

Information Competencies of Information Technology Specialists in the Conditions of the Pandemic: The Algorithms of Formation and Features of Development

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Abstract

The research has examined scientific developments and systematized practical data in the field of formation and development of information competencies of digital technology specialists in the conditions of the pandemic. This has become the research purpose of the academic paper. Digital transformations in the sphere of economy, management, social relations and production have caused significant changes in the methods and forms of training of specialists in the IT industry, and the research is focused on changes in the methods of organizing the educational process. The specifics of the evolution of teaching philosophy and methodology in the conditions of the pandemic are not gradual transformations, but the urgent need for rapid changes caused by a crisis situation in the conditions of quarantine restrictions. Unexpected changes require quick but qualitative changes. Distance learning technologies turned out to be relevant during the pandemic not only in the educational space of Ukraine; such changes took place in educational systems around the world. In order to study the issues outlined, a complex of bibliosemantic and analytical methods was used in the research.

Keywords: IT industry, media education, pandemic, information competence, digital technologies, media pedagogy, digital technology

1. Introduction

Globalization processes are a key feature of the modern world. This is a multi-vector process that should take place in parallel at all levels of the educational system: financial, production, market and communication. Globalization in the communication sphere must be permanent and systematic; it is a gradual movement of information flows, where media content can be used without connection to the actual location of it and the addressees. Such specificity dictates the need to study media literacy and media education in a globalized society, where information technologies are also a priority direction (Spirin & Ostrjans'ka, 2021; Mears-Delgado & Marzal, 2018). This is precisely why the investigations on media education and the determination of effective methods of teaching media literacy are becoming relevant.

Self-education is an important component of the work of all participants in the educational process in the conditions of distance learning. This skill implies independent thinking, which is based on previously acquired experience, the ability to use previously acquired knowledge. Erudition and bundle of knowledge without the ability to use them are not such significant learning tools, forasmuch as problem solving skills remain of particular importance. The ability to self-educate affects the quality of further knowledge gained in the course of distance education; it is also a constant desire to improve the tools of self-education. In such a situation, there is a need for the formation of the information competence of the education seeker, the training of a specialist who is able to apply his own competencies in the future real life. This means that information competence is an important component of professional competence. Information competence involves the formation of a group of abilities and skills, namely: modelling, creating one's own projects,

including within the scope of collective activities during the educational process; systematization, training, search, selection and evaluation of information, the ability to present and transmit it; the responsibility towards work, ideas, making operational decisions in critical situations; trying to follow life-long learning.

Some scientific works note that self-esteem and its development are a condition for professional development of future specialists (Spirin & Ostrjans'ka, 2021). The analysis of scientific and educational works showed that scientists conducted and analysed enough materials related to the work of training specialists in the field of information technologies. Primarily, the important role of informatization of the educational process has been determined; it is also connected with the need for high-quality training of specialists in the digital industry. Quarantine restrictions increased the need to acquire information literacy by IT specialists; they accelerated the process of methodical development of programs for training specialists in the digital industry. In modern conditions of acquiring education, it is necessary to use modern communication technologies that ensure high-quality distance learning and increase the professional level of young specialists. In a number of studies, the IT industry is considered from different standpoints; however, there are directions that require in-depth consideration and further exploration.

2. Literature Review

The introduction of modern software developments in business, as well as management and education is actively on-going, forasmuch as the transition of production and business sectors to work with the use of digital technologies is taking place. Such approaches have a number of positive aspects: savings, cost reduction; increasing the efficiency of employees; optimization of financial management; monitoring and optimizing the planning of the enterprise's work. The use of digital business tools, the understanding of their convenience and economic feasibility has led to an increase in the production of online applications designed for individual users; such business will continue to grow and improve. This is precisely why such media technologies are increasingly being used and contribute to additional consumer engagement. Accordingly, there has been a tendency towards a rapid increase in demand for professionals, specialists who are competent in the IT industry, and they will be able to work in all areas of the economy, production, business.

The demand for obtaining education in the IT industry, training of specialists is increasing, and this raises a question for the educational environment. After all, the training of specialists in the digital industry and teachers with a high level of digital competence is relevant; it is in the focus of pedagogical science. The studies on implementation of professional training of IT industry specialists are of particular relevance in the context of quarantine restrictions; this poses the problem of searching for and correctly applying effective tools for training corresponding specialists. As a result, we have a number of studies on the formation of the fundamentals of workers' information literacy in the digital industry, where active acquisition of the principles of working with business and educational information systems is ensured (Malihin & Jarmol'chuk, 2020).

The "information competence" concept is also defined as the ability to understand, process, and store information from various sources (Kogut, 2018). One of the eight competencies for lifelong learning is digital competence. It is also an important aspect of an active life, public standpoint and orientation in the labour market.

In the 50s of the XX century, the famous American sociologist J. Bell presented the theory of the post-industrial society, which is based on the guidelines of the information society, to which the majority of developed countries moved in the XX century and at the beginning of the XXI century. The main content of the study lay in the fact that the information society is an innovative post-industrial transformation, where the social structure with the information component has become the core component. V. Martin has proposed to single out the main features of the information society according to a number of criteria, namely: technology (information technologies are widely used in all spheres of society – management, finance, business, production, education); social (information technologies change the life quality, everyday life for the better, digital literacy is an important component in the labour market); economic (information is the main and very valuable commodity, it is the core of the economy, which can be a resource, a product, a source of value and a measure of employment); political (free access to information, freedom of its dissemination leads to increased participation of the society in political processes and gaining understanding between different social groups); cultural (information as a cultural phenomenon, promotion of information as a value for an individual and the society as a whole) (Spirin & Ostrjans'ka, 2021).

A number of researchers considered the successful use of digital technologies in educational institutions and worked on the development of the principles of IT education, the use of IT tools and the principles of their selection in the educational process, investigated the specifics of the use of information technologies in education.

The role of information technologies in the development of innovative teaching methods is important, however, in modern pedagogy there are still not enough works dealing with the algorithm for training and development of future specialists in the field of business informatics, where the emphasis would be on the development of information competence (Sena-Rivas, Casillas-Martín, & Barrientos-Báez, 2019). Intensive development and constant improvements in the post-industrial information society require constant attention to educational strategies and methods of their implementation, aimed at training competitive specialists in the digital industry. The studies Strohmeier (2020) and Sales (2020) represent a consideration of the potential of using information technologies in the professional activities of future specialists in this field.

The group of researchers (Kyzym, Khaustova, Reshetnjak, et al., 2019) considered the theoretical aspects of the formation of labour market requirements, and also conducted experimental studies related to the requirements of the labour market and the criteria necessary for the successful employment of a young specialist; recommendations on informatization of the educational space of modern universities have been created. Sales, Cuevas-Cerveró, Gómez-Hernández (2020) presented a theoretical work where the effectiveness of using databases in the educational process was determined and established in practice. Dawes (2019) considered the features of the methodology of training IT specialists, taking into account the increased requirements for digital competence in the conditions of total computerization of the society.

Cabero-Almenara et al. (2020) carried out scientific research on the role of information technology in the modernization of education. Castañeda, Esteve, & Adell (2018) represented a paper that was devoted to the problems of using cloud technologies during the training of IT specialists. The problem of organizing digital education in the conditions of a pandemic was considered separately; methods and technics of distance education were proposed. These studios provide recommendations for the preparation of distance learning courses (Ghebreyesus & Tedros-Adhanom, 2020). As noted in a number of studies conducted by Shebanina et al. (2021) Strikha et al., (2021), organizational and administrative work on developing a new type of educational technologies depends on the position of the regional authorities and the municipality. The high level of financing of digital technologies in education contributes to the formation of high-quality distance education in conditions of quarantine and pandemics. A number of studies (González-Calatayud, Román-García, & Prendes-Espinosa, 2018) also considered the problems of establishing the conceptual fundamentals of education and development of educational and scientific environments in educational institutions at the cloud level. The most important components of modern education are the ability of students to freely operate a software product that is adapted to education. This makes it possible to leave the space of a unidirectional curriculum in digital education and move to a multidimensional integrated approach to training not only IT specialists, but also young professionals competent in digital education (Jacobson, Mackey, O'Brien, & Keiffert, 2020). This approach provides an opportunity to develop one's own strategy for learning and professional development, revealing alternative positions in education. According to the definition, the specificity of innovative forms of education is an orientation towards the development of critical thinking, heuristics, creativity in professional activity, which helps to formulate and solve crisis situations and problems, based on the principles of systemic thinking, awareness of the place and role of digital technologies in the society (Malihin & Jarmol'chuk, 2020).

3. Materials and Methods

The research goal outlined involves the use of an integrated approach in the research methodology. A number of bibliosemantic and analytical methods were used in the academic paper. In order to determine the importance level of the implementing digital competencies and algorithms for improving these competencies, a study was conducted of the results achieved in the past and the current research, which was conducted in December 2021 at KPI named after Igor Sikorsky, National Technical University "Kharkiv Polytechnic Institute" (Ukraine). The survey method was used when working with employers of IT specialists, students and teaching staff of the university.

4. Results and Discussions

Technical education in Ukrainian universities is characterized by a sufficiently high level of digitization in the process of training IT specialists, as well as using information and communication technologies for the period 2017-2019 (Table 1; Figures 1, 2). Technical education in Ukrainian universities has undergone a significant transformation in recent years, with a particular focus on digitization and the use of information and communication technologies (ICT) in the training of IT specialists. The period between 2017 and 2019 saw a notable increase in the level of digitization in technical education, with universities incorporating a range of digital tools and platforms to enhance the learning experience for students. One of the key drivers of this digitization has been the growing demand for IT professionals in

Ukraine and around the world. With the rapid pace of technological change, it is essential for technical education to keep pace with the latest trends and technologies. Ukrainian universities have responded to this challenge by investing in state-of-the-art equipment, software, and ICT infrastructure, and by developing innovative curricula that combine theoretical knowledge with practical skills. In addition to the use of ICT in the classroom, Ukrainian universities have also embraced e-learning and distance education, providing students with greater flexibility and access to learning resources. This has been particularly important during the COVID-19 pandemic, which has forced many universities to shift to online learning models.

Table 1. Digitization in the Process of Training IT Specialists

Indicator	Year			Deviation	
	2017	2018	2019	2018- 2017	2019- 2018
Proportion of enterprises that conducted training in the field of ICT out of the total number of enterprises:					
training courses for professionals, %	3,7	3,8	4,6	0,1	0,8
training for other employees, %	4,1	4,3	4,8	0,2	0,5
Proportion of enterprises that used the Internet out of the total number of enterprises that had access to the Internet for purposes:					
sending or receiving e-mails, %	86,9	85,4	98,4	-1,5	13
making phone calls via Internet / VoIP or video conferencing, %	27,8	28,5	30,4	0,7	1,9
obtaining information about goods and services, %	78,2	77,1	87,6	-1,1	10,5
bulletin board, %	43	42,7	47,3	-0,3	4,6
use of instant messaging and electronic receipt of information from public authorities, %	71,2	70,4	79,8	-0,8	9,4
carrying out operations with public authorities (except for obtaining information), %	45,6	46,1	50,9	0,5	4,8
conducting banking transactions, %	85,5	84,3	96,6	-1,2	12,3
access to other financial services, %	35,8	35,8	39,2	0	3,4

Source: Reshetnjak & Bilousov, 2021

As we can observe, the data from Table 1 of the possibilities of social networks, and the Internet was used in education and industrial practice for the purpose of working with e-mail (2017 – 86,9%, 2019 – 98,4%), for carrying out banking transactions (2017 – 85,5%, 2019 – 96,6%), search and broadcasting of information about services and goods (2017 – 79,8%, 2019 – 70,4%). Thus, the presented data proved that digitalization and intellectualization of business activities and management is actively increasing. This is precisely why it is important to increase the number of qualified IT specialists in the production and administrative sectors.

The proportion of enterprises that conducted training in the field of ICT (Information and Communication Technologies) out of the total number of enterprises is an important indicator of the level of investment in human capital and the readiness of businesses to adapt to the demands of the digital age. As we can see from Figure 1, there has been a growing recognition of the importance of ICT skills for businesses of all sizes and industries. The COVID-19 pandemic has further accelerated this trend, as companies have had to rapidly adapt to remote work and digital collaboration.

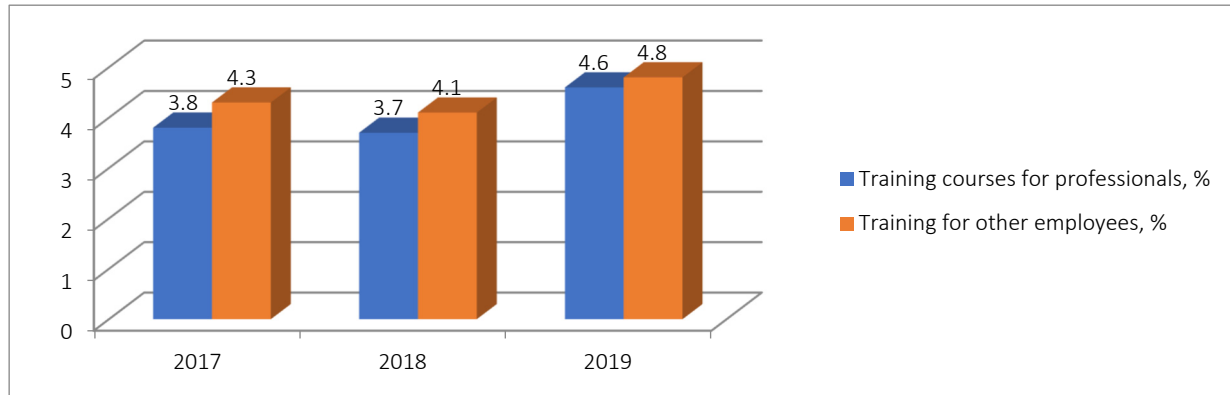


Figure 1. Proportion of Enterprises That Conducted Training in the Field of ICT out of the Total Number of Enterprises

Source: compiled by the authors according to the data Reshetnjak & Bilousov, 2021

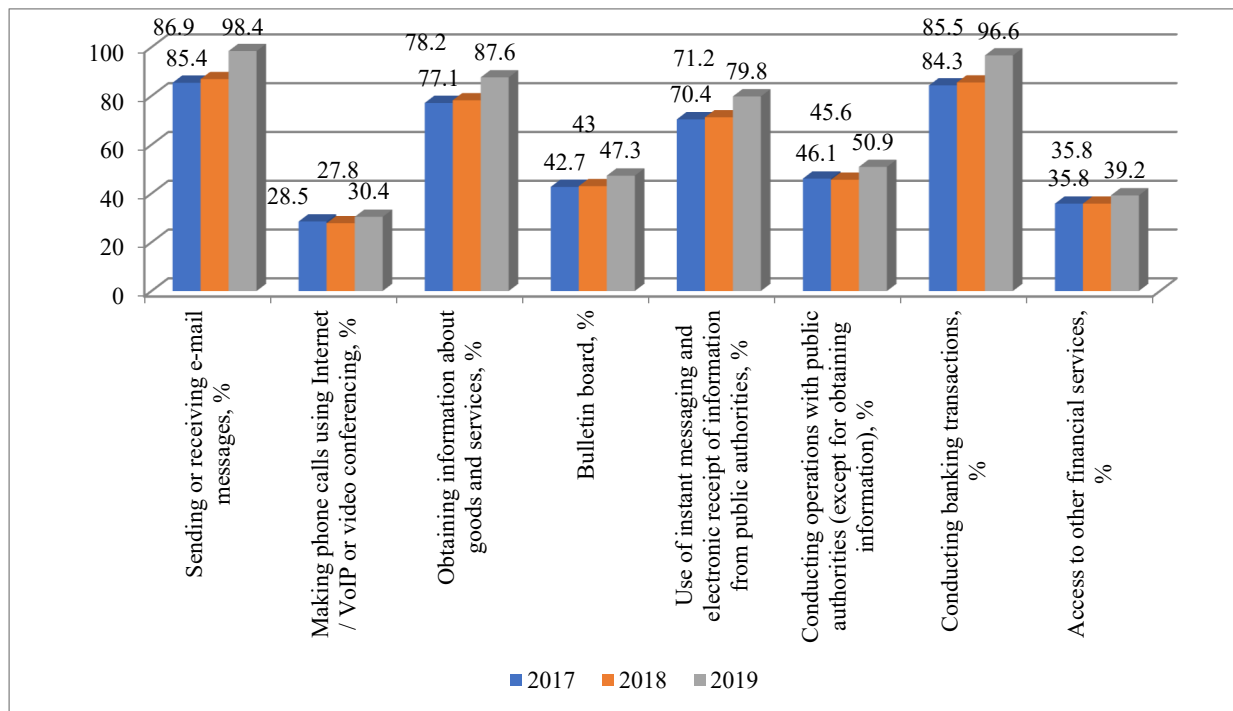


Figure 2. Proportion of Enterprises That Used the Internet for Relevant Purposes out of the Total Number of Enterprises That Had Access to the Internet

Source: compiled by the authors according to the data Reshetnjak & Bilousov, 2021

The proportion of enterprises that used the Internet for relevant purposes out of the total number of enterprises that had access to the Internet is an important indicator of the level of digital adoption and utilization among businesses. The period between 2017 and 2019 saw a significant increase in the number of enterprises that had access to the Internet, as well as a corresponding increase in the proportion of those enterprises that used the Internet for relevant purposes (Figure 2). The relevant purposes for which enterprises used the Internet varied widely depending on the industry and country, but included activities such as e-commerce, online advertising, social media marketing, and cloud computing. By using the Internet for these purposes, enterprises can increase their efficiency, productivity, and profitability, while also expanding their reach and customer base. Overall, the proportion of enterprises that used the Internet for relevant purposes out of the total number of enterprises that had access to the Internet increased in the period between 2017 and 2019, indicating a growing trend towards digital adoption among businesses.

In December 2021, a comprehensive survey of students, scientific and pedagogical workers, and teachers, managers of practice bases, graduates, and stakeholders was conducted. The purpose of the survey was to establish the degree of importance for general and industrial sectors of students' digital competence and their possession of tools for its improvement. All surveys were related to the experience of cooperation and training with specialists in the IT field prepared by the university. The results of the survey are shown in Figures 3, 4, 5, 6,7.

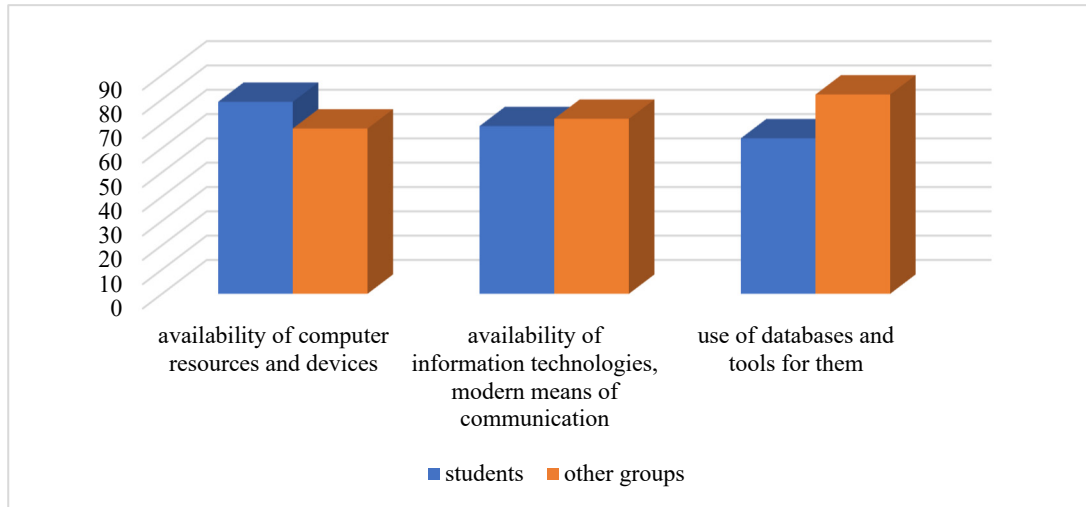


Figure 3. Assessment of the Adequacy of the Digital Competence Components by students and Teachers (author's development)

According to the survey results of respondents working and studying in the IT industry, the skills and scope of work with new information and communication technologies, operating various databases, producing and consuming information are of particular importance. Educators and stakeholders value a number of skills more highly than students.

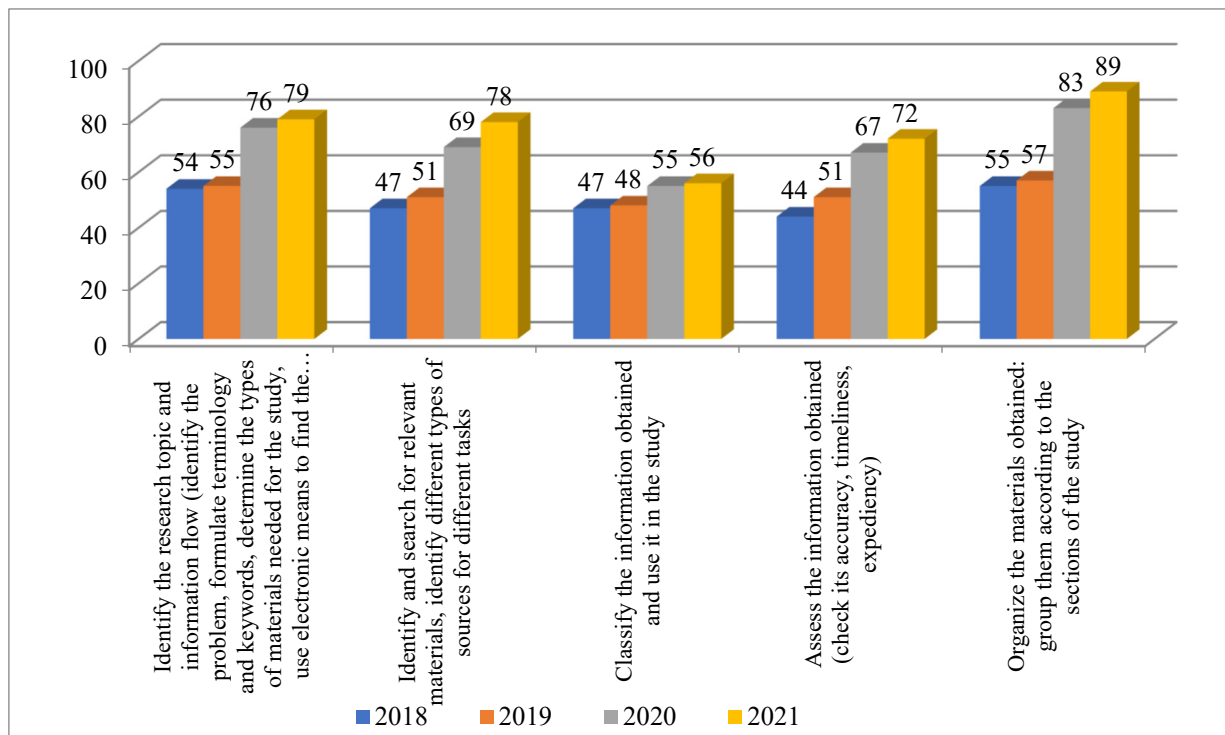


Figure 4. Correspondence of Digital Competence Components from the Viewpoint of Teachers and Stakeholders (author's development)

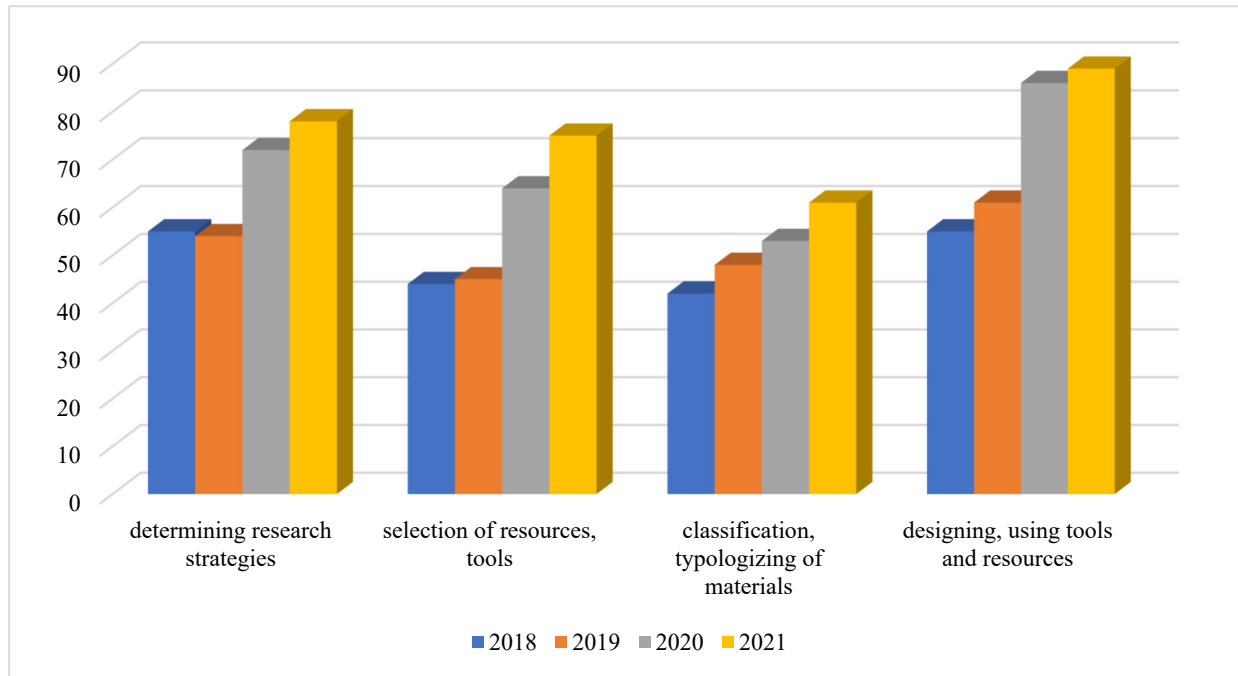


Figure 5. Correspondence of Digital Competence Components from the Viewpoint of Teachers and Stakeholders (author’s development)

As it can be seen from the results, the increase in the level of digital competence was constant and systematic. The ability to define a problem and strategies and tactics for its solution, the ability to conduct project activities, effectively use available resources and tools, navigate the types of materials and information blocks, and use electronic resources (grouping by sections and stages) turned to be significant skills. The positive dynamics of increasing the level of competence is connected precisely with the presented components.

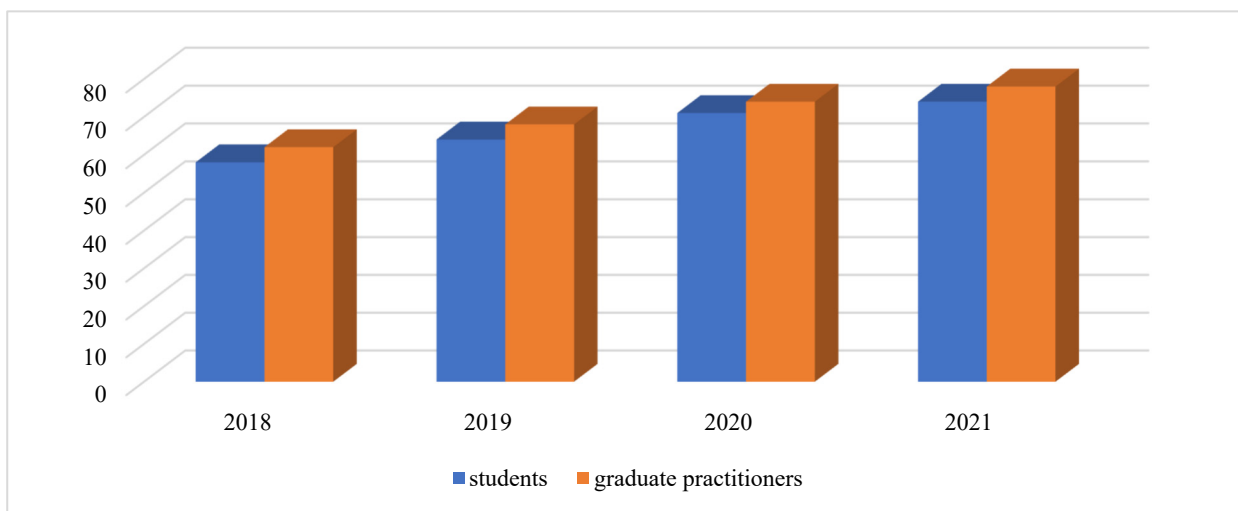


Figure 6. Evolution of the Digital Competence Level of Participants of the Educational Process (author’s development)

The evolution of the digital competence level of participants in the educational process (Figure 6) between 2017 and 2019 indicates a gradual increase in the digital skills and knowledge of students and graduates. This trend is in line with the growing importance of digital literacy in the modern workforce, where digital skills are increasingly essential for

success across a range of industries and occupations. The development of digital competence among participants in the educational process was likely influenced by a range of factors, including changes in curriculum and teaching methods, the availability of digital tools and resources, and broader societal trends towards digitalization and technology adoption. During this period, many educational institutions implemented measures to enhance digital literacy among their students, such as incorporating digital technologies and tools into coursework, offering online learning resources and platforms, and providing training and support for digital skills development. These efforts were aimed at equipping students with the knowledge and skills they need to succeed in a rapidly changing digital landscape.

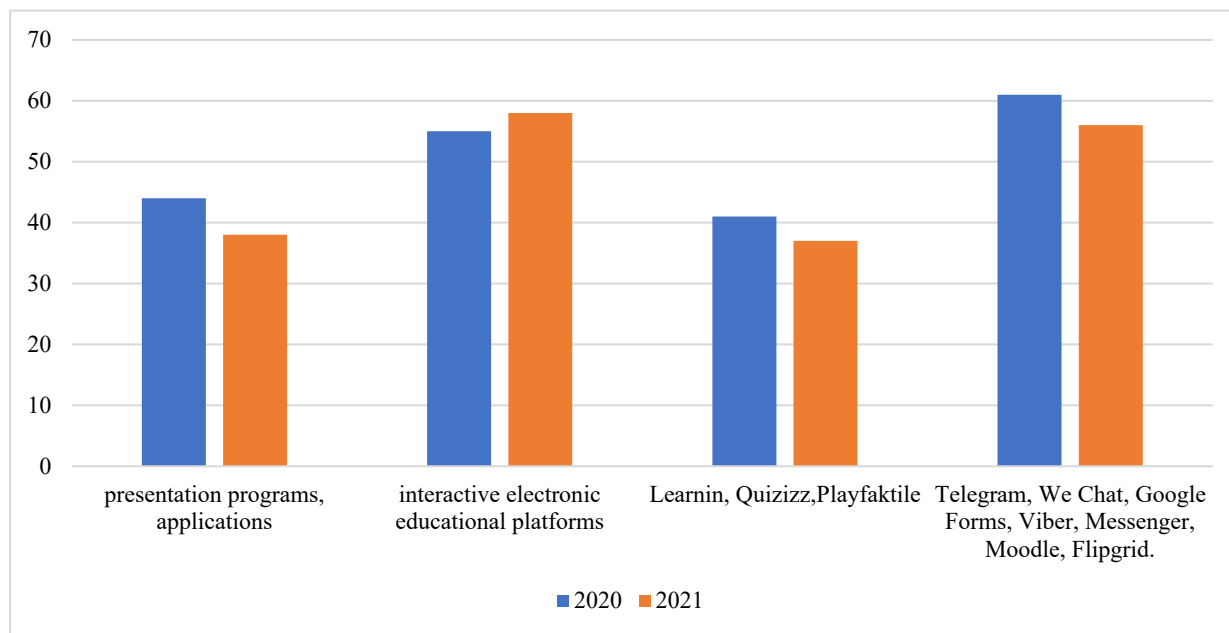


Figure 7. Tools and Resources Used in Training IT Professionals in Pandemic Conditions

As it can be observed from the results, the educational content intended for IT professionals includes a set of necessary educational programs and applications: presentation tools, online educational platforms, communication resources, for example, Google, Viber, Messenger, Moodle, Flipgrid, Telegram, We Chat. They have become essential for remote training and virtual classrooms. These platforms enable instructors to deliver live lectures, conduct group discussions, and provide one-on-one mentoring remotely.

5. Discussion

Theoretical justification and a number of projects implemented in practice and research studies, conducting surveys has shown that the development of digital competence of IT specialists is one of the main directions of education development, improving the quality of educational services. Along with this, in the theory and practice of education, different views on the components of the concept of “digital competence” and the tools for its improvement and development have been developed. According to the viewpoint of Galaevs’ka (2021), a person’s informational and communicative literacy is a person’s ability to navigate the ever-changing social-cultural environment, the space of different cultures; the ability to spread knowledge and information, be creative, improve communication skills, develop relevant methods of interaction, teamwork, active personality.

Reshetnjak & Bilousov (2021), for instance, define information and communication literacy as a person’s ability to cope with crises, solve production, life, household and educational problems using information and communication technologies. A number of researchers (Manso-Perea, Cuevas-Cerveró, & González-Cervantes, 2019) raise the issue of updating the definition of information literacy, which is presented as the ability to carry out effective information activities in the professional, educational, personal space, to be able to solve current problems, to rely on one’s own experience, study independently and organize one’s work and work in a group, be aware of one’s place in the educational and work process. The rapid introduction of information and communication technologies in all areas of human life and activity is connected not only with an increase in the amount of information, but it also sets new

requirements for security and the level of training of specialists. And this means a new series of problems and prospects for the development of education. They are reflected in the requirements for the personality development and its professional qualities; they require expanded consumption and production of information and its operation. While analysing the leading tasks of the modern education system through the prism of complex social-cultural and civilizational transformations, one should note the acceleration of the development of digital technologies, media and education. The problem of training highly qualified specialists in various fields of business, production, education, etc. remains relevant. It is also significant to prepare a young person for life in a complex society within the framework of constant development and dialogue in communications at different levels. This means that digital competencies and experience in their application are mandatory among the basic skills and abilities that must be formed in the process of education and personal development.

The solution of educational and pedagogical problems regarding the quality training not only of a specialist, but also of an individual for subsequent life in the conditions of the modern information society involves the introduction by teachers of innovative media-pedagogical models into the educational process. The directions that determine the development of the modern education system are as follows:

- communicative (use of media pedagogy and mass communication tools for the purpose of developing skills of activity in the information space, resistance to manipulations, striving for self-education and development (social, cultural, moral);
- cultural (constant search and development of new cultural paradigms, ways of thinking, methods of transformation of cultural meanings);
- legal (awareness and ability to apply in practice security tools in the field of legislation and law, related to information and communication technologies, informatization of the society).

The information society carries many risks and requires constant work with problematic tasks. Large amounts of information lead to the need to process it, optimizing its selection and ways of receiving it. It also contributes to the spread of digitalization of the society and creates the danger of manipulation of information, decision-making, threatens the dehumanization of the society. That is why media education is an additional element of the modern educational space. This is the field of acquiring social-psychological and pedagogical skills, which is intended for the development of human adaptation skills to social-cultural influences on the basis of new technological achievements. According to studies of L. Masterman, currently, media education is a relevant direction of pedagogical thought. The researcher identifies the following principal factors of such relevance, namely: a rapid increase in the volume of standardization processes; constant flow of large volumes of media information, diversification of ways of its distribution and management; the intensity of penetration of media influences into important democratic processes; the emergence of ideologically valuable mass media and its impact on public consciousness; the need to study and teach with increased didactic element.

Globalization in the context of informatization of the society has changed the world. The information space is constantly expanding and improving; this constantly provokes changes in educational approaches to learning. The present research has shown that in the conditions of informational and communicative influences, new ideas and value priorities are formed; this is explained by the society's desire towards understanding and constant development. This is precisely why a young specialist must be a holistic person; he should acquire a complex of those competencies of different levels that will help to possess new qualities of a comfortable and productive life in the society. The work on the formation of information hygiene skills of IT specialists remains relevant. At the beginning of the formation of specialists' information competence, it was not important how knowledge is related to the technological development of information and communication tools. However, recently, the focus of attention has shifted to the urgent problems of searching for and selecting information resources and tools, developing professional methods of collecting, analysing and producing information.

In the context of media education, a way of thinking is formed in which the ability to perceive and assess information is a priority together with the ability to operate the media and communicate on its terrain.

Lazarenko, Gurevych, & Kyzym (2021) evaluated the results of work with methodology, technologies and innovative modes of operation with modern information communications in education. The scholars proposed a number of recommendations in this direction, namely: to promote a broad discussion on the introduction of digital technologies into the educational process; searching for the most available and effective ways to acquire skills in the digital industry; to work on the inclusion of the digital literacy basics in regulatory and legal documentation within the "digital competence" concept; to stimulate the development of the digital space in education, to form open Internet resources

and databases with the aim of creating new educational complexes, to control the use of Internet resources and intellectual property; to work on virtual simulation technologies in the educational process; to support and constantly develop the initiative of private and public educational institutions regarding the use of educational information technologies.

6. Conclusion

The COVID-19 pandemic has had a significant impact on the way that information technology specialists acquire and develop their competencies. The sudden shift towards remote work and digital collaboration has highlighted the importance of skills such as digital literacy, online communication, and data management. To remain competitive in the post-pandemic job market, information technology specialists must continuously develop their competencies and keep up with the latest trends and technologies. This requires a commitment to lifelong learning and a willingness to adapt to changing circumstances. Overall, the algorithms of formation and features of development for information competencies of information technology specialists in the conditions of the pandemic must be centered around flexibility, adaptability, and a strong foundation in core competencies. By embracing these principles, information technology specialists can navigate the challenges of the pandemic and emerge stronger and more competitive than ever before.

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