Developing a Modern Educational Environment in the Digital Space at the Institution of Professional (Vocational-Technical) Education

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The purpose of this article is to substantiate and analyze the digital space of the information development and educational environment of IP(VT)E and identify current issues. The current state of the digitalization process in institutions of professional (vocational-technical) education [IP(VT)E] and its impact on the development of information and educational environment are studied. Teachers and students are faced with problems in training and production processes, including distance learning, brought about by quarantine restrictions during the Covid-19 pandemic. These issues were determined and an analysis of the activities of IP(VT)E in Ukrainian regions made with respect to the creation and development of an information and educational environment. This was achieved by developing models and implementing individual components of the digitalization process, and the development of electronic educational literature and introduction of 3D modeling technologies. The example is presented of an information and educational environment created by the Educational and Practical Center of Electrical Technologies in Kryvyi Rih and based on an electronic educational platform.

Keywords: digitalization, development of information, digital technologies, educational management, training

INTRODUCTION

Modern conditions for the development of a state and society in the global perspective are focused on finding solutions to new problems. Advances in technology change the traditional view of work, education, culture, communication, and other aspects of socio-political life. Due to the changing operational models and functions of industries focused on the introduction of new technologies, the task of "providing comprehensive and equitable quality education and encouraging lifelong learning for all" is a priority (strategic) task in Ukraine (Verkhovna Rada of Ukraine, 2019b). This approach encourages the search for new vectors for the training of specialists. Specialist training must be compliant to understanding modern technological tools and ensure the availability of vocational education for all categories, and the optimal formation of knowledge, skills, and abilities.

It is possible to achieve this by creating a computer-oriented educational environment that makes maximum use of information and communication technologies in all areas of activity. This approach in pedagogy is called "environmental" (Smolyuk, 2017 and it is a source of intellectual enrichment of the student to develop their confidence and motivate their learning. This approach is developmental in creating an environment that expands access to information technology, the Internet and information resources. It promotes the introduction of distance learning technologies to implement various forms (full-time and part-time) for training of highly qualified specialists, following effective regional policy and equalization of achievements in socio-economic development in regions (Bykov & Zhuk, 2005).

The urgency of implementing these changes in the field of professional (vocational-technical) education [P(VT)E] is especially important as shown during the COVID-19 pandemic when digitalization reduced the negative consequences for the market environment and consumers of educational services. Institutions of professional (vocational-technical) education [IP(VT)E] have new challenges related to improving human resources, technical equipment, tools and methods of training, the development of digital content to ensure the quality training of specialists, and the implementation of online hybrid learning. Such trends exacerbate a number of inconsistencies and require a powerful, coordinated effort to identify and resolve them. After all, digital technologies, when used effectively, open up opportunities for individualized, flexible, and oriented training for future specialists while taking into account the principle of continuity. At the same time, the function of the pedagogical worker is to promote cooperation between students in order to acquire new knowledge.

In this context, the priorities for the formation of key skills are changing. The skills of time management, leadership, teamwork, and the ability to adapt to new conditions are in demand. The unique advantage of implementing online learning technologies is in the integration of digital with professional competencies. This encourages the assessment of the experience and willingness of both teachers and consumers of educational services to implement and perceive this type of training, and the effectiveness of the existing virtual environment in order to identify the most efficient resources and expand them.

Despite certain advantages of implementing distance learning technologies, the possibilities of practicing professional skills by future specialists online in the areas of mining, electrical engineering, food, engineering, construction, and other heavy industries are quite controversial. The effectiveness, location, and role of these technologies are required to be determined. The aspects of studying this experience are important for the choice of future educational policy, quality, and access to digital skills and learning. Now we need take into account the views of the leaders of IP(VT)E as the founders of the strategy of P(VT)E and the compliance of existing practices with modern labor market needs in order to identify factors that influence the effectiveness of the P(VT)E system under this practice.

METHODOLOGY

In accordance with the purpose, the state of development of the information and educational environment in IP(VT)E in the context of the implementation of distance learning was analyzed. Representatives of various branches of IP(VT)E of seven regions of Ukraine and the city of Kyiv were involved in this process, and were divided into three target groups: 84 pedagogical workers (6 teachers of

professional and theoretical training and 6 masters of industrial training from each institution); 98 students (14 second-year students in different areas of training of each institution); 38 people from the management department (7 – directors, 7 – vice directors of educational and production work, 7 – vice directors of educational work, 7 – vice directors of educational work, 7 – masters of industrial training).

Three indicators were selected for presentation to each participant category: I) "Obstacles faced by educators during distance learning" for a group of leaders of IP(VT)E; II) "Experience of using distance learning in their teaching activities" – for teachers; and III) "Provision of computer equipment and other equipment for the effective organization of distance learning" – for students.

A set of interrelated methods was used in the research as follows:

- *theoretical*: systematic analysis of pedagogical and methodological literature, native legislative documents, scientific publications on reforming the system P(VT)E, statistical materials of the Ministry of Education and Science of Ukraine, Internet resources. This method was aimed to the study of the digitalization process and the essence of information and educational environment in IP(VT)E. As a result, it was established that some aspects of the problem are presented in the works of O.V. Bazelyuk (digitalization of vocational education as a global socio-natural process), V.Y. Bykov (cloud computing technologies, ICT outsourcing, and new functions of ICT departments of educational institutions and research institutions), O.D. Humenny (start-complexes of educational disciplines for IP(VT)E and information culture of the head), M.O. Ershov (the role of Ukrainian IT education in the global market of information goods and services), I.G. Yanenkova (Industry 4.0 technologies, investments in IP(VT)E), A.M. Gurzhiy (modern information technologies and innovative teaching methods in training), A.G. Kononenko (creation of information and educational environment in IP(VT)E), N.V. Morse (information technology in education), and O.M. Spirin (information technology and teaching aids).
- *empirical*: survey (questionnaire), the method of expert assessments, analysis of documents, statistical data of respondents (teachers, students, heads of IP(VT)E), by indicator groups: I – "Obstacles faced by educators during distance learning"; II – "Experience of using distance learning in the pedagogical activity"; III – "Provision of computer equipment and other equipment for the effective organization of distance learning."

The calculation of empirical data obtained during the study was carried out by determining the average value of the sample by the formula:

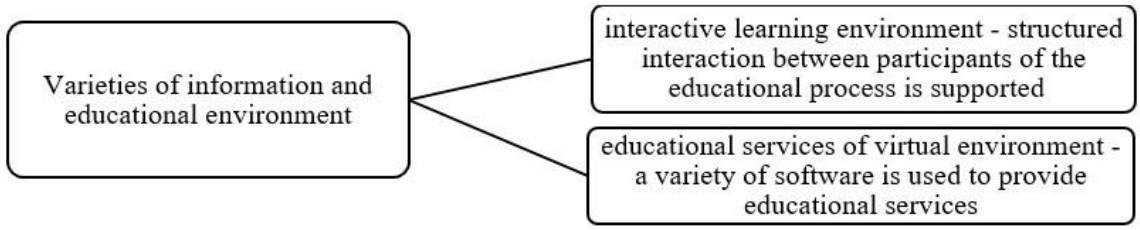
$$\bar{x} = \frac{\sum_{i=1}^{n} x_i}{n}, \quad (1)$$

where $\sum_{i=1}^{n} x_i$ is the sum of respondents' answers to one question and n = the total number of respondents.

RESULTS AND DISCUSSION

During our research, it was determined that as a result of different intensities of application of information and communication technologies, various types of information and educational environments are formed. In this environment, all information is integrated with the help of its various carriers (Figure 1) (Zhuk, 2004).

FIGURE 1
CHARACTERISTICS OF THE INFORMATION AND EDUCATIONAL ENVIRONMENT



According to E.R. Zaredinova (2017), the information and educational environment of an educational institution can be divided into seven structural components (strategic, sociocultural, personal, value-semantic, subject-activity, communicative, technological), each with its own content. It is important to note that the latest technological component of the environment (i.e., that provides for the introduction of modern educational technologies in management, training, and educational, production, and development activities) has particular importance today and is obligatory in the creation of an information and educational environment. The presence of a technological component contributes to the development of new functions of participants in the educational process: information, interactive, communication, learning, etc.

In our opinion, P(VT)E should be recognized by legally approved standards and its development promoted in all formats: formal, non-formal, and informal education for both students and other participants of the educational process, e.g., teachers, leaders of IP(VT)E, etc. This is confirmed by the State's vision in the field of vocational (vocational- technical) education, where one of the main directions of its transformation is to update the content and improve the quality of education, including and due to:

- the creation of modern standards of professional (vocational-technical) education according to the competence approach;
- recognition of non-formal and informal education; and
- the creation of a system of obtaining and independent assessment of full and partial professional qualifications (Ministry of Education and Science of Ukraine, 2019).

In our opinion, the implementation of these directions lies in the plane of modernization of P(VT)E. According to modern observers, such "modernization" is "digitalization." This process is characterized by electronic–communication interaction between systems and the presence of appropriate electronic–digital devices and tools. Experts claim that in February 2020, the number of Facebook users had increased by 70% over the previous year, totaling 2 million people. At the same time, 81% of Internet users are registered in at least one social network. In comparison, in the USA, this number is 65% (Korrespondent.net, 2012).

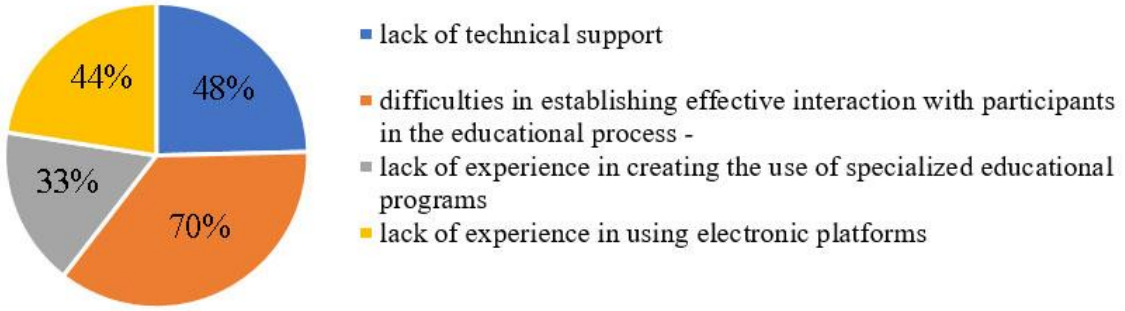
Experts also believe that the ability to work in social networks effectively is an important advantage for any professional and soon will become an advantage in any society. According to current challenges, including the challenges caused by the Covid-19 pandemic, the regions' IP(VT)E were not ready for change. Managing director of the Directorate of Vocational Education of the Ministry of Education and Science of Ukraine, I.V. Shumik, thinks the most common problems that IP(VT)E faced during distance learning are:

- lack of experience in organizing distance learning;
- impossibility to transfer practical blocks to a remote format, in particular due to the peculiarities of professions;
- poor provision of institutions and students with gadgets, and lack of access to quality Internet;
- unwillingness to master new formats of interaction;
- limited number of e-learning materials (Ministry of Education and Science of Ukraine, 2021).

Our study found that the main problems in the implementation of distance learning among teachers are the lack of necessary technical support, limited access to the Internet, and lack of experience in creating

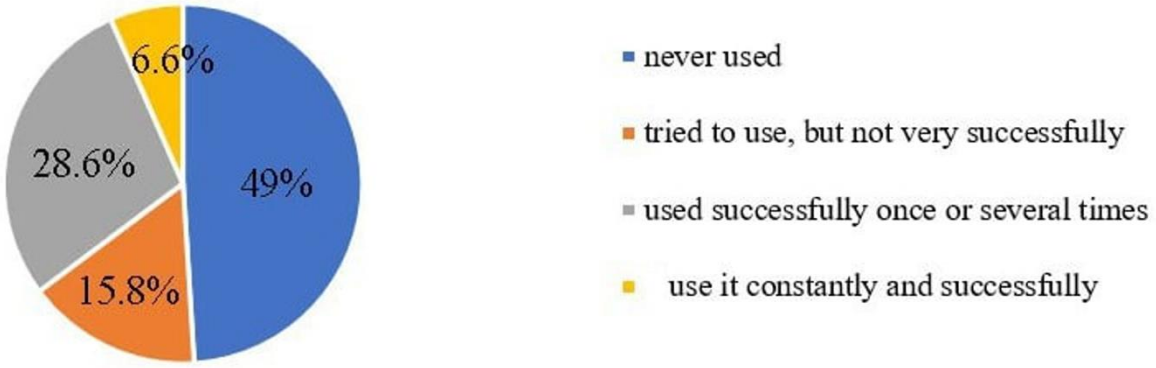
and using specialized educational programs on electronic platforms. Seventy percent of managers of IP(VT)E pointed at difficulties in establishing effective interaction with students, i.e., not all students have the opportunity to get in touch, express a desire to participate in online activities, or do homework (Figure 2).

FIGURE 2
KEY ISSUES THAT TEACHING STAFF OF IP(VT)E FACE DURING DISTANCE LEARNING



This observation is confirmed in studies that were conducted as a part of experimental work by the Institute of Vocational Education of the National Academy of Pedagogical Sciences of Ukraine to assess the experience of pedagogical staff of IP (VT) E on the use of distance professional learning in their own teaching activities (Figure 3) (Radkevych, 2017).

FIGURE 3
DISTRIBUTION OF TEACHERS BY EXPERIENCE OF USING DISTANCE LEARNING IN THEIR TEACHING



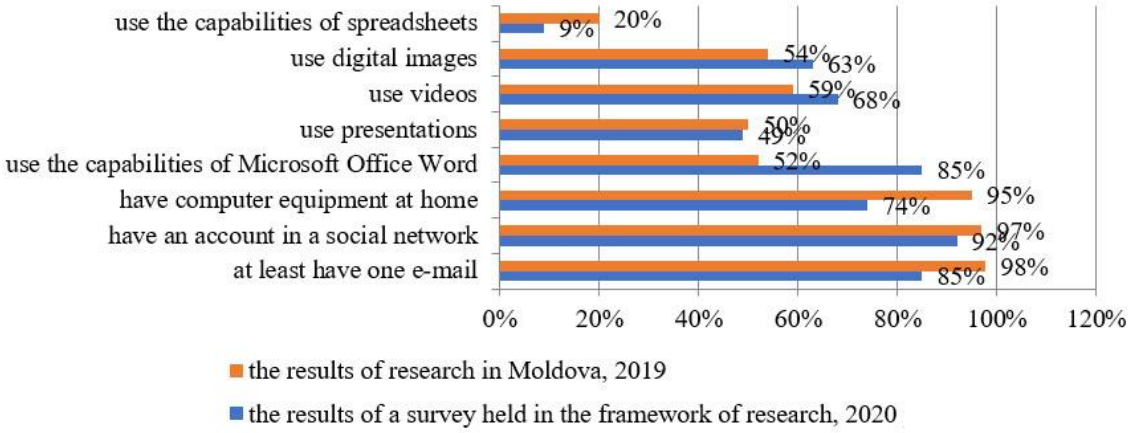
According to a study organized in 2019 by the educational center ProDidactica in Moldova, 65% of teachers in the field of P(VT)E expressed the need to improve their digital competencies (Ministry of Education and Science of Ukraine, 2020). Leaders of IP(VT)E in regions of Ukraine claim that about 10% of their teachers annually take refresher courses to improve their competencies in mastering information and communication technologies, and in Moldova, 10–12%. This figure in Azerbaijan until 2020 was about 6% (200 people) of all staff in the field of vocational technical education (VTE) per year. However, in 2020, this number increased significantly when about 2,000 teachers and VTE trainers received intensive training in digital technology, particularly for MS Office, MS Teams, and Cisco cybersecurity (European Training Foundation, 2019).

A significant proportion of teachers (83%) say that they mostly use asynchronous training. In general, the survey revealed the following: 85% of respondents have at least one e-mail box; 92% have an account

on a social network, 74% have a computer at home; 72% use the capabilities of Microsoft Office Word during teaching; 49% for presentations; 68% for video materials; 63% for digital images; and 9% for spreadsheets. Comparing the results of our study with the monitoring studies conducted in Moldova, we can talk about small deviations in the indicators (Figure 4).

The single educational platform for all pedagogical staff was mainly used in the distance learning in IP(VT)E. 93% of responded teachers, 95% of managers and 89% of students confirmed it. The information space was mostly hosted on G Suite for Education Google Classroom, Microsoft Teams, Moodle, and others. Feedback from students and teachers (96%) was implemented through messengers (Viber, Telegram, Messenger, WhatsApp, etc.); 64% used the capabilities of Skype, Zoom, and other means of video conferencing; 37% used specialized software (LearningApps, programs/simulators, augmented reality); and 9% organized educational activities through e-mail.

FIGURE 4
COMPARATIVE ANALYSIS OF A SURVEY OF TEACHERS IN MOLDOVA AND UKRAINE ON THE IMPLEMENTATION OF DIGITAL TECHNOLOGIES IN THEIR TEACHING ACTIVITIES



During an analysis of Armenia's experience in organizing distance learning during the aggravation of the pandemic, it was found that at the organizational level, new rules of procedure of the educational process were adopted. Modules that can be studied with online resources were identified, mass online courses were developed, and changes in educational programs were made. To implement the practical component of cooking courses, teachers developed detailed video content for cooking various dishes. Confirmation of students' knowledge, skills, and abilities was also carried out using a video format. The greatest difficulties for teachers were in the organization of entrance exams and determining the level of qualification of students. A course was developed to help develop the digital skills of teachers and students. This course was approved as a mandatory tool for the system of establishing and confirming qualifications for all participants in the educational process in VTE (European Training Foundation, 2020a).

In Azerbaijan, donor organizations have developed video lessons in 12 specialties, which are broadcast on the national TV channel (www.medeniyyettv.az) and YouTube. Such classes last 7–15 minutes. These lessons are distributed between theoretical information and practical work, and conducted by highly qualified specialists. Assessment was also a challenge for the VTE of Azerbaijan and was implemented mainly through WhatsApp or Zoom, which provided individual communication with each student in turn.

The Baku Center for Industry and Innovation developed online webinars for students of education in electrical technology using tools for modeling production processes. Alongside with professional competencies of the students, digital ones are being formed as well (European Training Foundation, 2019). To expand the capabilities of teachers in the Republic of Belarus, who switched to online training in

connection with the Covid-19 pandemic, the Republican Institute of Vocational Education organized a series of webinars on topics such as screencasting in the learning process, Moodle settings, distance learning, video lectures, and online and offline learning (European Training Foundation, 2020b).

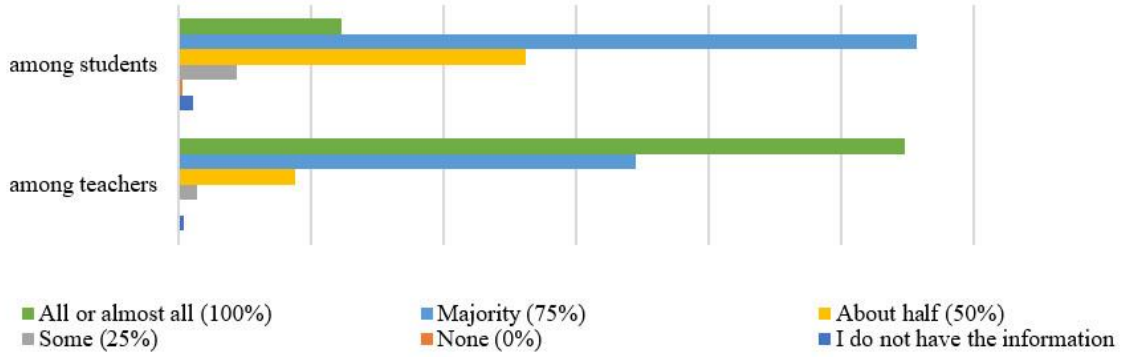
A study of the online vocational training system in Shanghai showed that this process was based on the concepts of quality assurance of practical classes on the Internet. Thus, a team of the most experienced educators from various vocational schools was created. They conducted courses and developed online activities using WeChat capabilities to provide technical advice and guidance on the use of software and the creation of online courses. Distance learning was also implemented through various platforms and Shanghai television. Social media tools, such as Tencent Classroom, WeChat Work, DingTalk, and public online communication platforms, were used to ensure dialogue between teachers and students. Some vocational schools used online tasks and testing to determine learning outcomes. Online laboratories were also widely used to integrate "learning, work, practice, and assessment." That is, training with the help of information technology was aimed at the implementation of research training methods (European Training Foundation, 2020c).

In general, 95% of IP(VT)E managers assess the effectiveness of distance learning in the regions of Ukraine as less effective than training in an educational institution. About 43% believe that elements of distance learning should be one of the constant tools of interaction between teachers and students, whereas only 1% of respondents believe that distance and full-time learning are equally effective. The survey of students conducted in our study showed that the vast majority of respondents (73%) assess the level of quality of distance learning in IP(VT)E as sufficient for the development of their professional competencies in accordance with the requirements of the market environment although 19% of applicants lacked practice-oriented classes and training materials. The majority of respondents (67%) indicate that distance learning is more attractive to them than traditional. According to a study by B. Mulyanti, W. Purnama, and R.E. Pawinanto, 78.8% of students at higher vocational schools in West Java (Indonesia) note that distance learning is unattractive to them although most acknowledge the availability of learning tools, the availability of teaching materials, their active involvement in the learning process, and high level of teaching (UNESCO Institute for Information Technologies in Education, 2020).

Generalization of the received answers reveals that almost half of pedagogical workers (49%) before the pandemic never used any elements of distance professional training in their pedagogical activity. Other surveyed teachers tried to use elements of distance professional training (15.8% tried to use but not very successfully; 28.6% used it once or several times successfully in their own activities). Almost every sixth surveyed teacher reported a negative experience (15.8% tried to use, but not very successfully.) Only a third of teachers (28.6%) have a positive experience of using elements of distance professional training, and 6.6% did it systematically and effectively.

In their research, the Ministry of Education and Science of Ukraine together with SNU "Institute of Educational Analytics" found that 54.8% of respondents said that all or almost all teachers are provided with computer equipment and other equipment for the effective organization of distance learning. 12.3% of respondents confirmed a similar level of digital support. The percentage of answers "majority (75%)" was relatively high, 55.7% for students and 34.5% for teachers (Figure 5) (Mulyanti et al., 2020).

FIGURE 5
RESPONSES TO THE QUESTION: "HOW MANY PARTICIPANTS IN THE EDUCATIONAL PROCESS OF YOUR INSTITUTION ARE PROVIDED WITH COMPUTERS AND OTHER EQUIPMENT FOR THE EFFECTIVE ORGANIZATION OF DISTANCE LEARNING?"



The implementation of computer programs and the use of information and educational resources should become one of the priorities in the development of vocational (vocational-technical) education and occupy a prominent place in strategic regulations because in the 21st century, having human capital that develops artificial intelligence technologies based on the processing of various data into a new system of knowledge is very important. The modern economy is becoming more innovative in areas of new information, economy of knowledge, electronics, networks, Internet economy, Web economy, Smart economy, and cryptoeconomics (Kovalchuk et al., 2018).

Today, electronic services, payment systems, and electronic money are used in the payments for goods and services. New image recognition systems are emerging in the fields of educational, non-educational, and self-learning, and systems of intellectual decision support. Today, the countries with the most developed digital economies in the world are Norway, Sweden, Switzerland, the United States, the United Kingdom, Denmark, Finland, the Netherlands, Singapore, South Korea, and Hong Kong (Stepanova, 2017). According to the indices of gross domestic product and human development, countries are divided into four groups according to the level of digitalization: countries with limited development, origin, transformation, and advanced development (Dyba & Gernego, 2018). Ukraine is 60th in rank, between Peru and Argentina, and classified as a transformational level of digitalization (Pogoida, 2019). Therefore, it is important for Ukraine to recognize the priority of such a direction of development as digital transformation, which will affect the integration of digital technologies in all spheres of society and the state; that is, it will change the pace of achieving common, economic, and social goals, and provide ways to ensure value for themselves and their employees, customers, and partners. As a result of the digital transformation, the goals will be achieved much faster and cheaper (Ukrainian Institute of the Future, 2019).

In general, digital transformation will fundamentally change the relationship between citizens, businesses, institutions, and organizations and, accordingly, between the participants of the educational process. It is important for Ukraine to adopt the strategy "Ukraine 2030E - a country with a developed digital economy" (Verkhovna Rada of Ukraine, 2019a), which states that digitalization will be the main tool for achieving the strategic goals of the country. Recognizing this concept, we believe that in P(VT)E, digitalization should become an important component of the development of information and the educational environment of the institution. In accordance with the concept of implementation of State policy in the field of vocational (vocational-technical) education ("Modern vocational (vocational- technical) education") for the period up to 2027, the basic first tasks include the following:

- modernization of the educational environment to provide innovation, accessibility, transparency, flexibility, and openness of the educational process, and

- formation of a system of professional qualifications and creation of a single educational environment of professional (vocational-technical) education (Kartashova et al., 2018).

The creation of digital infrastructure in IP(VT)E should include a set of different technologies, products, and processes. We analyzed the capabilities of Ukraine's digital infrastructure as proposed in the strategy "Ukraine 2030E - a country with a developed digital economy." In Table 1, a set of digital technologies, products, and processes for IP(VT)E is developed on the basis of that strategy.

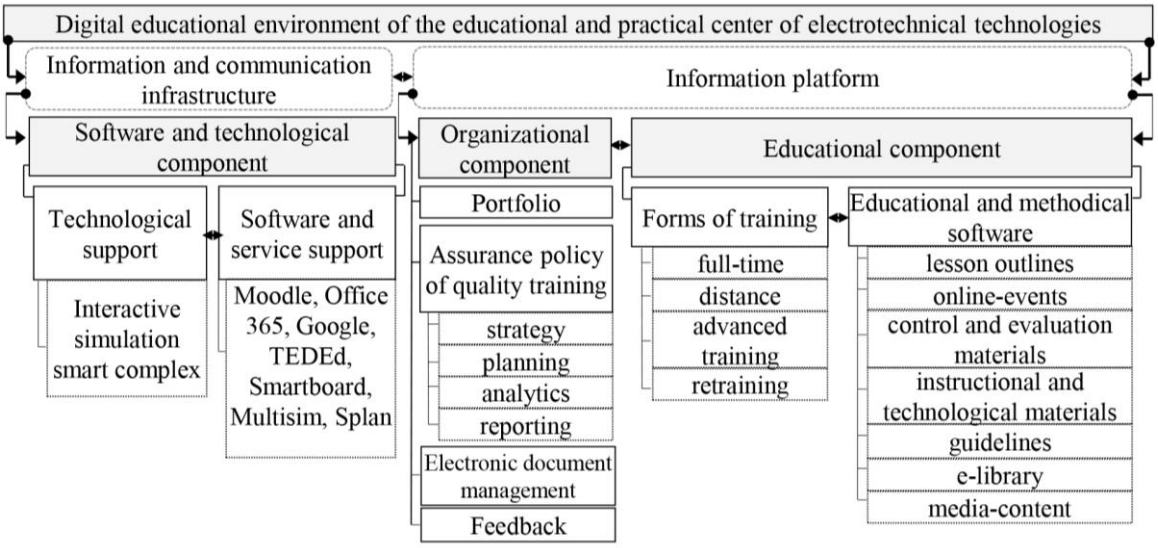
TABLE 1
COMPLEX OF DIGITAL TECHNOLOGIES, PRODUCTS, AND PROCESSES FOR IP (VT) E IN ACCORDANCE WITH THE STRATEGY "UKRAINE 2030E - A COUNTRY WITH A DEVELOPED DIGITAL ECONOMY"

	State	*IP(VT)E*
Supporting (solid) infrastructure	– fixed broadband Internet access infrastructure (BIA); – mobile communication and broadband access infrastructure (3G, 4G, 5G); – radio infrastructure; – satellite communication infrastructure; – computing infrastructure (cloud or virtual); – cybersecurity infrastructure	– Internet connection in the computer room; – students' workstations have permanent Internet access through; – mobile communication infrastructure, broadband access (3G, 4G, 5G), and Wi-Fi at the level of the educational institution; – satellite infrastructure, cloud computing infrastructure, and cybersecurity infrastructure
Service (soft) infrastructure	– identification and trust infrastructure; – open data infrastructure; – public services infrastructure; – interoperability infrastructure; – e-commerce and e-business infrastructure	– open data infrastructure; – life support infrastructure (digital educational systems; – local network and technical means of multimedia, software of the educational process, platforms for Internet conferences, meetings, webinars, seminars, etc.)

As can be seen from Table 1, appropriate digital infrastructure should be created in IP(VT)E. The institution should be equipped with an electronic control room, an electronic study room (web-room), an electronic study room for students/parents, and a web-library containing educational and methodical content adapted to the tasks and specifics of the IP(VT)E e-environment (Ukrainian Institute of the Future, 2019). The computer room, electronic workstations, etc. should be connected to broadband Internet and local area networks and contain appropriate technical means of multimedia, software products, electronic platforms, etc. (Zayets, 2018).

A peculiar analog of the digital educational environment is the Educational and Practical Center of Electrical Technologies of Kryvyi Rih Professional Mining and Technological Lyceum, which uses an internal platform as a tool of technological, organizational, and complex methodical support of the center. At the same time, it combines the coordinated functioning of all components of professional training of future specialists in electrical engineering by implementing new approaches to the interpretation of educational programs on the basis of integrated learning and open access (Figure 6).

FIGURE 6
BLOCK DIAGRAM OF THE DIGITAL EDUCATIONAL ENVIRONMENT OF THE EDUCATIONAL AND PRACTICAL CENTER OF ELECTRICAL TECHNOLOGIES



The digitalization of IP(VT)E is characterized by the creation of an information and educational environment, maximally provided with electronic–digital devices, tools, and systems with an established electronic–communication exchange between them to provide integrated (virtual and physical) interactions, thereby creating an electronic educational resource. We think that the domestic P(VT)E system should use the opportunity and its own human potential to improve the State's economy by means of digitalization. Therefore, the important goals of digitalization in IP(VT)E should be:

- investment attraction;
- ensuring competitiveness and efficiency;
- technological and digital modernization of the educational process and the creation of experimental high-tech jobs;
- accessibility for participants of the educational process of the benefits and opportunities of the digital world;
- realization of human resources and development of digital entrepreneurship.

The digitalization of Ukraine's economy requires updating the State's classification of occupations, which should embrace new *digital professions*, including the electrical branch, taking into account labor market requirements and digital trends. This requires the development of new educational and educational-production programs for the training of competitive specialists in IP(VT)E. Such programs should provide for the formation of general and professional digital competencies, and based on the strategy of accelerated development of the digital economy in Ukraine.

By digital competence, we mean the ability to use digital media and information and communication technologies, to understand and critically evaluate various aspects of digital media and media content, and to be able to communicate effectively (Stephanie et al., 2017). Despite the lack of a systematic approach to the implementation of the digitalization process in IP(VT)E, scientist L.E. Vysotska generalized some practical experiences in developing models and implementing individual components (Vysotska, 2018), namely:

- Kryvyi Rih Professional Building Lyceum – a model was developed for the implementation of full-time and distance learning and electronic courses in the professions of construction, electrical engineering, culinary branch, and trade;

- Higher Vocational School №7, Kremenchuk – a virtual portal was created that provides quick access of users to catalogs of theoretical and video materials, online games, test questionnaires, etc.;
- Vinnytsia Interregional Higher Vocational School – an experimental study "Application of modern means of information and telecommunication technologies in the educational process of vocational schools" was conducted;
- SEI "Interregional Higher Vocational School of Printing and Information Technology" − an information and educational environment was developed with the electronic–scientific and educational complex, "Network Information Technology" – "Virtual Department MVPUPIT" (working title – "Virtual methodical room") as its structural basis;
- Institute of VTE NAPS of Ukraine, SEI "Odessa Higher Vocational School of Trade and Food Technology" – an experimental study on "Creating an information and educational environment in vocational schools of trade and food technology" was conducted.

Among the branches of digitalization, the development of electronic educational literature has become widespread (Table 2) (Stoychik, 2020).

TABLE 2
DEVELOPMENT OF ELECTRONIC EDUCATIONAL LITERATURE IN IP(VT)E

Educational Institutions	Electronic Educational Literature
Uzhhorod Higher Vocational Lyceum of Trade and Food Technology, Mukachevo Center for Vocational Education	"Commodity of non-food products" in the profession of non-food products seller, qualification: 3, 4 categories
Higher Vocational Lyceum No. 3 Mukachevo	"Fundamentals of Radio Electronics" in the profession of electronic equipment and devices regulator, qualification: 3 category
Uzhhorod Higher Commercial Lyceum of Kyiv National University of Trade and Economics	"Fundamentals of Sanitation and Hygiene in Services"
Khust Vocational Lyceum in the field of services	"Technology of making men's pants" in the profession of tailor
SVTEI "Radomyshl Vocational Lyceum"	Electronic textbook on labor protection
Kryvyi Rih professional mining and technological lyceum	Electronic textbook on labor protection
Lysychansk Professional Building Lyceum	Complex and methodical support in the profession "Facing-tiler." Catalog of e-learning tools that combines more than 60 items and includes presentations, educational films, instructional and technological cards, posters, methodological developments, etc.
Research Laboratory of Electronic Educational Resources of the Institute of Vocational Education of the National Academy of Pedagogical Sciences of Ukraine	Electronic textbooks: "Electrical engineering with the basics of industrial electronics"; "Electrical engineering with the basics of industrial electronics" (for occupations in the building industry); "Car construction"; "Information systems and technologies in accounting"; electronic resources "Mechanization of agricultural production (for fruit and vegetable growers)"; "Technology of stone works"; "Technology of finishing works"; "Technology of turning (turner of the 2nd category)"; and textbook "Information and educational environment of vocational schools."

There are some similar developments also in the field of 3D modeling technologies in the educational process (Stoychik, 2014; Gulina, 2016), in particular:

- educational 3D films: “Elements of formation of layered deposits and basic information about their discovery and preparation”; “Purpose and body structure of the locomotive 2TE10M and TGM3”; and “Drilling holes with a drilling rig Boomer S1D company Atlas Copco” (Kryvyi Rih professional mining and technological lyceum);
- mobile applications: “Augmented reality KPGTL” with the help of integrated environments “Android Studio”; “Visual Studio”; “Unity 3D”; “Vuforia”; and 3D models of modern production equipment and transport, in particular, pneumatic perforator YT-28 with animation, locomotive 2TE10M, drilling rig Boomer S1D, and culinary equipment (Kryvyi Rih professional mining and technological lyceum);
- tutorials containing 3D-animation, which demonstrate the necessary standard actions for maintenance, installation, defecting, and repair of electrical installations in the profession “Electrician for repair and maintenance of electrical equipment” (Mariupol Professional Engineering Lyceum).

CONCLUSIONS

According to the results, it was determined that modern digital technologies significantly change the structure and functions of management, the conditions of the educational and production process, and the ways of interaction between its participants. It was determined that the State’s educational policy is aimed at modernization of the educational environment, its innovation, accessibility, transparency, flexibility, and openness, and the formation of a single educational environment of vocational (vocational-technical) education.

The most common problems in IP(VT)E are: the lack of some professional experience of teachers; poor provision of students with gadgets; limited access to quality Internet; and the number of e-learning materials. The positive dynamic is the development of electronic educational literature, and the introduction of 3D technologies.

At the same time, there are certain limitations in the training and production processes of IP(VT)E caused by the Covid-19 pandemic. The gaps that need to be resolved include further active creation and implementation of electronic educational resources in the educational process, in particular: virtual classrooms, workshops, electronic textbooks, sites, blogs, video tutorials, etc.; increasing the level of competence of teachers in the development of electronic educational resources; and searching for ways to ensure quality training of students for training and production activities in the information and educational environment of the institution.

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