Commission conducted a survey of citizens' opinions and published it in the framework of the Eurobarometer [2].

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In recent decades, a unique situation of dialectical contradiction unfolds: a generation is growing that from an early age knows how to handle various gadgets, and this generation is taught by those who grew up in the system of classical education without constant access to the Internet and without social networks. The Eurobarometer data confirms these provisions: only 20-25% of students in European universities are studied by teachers who are confident users of new technological advances, 43% of Europeans do not have basic digital skills, and 71 million students in European countries lack skills for a digital society. Considering the need to take decisive action in the field of education, the European Commission adopted the main provisions of the Digital Education Action Plan in 2021-2027 years. [3].

Now in Ukraine, a large number of teachers are motivated to use digital technologies in the teaching process, however, more resources are needed to support the development of sound digital practices, since it is obvious that the digital environment and infrastructure of domestic higher education institutions require investment.

The EU wishes to raise awareness of the European lifelong learning space through Internet platforms (e-learning) to support the modernization of education and training systems.

The Council of the European Union adopted on 22 May 2018 a revised recommendation on core competencies for lifelong learning [4], which emphasizes the need to support the development of core competencies, with a particular focus on improving the achievement of basic digital skills and participation in society in a lifelong perspective, increasing and improving the level of digital competencies at all stages of education and training for all segments of the population.

The education system is forced to constantly improve, since the prospects for the functioning of the state depend on how the level of education develops.

The modern space of higher education in Ukraine sets a new educational paradigm focused on students and lifelong learning. This includes changes in professional competence since the training must be adapted to the requirements of the new context.

The Concept for the Development of the Digital Economy and Society of Ukraine for 2018-2020 [5] defines the creation and implementation of the national training program for general and professional digital competencies and knowledge as one of the priority tasks on the way to the accelerated development of the digital economy.

The Concept for the Development of Digital Competences [6] also notes the need to improve the quality of training of workers to create the possibility of modernizing the country's economy in accordance with modern requirements.

2. Research methodology

Today, the pace of computerization is well ahead of the skills of the vast majority of users.

According to the results of the first all-Ukrainian study of digital literacy of Ukrainians (December 2019), 53% of the population of Ukraine is below the "basic level" mark. At the same time, 37.9% of Ukrainians aged 18-70 have digital skills at a level below the basic level, and 15.1% do not have them at all. However, only 47% of Ukrainians aged 18-70 (mostly young people) believe that digital skills training is relevant for them [7].

Interpretations of the essence of the concepts of "digital literacy", "digital competence", "digital culture", "digital technologies", the definition of their structure and features are considered in many works of foreign and domestic scientists, in particular J. Stommel [8], C. Scott [9], S. Carretero, R. Vuorikari , Y. Punie, [10], L. Havrilova, Y. Topolnik [11], V. Bykov, O. Spirin, O. Pinchuk [12] and others.

Currently, the concept of "digital literacy" as a person's ability to navigate the digital environment is widely used by the international educational communities. Digital competence is seen as the conscious, confident, responsible, and critical use of Information Society Technology (IST) for work, social activities, free time, and communication [13].

Digital competencies include information literacy, communication and collaboration, digital content creation (including programming), and security (including digital well-being and cybersecurity competencies). According to Henseruk [14], digital technologies actively influence the learning process, since they change the scheme of knowledge transfer and teaching methods; their application in the educational process stimulates interest in learning, contributes to the formation of

logical and creative thinking, which mainly leads to the formation of the information culture among the students.

The purpose of the article is to research the competencies determined by educational and professional programs and the levels of formation of digital competencies of students of the "bachelor" educational level (future specialists in economics of an analytical profile).

Research methods: analysis (dividing the general concept of "digital competence" into its constituent elements), synthesis (combining the separated and explored parts), induction (generalized consideration of digital technologies and digital competencies), deduction (transition from the general perception of digital technologies and digital competencies to the determination of properties and characteristics of individual competencies and skills), abstraction (determination of the features inherent in digital competencies), and concretization (study of the features of individual digital competencies).

The main objectives of the study are: first, to clarify the concepts of information literacy and digital literacy; secondly, in defining the components of digital literacy; thirdly, in identifying the educational opportunities of the university in creating a digital environment that contributes to the development of digital literacy of students within the framework of special disciplines for future specialists-economists of an analytical profile.

3. Results and discussion

Digital literacy is a broad and holistic concept that encompasses much more than the functional digital skills that students must use in a digital society. Despite the fact that many students are well-versed in the use of modern digital technologies, they often do not have all the necessary digital competencies to successfully study in a higher education institution.

University studies should develop digital literacy skills both over time and in aspects related to professional development and gaining professional experience.

In order to train the qualified specialists-analysts of economic profile, one of the competencies that must be formed is precisely “digital competence”.

The analyst must have key skills, namely industry knowledge (specifics of the industry, business processes, standards, and trends), effective communication with customers (methods of structured problem solving and facilitation, brainstorming for generating ideas with their subsequent visualization, as well as experiments and research), work with processes and data (strategic analysis, business process management and optimization, data modeling), learning skills, and writing business cases.

To clarify the place and role of digital competence in the general structure of professional competence of future specialists in economic specialties, an analysis of educational and professional programs (EPP) was carried out and the mapping of digital competencies in the content of professional training of students of specialties 051 "Economics" and 075 "Marketing", which are implemented in Taras Shevchenko National University of Kyiv, was conducted [15-18].

As a result, the general and special competencies listed in the EPP were identified, which can be classified as digital, i.e., please, check

Table 1.

A quantitative and qualitative analysis of the identified competencies made it possible to determine the following: in these educational and professional programs and at different levels of training, there is a slight difference in the content and number of competencies that can be classified as digital.

The authors consider that there is some contradiction between the real requirements of society and the labor market for the content and quantity of digital competencies and the normative requirements for the content of professional training of future analytic economists.

To solve the above problem of the formation of digital literacy, taking into account the peculiarities of thinking of modern students, there are two approaches. The first is to conduct additional courses aimed at building digital competencies. The second approach involves the parallel development of digital skills and competencies during hands-on training. Since digital skills are integrated in the educational process with professional knowledge, it is likely that the student will use them in their professional activities. Despite the fact that there is no generally accepted didactic theory of digital literacy, many disciplines from the EPP at Taras Shevchenko National University of Kyiv have the potential to solve this problem.

Table 1

Digital competencies in educational and professional programs of the economic profile at Taras Shevchenko National University of Kyiv

Specialty, EPP	The first (bachelor's) level of higher education			The second (master's) level of higher education		
	General competencies	Special (professional) competencies	Program learning outcomes	General competencies	Special (professional) competencies	Program learning outcomes
051 Economics, "Economic Analytics and Statistics"	GC5. Skills in the use of information and communication technologies. GC6. Ability to search, process and analyze information from various sources.	PC7. Ability to use computer data processing technologies to solve economic problems, analyze information and prepare analytical reports	PLO20. To use the information and communication technologies to solve socio-economic problems, prepare and submit analytical reports. PLO23. To demonstrate flexibility and adaptability in new situations, in working with new objects, and in uncertain conditions.	-	PC4. Ability to use modern information technologies, methods, and techniques of research of economic and social processes, adequate to the established needs of research.	PLO10. To apply modern information technologies and specialized software in socio-economic research and in the management of socio-economic systems.
075 Marketing, “Marketing”	GC9. Skills in the use of information and communication technologies.	SC10. Ability to use marketing information systems in marketing decisions and develop recommendations to improve their effectiveness	PLO7. To use the digital information and communication technologies, as well as software products necessary for the proper conduct of marketing activities and practical application of marketing tools	GC6. Ability to search, process and analyze information from various sources.	-	PLO15. To collect the necessary data from various sources, processes and analyze their effectiveness using modern methods and specialized software

Currently, the educational process is being provided with modular courses aimed at developing digital literacy; building an educational process based on blended learning technology; the use of active, interactive, problem-based teaching methods taking into account the individual characteristics of the modern generation of students. It carried out a constant update of the content of regulations that dictate the requirements for the training of specialists and focus on improving the education system, aimed at training personnel with the competencies of the digital economy at the average world level.

In the training of future specialists in economics at Taras Shevchenko National University of Kyiv, a special place is occupied by innovative didactic teaching aids based on the use of digital technologies covering a wide range of educational software. Among such software, one should highlight electronic training courses, software tools, electronic educational and methodological complexes, network programs, and control and diagnostic systems. Most of the tasks using digital technologies that students perform are creative. They stimulate motivation, activate the cognitive activity of students, contribute to the effective development of skills in working with electronic documents and cloud services, the ability to analyze, draw generalizations and conclusions, as well as obtain practical results of the work performed.

It should be noted that digital literacy is of particular importance in the process of training specialists. Students use the full range of Internet resources to prepare for practical, laboratory, seminars, colloquia, project tasks, and the like. The quality of his work and the assessment of progress depends on how a student is able to work with information.

To determine the level of formation of digital competence of future analytic economists, the classification developed in 2017 by the European Joint Research Center is used, which includes a number of levels of proficiency and examples of knowledge, skills, and abilities in each of the areas of competence (DigComp 2.1 The Digital Competence Framework for Citizens 2017) [19].

The digital literacy of higher education applicants within the European approach includes the personal, technical, and intellectual (digital) skills that are necessary to live in a digital world (see Fig. 1).

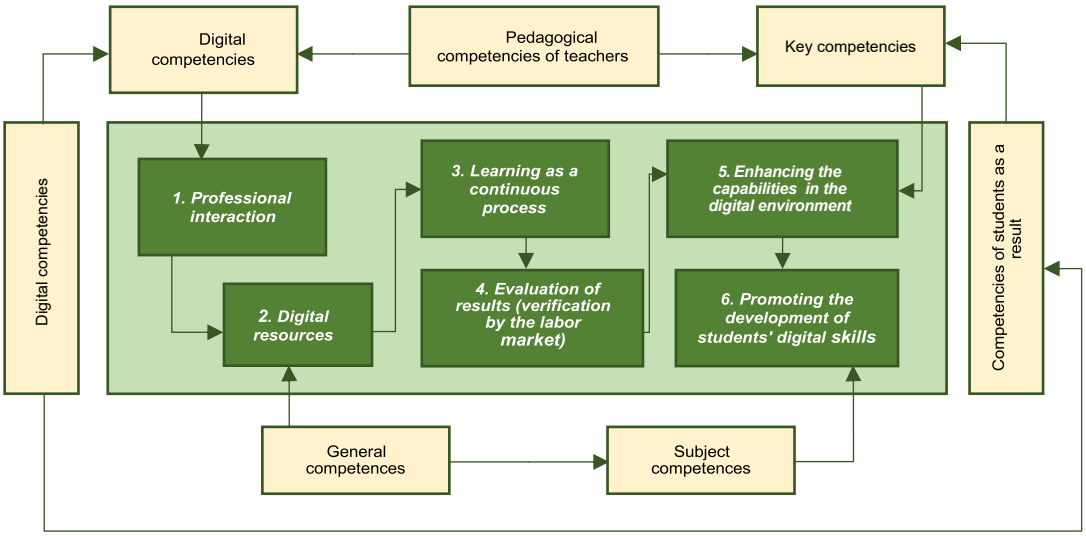

Figure 1: Plan-diagram of a model of digital competencies in education in the interpretation of the European Union "DigComp 2.1: The Digital Competence Framework for Citizens with eight proficiency levels and examples of use", 2017 [20]

Of particular importance in the above model is the central block, which can be characterized as the integration of resources, platforms, and results. The outer contour is a new format of requirements for the quality of teaching and characteristics of competencies, as fundamentally new in relation to traditional models and technologies of teaching.

In the process of research to identify the level of formation of digital competence, the authors used the national test for digital literacy (project Tsifrogram implemented by the Ministry of Digital

Transformation of Ukraine together with USAID and the Eastern Europe Foundation on the online platform "Action. Digital Education" [21]), which determines the main components of digital competence in terms of knowledge, skills and abilities required in a digital society. After filling it out and calculating the number of points, the respondents receive an assessment of their level of digital competence formation.

The Ministry of Digital Transformation of Ukraine in 2021 proposed the project Digital Competence Framework for Citizens of Ukraine (DigComp UA for Citizens). The "DigComp UA for Citizens" is based on the conceptual reference model DigComp 2.0 and the updated European framework DigComp 2.1, which are adapted to the national, cultural, educational, and economic features of Ukraine.

The results of testing the level of formation of digital competence of applicants for higher education can be assessed by the areas of the components given in Table 2. Each of these areas of knowledge covers 5 competences. The Tsifrogram offers testing participants to answer 90 questions.

Table 2

Features of digital competence assessment using the adapted model DigComp UA for Citizens and Tsifrogram

Adapted model DigComp UA for Citizens		Competencies and descriptors of Tsifrogram national test		
Competence areas (CA)	Competences (C)	Competence areas (CA)	Competences' names	Evaluation points
CA0. Basic digital skills	C0.1 Use of digital devices; C0.2 Using basic digital device software.	Basics of computer literacy	1) Use of computer and mobile devices; 2) Use of basic software; 3) Use of applications and application software; 4) Use of the Internet and online applications; 5) Digital identity management	0-15
CA1. Information and data literacy	C1.1 Viewing, searching, and filtering data, information and digital content; C1.2 Evaluation and interpretation of data, information and digital content; C1.3 Management of data, information and digital content; C1.4 Meeting own needs with the help of digital technologies	Information and data literacy	1) Viewing, searching, and filtering data, information and digital content; 2) Critical assessment and interpretation of data, information and digital content, verification of the reliability of sources and information; 3) Management of data, information and digital content; 4) Implementation of your own requests and needs using digital technologies; 5) Self-realization and personal development in a digital society	0-15
CA2. Communication and collaboration	C2.1 Digital engagement; C2.2 Digital exchange; C2.3 Realization of civic position using	3.Communication and collaboration in the digital society	1) Digital engagement; 2) Dissemination and exchange of data using digital technologies; 3) Collaboration using digital technologies;	0-15

	digital technologies; C2.4 Digital collaboration; C2.5 Netiquette; C2.6 Digital Identity Management		4) Implementation of civic position using digital technologies, digital citizenship. Use of E-services, E-signature; 5) Responsibility. Legal and ethical standards. Netiquette.	
CA3. Digital content creation	C3.1 Development of digital content; C3.2 Integration and processing of digital content; C3.3 Copyright and licenses; C3.4 Programming	4. Digital content creation	1) Development of digital content; 2) Editing and integration of digital content; 3) Copyright and licenses; 4) Primary programming skills; 5) Creative use of digital technologies	0-21
CA4. Safety	C4.1 Device protection; C4.2 Protection of personal data and privacy; C4.3 Protection of health and well-being; C4.4 Protection of consumer's personal rights against fraud and abuse; C4.5 Environmental protection	5. Safety in the digital environment	1) Device protection and secure Internet connection; 2) Protection of personal data and privacy. Internet security; 3) Protection of consumer's personal rights against fraud and abuse; 4) Protection of health and well-being; 5) Environmental protection	0-24
CA5. Problem solving and further training	C5.1 Solving technical problems; C5.2 Identification of needs and technological response measures; C5.3 Creative use of digital technologies; C5.4 Identifying gaps in digital competence	6. Problem solving in the digital environment and lifelong learning	1) Solving technical problems; 2) Identification of needs and their technological solution; 3) Self-assessment of the level of own digital competence. Identification and elimination of gaps; 4) Solving life problems with the help of digital technologies; 5) Lifelong learning. Professional self-development in the digital environment	0-21
Total (maximum score)				111

When assessing the formation of digital competencies, there are three levels of mastery: high - characterized by the ability to use digital and information and communication technologies in full (including creating a digital product); medium - can be described as knowledge of the availability of all digital competencies, but only partial application; basic - differs in the presence of knowledge about digital components, but is characterized by the inability to correlate the components of knowledge with professional tasks.

In the 2020/2021 academic year, 91 applicants for the first level of higher education in Economics and Marketing specialties took the National Digital Literacy Test; of these, 7.7% passed Tsifrogram test at the B1 level, and 90.1% - at the B2 level, 2.2% - at the C1 level (see Fig. 2). Analyzing the results obtained, one can conclude that digital competencies are developed at the average level for most students.

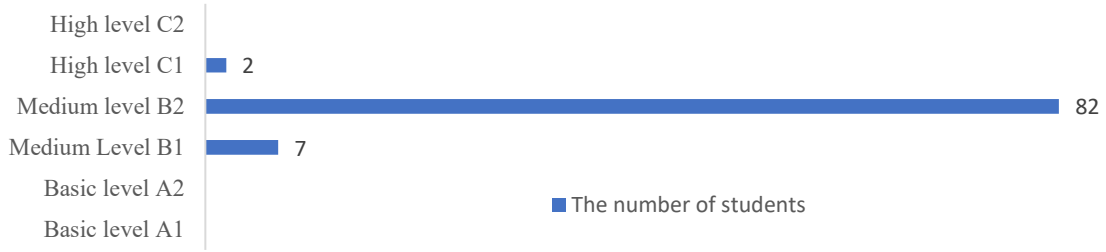

Figure 2: Level of digital competence of students of the analytical profile of economic specialties at Taras Shevchenko National University of Kyiv in 2020/2021 academic year

The level of knowledge and skills of students in the field of digital competence turned out to be different, depending on the level of their self-development, self-motivation, and other factors. Using the Internet for communication, searching, downloading and creating content, solving technical problems, shopping and payments are the different possibilities and, accordingly, different resources are needed to implement them. Both the average level in digital development and the high one can be both general (in many areas of activity) and partial (in certain areas). Therefore, when researching digital competence, it is important to study its components and cells in which each of the components can receive specific development and implementation.

The detailed analysis of the questionnaire shows that the development of digital competence components is not equally developed among students (see Fig. 3). Components such as fundamentals of computer literacy, information literacy, data skills and communication and interaction in a digital society are best developed.

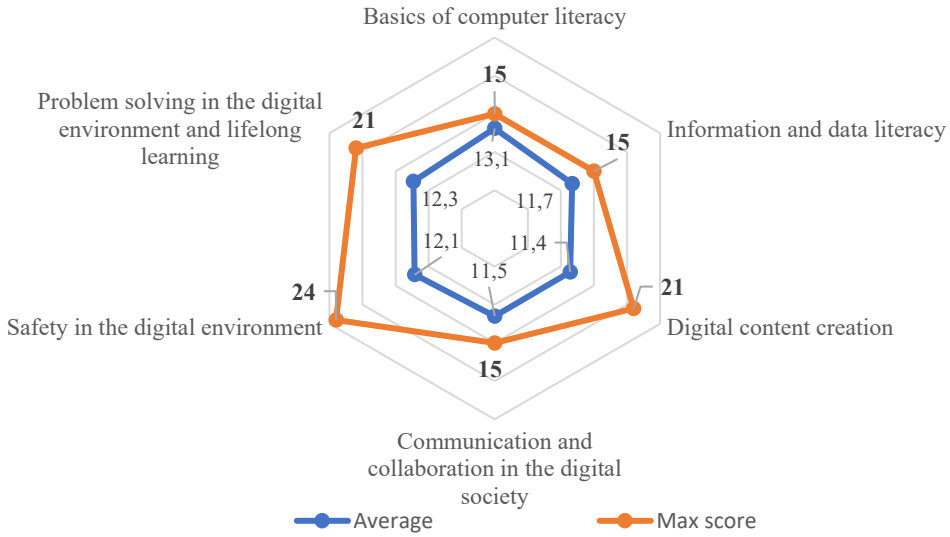

Figure 3: Distribution of the scores received by the students of the analytical profile of economic specialties at Taras Shevchenko National University of Kyiv in the 2020/2021 academic year by components.

Students of the analytical profile of economic specialties showed the highest results in the "basics of computer literacy" competency (in particular, use of basic software, applications, and applied software): 89% of students received a high level of knowledge C1 and C2 (see Fig. 4). This means that they actively respond to the emergence of new types of computer and mobile devices, can use (including installing, updating and configuring the system software) the main common computers and mobile devices of medium complexity, easily master new applications and new application software, independently install, configure and use the software, create online services of medium complexity, learn the basics of web design, and know different ways to protect their reputation on the Internet.

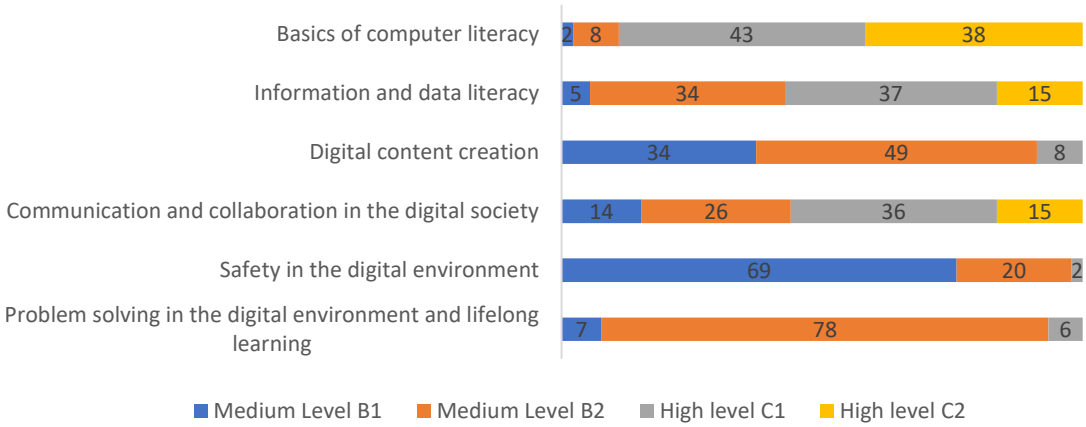

Figure 4: Distribution of the scores received by the students of the analytical profile of economic specialties at Taras Shevchenko National University of Kyiv in the 2020/2021 academic year by competency levels.

Good results were obtained by students in the "information and data literacy" and "communication and collaboration in the digital society "competencies: respectively 57% and 56% of students received a high level of knowledge C1 and C2.

Lower knowledge was found by students in the "safety in the digital environment" competence (in particular, on the Protection of consumer's personal rights against fraud and abuse and device protection and secure Internet connection): 76% of students received an average level of B1, and only 2 students out of 91 high level of C1.

Owing to Tsifrogram National Digital Literacy Test, the bachelors of analytical profile of economic specialties received recommendations to improve the level of digital competence in these areas, which will allow in the future to acquire the necessary knowledge, improve their skills and be successful professionals in modern society. In the future, it is planned to develop a model of digital competence formation for the training of competitive analytical specialists with a high level of digital competence.

4. Conclusions

Based on the results of the research, it can be concluded that the digital competence is an important component of the professional competence of future specialists-economists of analytical profile. This competence combines knowledge and skills to use the digital technologies when working with modern business processes, their optimization, and data modeling.

Despite the large number of studies devoted to the concept of digital competence, the issue of its interpretation (namely, for future specialists-economists of analytical profile), definition of the structure and content requires further research.

The authors consider it extremely important to further research the approaches to creating a digital model of competencies, determining the conditions for its formation and prospects for the

implementation of the developed model to ensure the lifelong development of the specialists-economists of analytical profile.

Achieving the maximum degree of mastery of information and communication competence by a future specialist is possible only with systematic work on all components of the competence. Without information literacy and knowledge of the laws of information security, communication, and interaction, it is difficult today to create adequate digital content and solve technological problems. The ability for reflection and self-esteem is, of course, the path to self-development. Confident, conscious, and creative use of information technology for education, work, leisure time and social activity is the key competence of an individual in the 21st century.

The challenge for research and teaching staff is to move beyond thinking about information technology as a tool or " information technology support platform." An integrated approach to solving the problem of the formation of digital competence in the process of training specialists at the university within the framework of any academic discipline is required.

The development and implementation of a pedagogical system for the formation of students' digital competence in the learning process, as well as the ways of delivering, should include targeted, active, informative, and effective components.

The use of project-based or inquiry-based learning as a tool to increase students' interest is the key to developing a range of competencies. Project-based learning is really at the heart of learning new digital skills right now. Traditional learning models are too passive to create such skills. The competency model is the basis for key changes in education training for the digital economy.

The analysis performed makes it possible to draw the following conclusions and generalizations.

1. In the light of modern trends in social development, digital competence of specialists, which provides an individual's opportunity for successful interaction, accumulation, and exchange of experience with subjects of the surrounding world and professional activity, is of particular importance. For future specialists in economic specialties, digital competence is also necessary, since it ensures the effective implementation of professional functions, personal success, and readiness for further professional development.

2. It seems advisable to use the systems based on DigComp 2.1 for a diagnostic test of the competence of applicants for education, advanced training of scientific and pedagogical personnel, and the introducing digital literacy into educational programs.

3. It is necessary to ensure the consistency and systematic way of the formation of digital competencies of future specialists in economic specialties at different levels of higher education.

In further research, it is proposed to carry out a deeper analysis of the content and technologies for the formation of digital competencies of future economists at different levels of education.

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