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Information and Analytical Resources in the Systems of Technological and Vocational Education

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Abstract. A series of quarantines caused by the COVID-19 pandemic has led to the massive introduction of distance learning technologies into the vocational education system. The subsequent decline in the level of effective organization of training of future specialists, including ensuring the quality of knowledge transfer to them and creating comfortable conditions for their acquisition of professional competencies, provoked a pedagogical search for appropriate methods and technologies that would allow satisfying the educational needs of the subjects of the educational process. The article raises the issues of improving the quality of vocational education, in the basis of which it is proposed to take into account the components of a continuous technological process of forming the competence of future specialists and skilled workers. In this vein, technological education is an important link in the formation of the vocational education system, especially in the vector of its modern transformations associated with online learning. The authors focus on the positive and negative aspects of the use of digital technologies, which, on the one hand, ensure the possibility of implementing the educational process of educational institutions during quarantine restrictions, and on the other hand, given that the activity-based basis of training a profession is a priority competence component. At the same time, the use of information and communication technologies can significantly improve the quality of the educational process. Despite the impossibility of full-fledged remote training in various professional and technological operations, the use of augmented reality technologies and virtual laboratories for remote training allows to train various types of activities and combine them in different combinations. It also helps to assimilate technological operations and develop one's abilities, create communicative situations, automate practical actions, as well as provide an opportunity to influence the leading representative system, implement an individual approach and intensify students' independent work. The article analyzes a number of electronic educational resources, the use of which can provide significant assistance in the preparation and conduct of classes for teachers of vocational institutions and become a significant help for improving the quality of the educational process.

Keywords: Technology Education, Vocational Education, Information and Analytical Resources, Electronic Educational Resources, COVID-19 Pandemic.

INTRODUCTION

The educational system of Ukraine, as well as the educational systems of other countries, in 2020 (2021) was subjected to a very serious test. The COVID-19 pandemic necessitated the introduction of anti-epidemic measures,

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one of which was the very frequent introduction of quarantine. In previous years, the Ukrainian education system has faced the introduction of quarantine measures, for example, limited attendance at educational institutions during peak values of influenza epidemics. The fundamental difference between these situations is that there has been a transition from quantity to quality. If in previous years the reduction of study time could be partially compensated by summer vacations, training material was made up by intensification of teaching, a slight increase in hours for independent work, introduction of additional consultations, etc., in the past year and a half the number of out class trainings was very large. In organizational terms, this has led to the mass introduction of remote learning technologies into the education system.

RESEARCH PROBLEM

It should be noted that remote education in our country has a rich and long history, dating back to times when computer and network technologies were not used in pedagogy. The use of electronic means of remote education has become commonplace in recent decades. With a few exceptions (usually older teachers), all teachers are able to use a computer at the level of an experienced user, can work with text editors, use e-mail, various messengers, have accounts on social networks, etc. In other words, theoretically, at the time of the pandemic, teachers already had a sufficient basic level of computer skills. Certain difficulties arose with video conferencing (remote video lessons) - that for when leading Internet companies provided free multi-user conferences, the experience of remote video communication for most teachers was either limited to personal communication or was absent completely. In addition, it should be noted that according to official data, 100% of educational institutions in our country are computerized. The percentage of educational institutions not connected to the Internet is small.

Thus, according to the Ministry of Education for secondary educational institutions on September 1, 2020, 74 schools were not connected to the Internet, ie. about 0.5% of their total [1]. Secondary vocational education institutions were fully connected to the Internet.

As practice has shown, despite the generally quite optimistic picture, there are a number of factors that have led to negative trends in the implementation of the educational process in remote education. The widespread use of remote education technologies has shown that about 40% of schools [2] have a slow internet connection and cannot use online tools with video support. Another problem was that teachers of both schools and vocational schools were not ready for the full transition to remote education. First of all, we are talking about teachers of special disciplines of educational institutions, providing vocational training and teachers of general education institutions, leading the subject of technology (labor training). Despite the fact that most of these teachers have been trained and retrained in specialized courses and are owners of diplomas and certificates confirming their education in the field of remote learning, they were the weakest link.

The main reasons for this situation where: lack of psychological readiness to use remote learning tools; imperfection of labor legislation, which does not take into account that the preparation of remote learning is a much more labor-intensive process than the preparation of a traditional lesson; low information and technological literacy; complete or partial lack of developed electronic educational resources in many special disciplines, as well as poor awareness of the availability of remote resources and lack of experience with them, as well as much more.

In our article, we have analyzed a number of electronic educational resources, the use of which can provide significant assistance in training and conducting classes for teachers of special disciplines of vocational institutions and teachers of school subject "technology" and become a significant help to improve the educational process.

APPROACH

The role of the subject “Technology” is to train students for transformational activities, life and professional self-determination and adaptation to new socio-economic conditions. This subject provides the formation of polytechnic and labor knowledge in the sphere of technology, economics, organization and ecology of modern production, ideas about the prospects of its development, the world of professions, the basics of entrepreneurship, housekeeping, equips with experience of independent practice, promotes students' creative thinking [3]. In this sense, the school subject of technology is not only an independent discipline, but is the basis of pre-vocational education, including ensuring the continuity of education in connection with the school – the Institution of Professional (Vocational) Education. Analysis of the content of the school subject “Technology” and special subjects in professional (vocational) education has shown that their common feature is the need to obtain practical skills, which is extremely difficult to do remotely. For example, the variable module “metal turning technology” (grade 9) involves the use of

special equipment (lathe). And there are many such examples – for full-fledged training of the subject “Technology” in school and many special subjects in vocational education, students in the remote mode have no training materials or equipment to work with them. At the same time, there are a number of topics whose learning in the mobile mode is possible, at least in part. Analysis of the content of the school subject “Technology” and special subjects in vocational education has shown that their common feature is the need to obtain practical skills, which is extremely difficult to do remotely. For example, the variable module “metal turning technology” (grade 9) involves the use of special equipment (lathe). And there are many such examples – for full-fledged training of the subject “Technology” in school and many special subjects in vocational education, students in the remote mode have no training materials or equipment to work with them. At the same time, there are a number of topics whose learning in the mobile mode is possible, at least in part. As the analysis of information and analytical resources on the Internet showed, among the significant number of electronic resources to support remote learning technology, only a few are focused on supporting the subject of “Technology” and special subjects of vocational education. In addition, among them there are virtually no resources that meet national standards or, at least, have a Ukrainian localization.

Higher professional education teachers found themselves in a slightly more advantageous situation. Traditionally, attention was paid to this very link in terms of the development of remote education. Institutions of higher and postgraduate professional education were financed slightly better than others and had the opportunity to acquire various platforms for remote education, create online courses and develop e-learning tools. In addition, extramural education was widespread in these institutions, which led to a higher degree of readiness of teachers for massive remote learning of students. In the proposed work, we conducted a search on the Internet, investigated the availability of information and analytical resources that support the professional and practical component of the educational process, analyzed their content, developed a classification, taking into account national characteristics, and presented the results in the form of an ontological graph.

STATEMENT OF BASIC MATERIAL AND THE SUBSTANTIATION OF THE OBTAINED RESULTS

Education reforms have brought Ukrainian education closer to the system of technological training of schoolchildren operating in the United Kingdom and many Western European countries. As well as in the education of these countries, in the system of general secondary education of Ukraine there is an integrated subject “technology”, providing pre-vocational training of schoolchildren. The main purpose of studying the subject “Technology” is to train students for work in the technological stage of scientific and technological progress. In the process of its study, certain key competencies are formed, which receive their further development in the system of professional (vocational) education, ensuring the formation and preparation of a person for future daily and professional activities. This is provided by a number of disciplines of general education, general technical, professional-theoretical and professional-practical training.

Digital transformation of higher education has been discussed in the past decade, and the vision deals with many aspects, such as managerial strategy, asynchronous collaboration, and the use of communication tools. A key approach is a rethinking of the learning process, enabled by technology, i.e., the development of a digital learning space [4]. Agreeing in general, we note only that the development of digital technologies alone cannot lead to a qualitative restructuring of the educational process, as did not lead to such a restructuring of informatization (for which, in fact, there was a need for digital transformation). Modernization must lead to transformational changes in the entire training system, from the goal to the result.

As we have already noted above, the common thing for the school subject “technology” and special subjects in the institutions of vocational technical institutions is professional and practical training, which should be carried out in training workshops, on training grounds, on simulators, autodromes, in educational and production units, educational farms, as well as at workplaces in production or in the service sector in the following forms: a lesson in industrial training in an educational institution; a lesson in industrial training in production or in the service sector; industrial practice at workplaces in production or in the service sector; pre-graduation (pre-graduation) practice in production or in the service sector; other forms of professional practical training. Professional and practical training of students, listeners is carried out in close combination with the manufacture of useful products, the provision of services which are charged in accordance with the legislation [5].

Further, although this is not entirely true based on the terminology adopted in our country, we will understand the VE system as a combination of these two educational systems that ensure the continuity of vocational and practical training of students from school to VE institutions.

Despite the impossibility of full-fledged remote training in various technological operations, remote training allows you to train various types of activities and combine them in different combinations, helps to understand, shape abilities, create communication situations, automate practical actions, and also provides an opportunity to influence the leading representative system, implementation of an individual approach and intensification of students' independent work. Our research has shown that digital educational resources (hereinafter DER) used in the vocational education system, based on their functions, are advisable to be presented in the form of the classification developed by us and given below.

1. Management web resources.

a. National level – portals of the Vocational Education system; websites of the Institute of Vocational Education of the National Academy of Pedagogical Sciences of Ukraine (hereinafter IVET) and the website of the Institute for Modernization of Education Content; website of the Ministry of Education and Science.
b. Regional level. At this level are the sites of scientific and methodological centers (cabinets)- SMC; departments of preschool, secondary, professional (vocational) education.
c. The local level, consists of three sub-levels: personal resources of teachers, sites of training groups, sites of educational institutions.

2. Information resources

a. Resources of communities of interest (as a rule, groups in social networks);
b. Periodicals (mass media, scientific publications);
c. Scientific and analytical publications of a non-periodical nature (articles, monographs, theses, etc.)

3. Simulators of practical activities

a. Virtual laboratories;
b. Simulators of professions (within the framework of the concept of gamification of education);
c. Interactive 3-D models.
4. Thematic virtual collections
a. Virtual reading rooms;
b. Libraries of electronic textbooks;
c. Libraries of electronic copies of textbooks;
d. Knowledge bases (reference books, databases, document collections, repositories - including regulatory, methodological);
e. Museums.

5. Resources to directly support the organization of training sessions

a. Support systems for synchronous communications (video conferencing, instant messengers, chats);
b. Asynchronous communication support systems (messengers, e-mail, forums);
c. Knowledge assessment automation systems;
d. Organizational support resources (e-diary, student portfolio, call schedules, events, etc.)

6. Toolkit for building electronic resources

a. Development of educational (interactive) applications;
b. Model editors;
c. Site creation systems;
d. Presentation editors, etc.

7. Integrative systems of support for distance learning

a. LMS (Learning Management System);
b. LCMS (Learning Content Management System).

8. Analytical systems

a. Monitoring and statistics systems;
b. Peer review systems.

Obviously, such a division is rather arbitrary, since several diverse information objects can be presented on one web resource, and the same object belongs to different types according to our classification.

As the practice of mass introduction of remote education into the pedagogical process has shown, teachers of institutions of higher professional education have successfully used existing developments and web resources familiar from pre-pandemic times and integrative systems to support remote learning. It should be noted that a significant difference was the increase in the use of resources that provide virtual labs. Based on a survey of 3 –year students for the period from January 2020 to May 2021, the number of online laboratory work on the subject of "Physics" increased by 70-150%, the subject "Chemistry" by 80-120%. In the subject "Resistance of Materials", students noted "a significant increase in the number of virtual laboratory work."

Despite the noticeable progress in primary vocational education and, partially, in higher vocational education, the general situation with the use of information and analytical resources remains disappointing. As well as 2 years ago, there is an acute shortage of such resources as electronic textbooks and manuals, simulators, 3D models, libraries, collections, etc., requiring a significant investment in their implementation.

Within the framework of our research, we will select from these DER information and analytical resources used directly in the system of vocational education. To begin with, let's define an understanding of what they are. Let's build a Vienna diagram. Within the framework of our research, we will select from these DER information and analytical resources used directly in the system of vocational education. To begin with, let's define an understanding of what they are. Let's build a Vienna diagram (Figure 1).

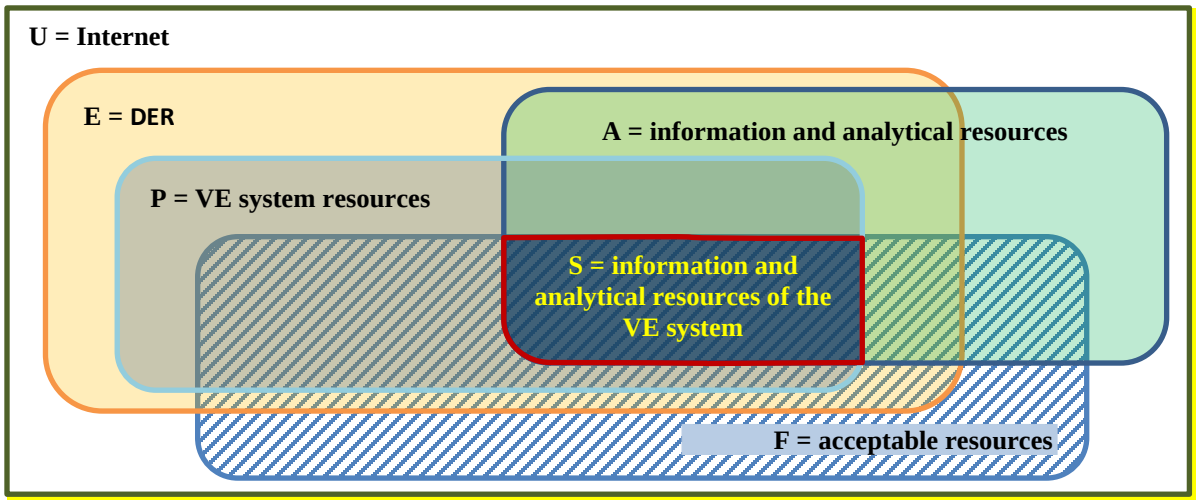

FIGURE 1. Diagram "Information and Analytical Resources of the VE system" on the Internet.

As can be seen from the diagram, the information and analytical resources of the VE system can be considered as some kind of DER, which are at the same time part of other groups of resources:

$$S = P \cap A \cap F \quad (1)$$

Where P is the DER used in the VE system, A is information and analytical resources, F is potentially acceptable resources.

Let's expand on the content of the diagram elements. So, by the resources of the VE system, we mean those DERs that are used by institutions of the VE system, regardless of whether they are used by institutions of other systems. For example, the website of the Ministry of Science and Education is used not only by VE institutions, but also by institutions not related to education in general. However, we categorize it in the "P" category.

By acceptable resources (F), we mean a group of resources that satisfy a number of requirements of a social, psychological, technical, legal, and other nature. So, for example, sites containing calls for violence, ethnic hatred, alienation of territory are unacceptable. Also, inappropriate resources include sites with an unknown localization language for students, sites infected with a virus, containing commercial advertisements, with outdated information, etc. For example, the portal https://proftekhosvita.org.ua, created in 2009 as part of state support for the VE system, has actually ceased functioning – the latest news is dated January 4, 2017, and the programs of international projects posted on it end in 2013.

By information and analytical resources, we mean resources that support information and analytical activities in the VE system. In intersection with the DER, these are resources from the above classification described in points 1, 2, 4 and 8 (some examples are given in Table 1).

TABLE 1. Examples of information and analytical resources of the VE system.

Type	**Exploratory research**	
Paragraph	**URL**	**DESCRIPTION OF THE RESOURCE**
1.a	https://mon.gov.ua/ua/tag/profesiyno-tekhnichna-osvita	Section "Vocational Education" of the website of the Ministry of Education and Science.
	https://imzo.gov.ua/osvita/profesiyno-tehnichna-osvita-2/profesiyna-osvita/	Section “Professional Education” of the website of the Institute for Modernization of Education Content.
	https://ivet.edu.ua/	IVET website.
	http://pto.org.ua/	Vocational Education Portal of the VE Institute.
	https://sites.google.com/view/portalpto/	All-Ukrainian Methodological portal of VE.
1.b	https://dnpb.gov.ua/ua/virtualni-chytalni-zaly/virtualnyy-chytalnyy-zal-osvityanyna/	The list of educational, educational and methodological centers and classrooms in Ukraine in the section “Professional (Vocational) Education”.
8.b	http://www.ukrstat.gov.ua/operativ/operativ2005/osv_rik/osv_u/ptu_u.html	Statistical information that is published in the publications of the State Statistics Service.
	https://mon.gov.ua/storage/app/media/mizhnarodna/2020/Mizhnarodni%20proekty/Uchast%20u%20Turynskomu%20protsesi/Turynskyy%20protses.pdf	Statistical indicators from the Torino Process study.
	https://registry.edbo.gov.ua/profesiyno-tekhnichna-osvita/	Statistical information of the Unified State Electronic Database on Education (USEDE).
Type	**Practical research, create, modernization**	
1.a	http://pto.org.ua/	Portal of vocational education of the VE institute.
1.b	https://nmcdon.org.ua/	Site of Donetsk SMC VE.
	http://zpto.in.ua/	Site of the Transcarpathian SMC VE
1.c	http://www.bplsp.com.ua	Website of the Beregovo Professional Lyceum of the Service Sector.
	https://rpl80.org.ua	Rodinsky Professional Lyceum website.
	http://college.eor.in.ua	The site of the 3rd year group of the specialty "military car mechanic" of the state educational institution "Kiev Professional College with Enhanced Military and Physical Training.
4.b	https://lib.pto.org.ua/	Library of electronic textbooks for the VE system of the Institute of VE.
	https://libupal.pto.org.ua/	Library of electronic textbooks for the VE system SEI “Uman Professional Agrarian Lyceum”.
	http://dcsp.pto.org.ua/	Library of electronic textbooks for VE system SEI “Khmelnytsky VE Center of the Service Sector”.

The most extensive group of resources is group 2. There is a large number of communities, both official and unofficial in social networks, which have some relation to the VE system. So almost all educational institutions in Ukraine (over 95%) have their own Facebook accounts, where they post event announcements, news, chronicle, etc. There is a number of periodicals that have an electronic copy, or are an electronic journal. The IVET – sections

"Periodicals" and "Library", is actively involved in the creation of information and analytical DERs in category 2, covering all three of its subcategories, as well as category 4. Informational publications regularly appear on the sites of the SMC, most of which have their own small electronic libraries (collections of the DER) – paragraph 4. of our classification.

So the electronic library of the Educational and Methodological Center for Vocational Education in the Dnipropetrovsk region http://nmc-pto.dp.ua/ contains more than 1500 full-text sources. Paragraph 8. Includes resources with statistical information [6].

Our research also had a practical component. The co-authors took part in the development, creation and modernization of such resources as the above-mentioned portal of the VE Institute (all-Ukrainian level), a number of sites at the regional and local levels. Also, with the participation of the authors of this article, a virtual reading room for an educator was developed by the V. O. Sukhomlynskyi State Scientific and Pedagogical Library of Ukraine in NAES of Ukraine (https://dnpb.gov.ua/ua/virtualni-chytalni-zaly/virtualnyy-chytalnyy-zal-osvityanyna/), in which the most complete selection of information and analytical resources of the VE system of Ukraine was presented.

Another development created to support the educational process, both in the vocational system and in the system of school education, is the resource http://ontos.xyz, described more detail in articles [7], [8] and [9]. This resource was created to visualize knowledge bases in the form of object ontologies. With its help, an ontological model of information and analytical resources of the VE system of Ukraine was built Ontological Model of Information and Analytical Resources of the VE System of Ukraine (Figure 2).

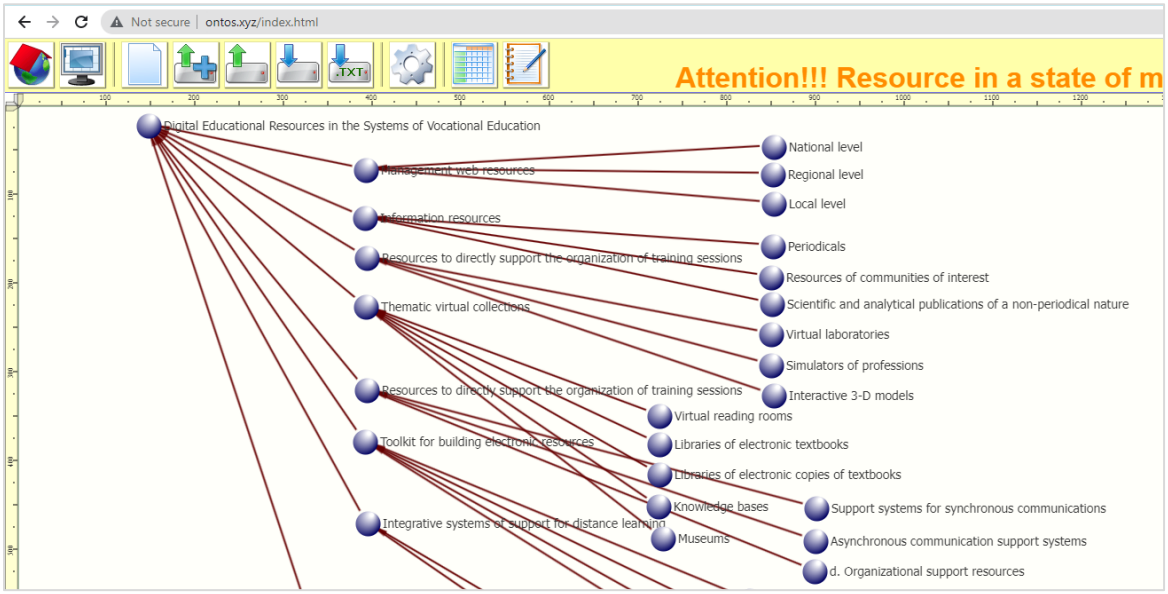

FIGURE 2. Ontological Model of Information and Analytical Resources of VE systems of Ukraine created at http://ontos.xyz

As shown by communication with teachers, methodologists, the administration of VE institutions, many teachers do not use in their activities the possibilities of information and analytical resources available in the VE support system. First of all, this is due to the low awareness of teachers and administration about the availability of certain electronic resources. Another difficulty is the weak electronic methodological literacy. Even if they have knowledge about certain resources, teachers often do not understand the possibilities and ways of using them in a remote educational process.

The large-scale need for the transition to remote education technologies caused by the Covid-19 pandemic has shown the need to improve existing and develop new information and analytical resources. One of the most vulnerable links in the education system turned out to be pre-vocational and vocational education, based on vocational and practical training of students.

CONCLUSION

Modern challenges to the educational process, the most difficult of which is the Covid-19 pandemic, made it necessary to rethink approaches to remote education. The introduction of remote education into the system of pre-professional and vocational training is especially difficult. The most important factors were both the rather low computer literacy of teachers at this link in the education system, and the absence of a national system of electronic information and analytical resources of the vocational education system. The existing resources do not fully cover the needs of the pedagogical process of studying practice-oriented disciplines.

The current situation is aggravated by the problems of the psychological readiness of teachers for the full implementation of distance learning, insufficient computer literacy, as well as their poor awareness of the availability of information and analytical resources in the field of education. Our research aims to overcome this problem. This state of affairs does not contribute to improving the quality of the educational process in vocational education institutions in the context of remote learning. We see the need to create integrating information (information and analytical) catalogues of digital educational resources, targeted information campaigns to familiarize the participants of the pedagogical process in the VE system with them. Our research aims to overcome this problem. This state of affairs does not contribute to improving the quality of the educational process in vocational education institutions in the context of remote learning. We see the need to create integrating information (information and analytical) catalogues of digital educational resources, targeted information campaigns to familiarize the participants of the pedagogical process in the VE system with them.

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