Analysis of Completeness, Diversity and Ergonomics of Information Online Resources of Diagnostic and Correction Facilities in Ukraine

Volodymyr Pasichnyk[0000-0002-5231-6395], Tetiana Shestakevych[0000-0002-4898-6927], Nataliia Kunanets[0000-0003-3007-2462], Vasyl Andrunyk

Lviv Polytechnic National University, Lviv, 79000, Ukraine
Tetiana.V.Shestakevych@lpnu.ua

Abstract. In Ukraine, one of the most up-to-date and powerful sources of information for people with special needs is online information resources of state psychological and diagnostic facilities, called PMPK. The most popular online information resources for this category of users are the sites of PMPK and profiles-oriented pages on social networks. These resources were analyzed whether they provide complete information support of each stage of the inclusive education, as well as if their structure and presentation correspond to ergonomic needs and demands of the users with special needs. Both the sites` content presentation and accordance with the existing international ergonomic rules is insufficient. There is no systematic approach to the IT online support for inclusive education processes by means offered by and/or available to PMPK specialists.

To became an institution of professional care of integrated IT support, PMPK system in Ukraine the should involve the specialists of information and communication technologies, methods and means of Big Data analysis. To create the platform of IT support of education of people with special needs at the national level, one should use of a wide range of mobile IT services of prompt and convenient online access to results of psychophysical diagnosis, personal learning trajectories, etc. with full-fledged protection and confidentiality (as an option, the *blockchain* technology was proposed). As the creation and management of own computing infrastructures in PMPC facilities seem to be ineffective and expensive, it is expedient to use technologies and services based on cloud computing models.

Keywords: inclusive education IT support, IT resources ergonomy, blockchain technology.

1.   Introduction

In January 2018, the European Commission adopted new initiatives aimed at improving the key and digital competences of European citizens, promoting common values and inclusion. Specialists of the European Commission have been approved a number of documents that reflect the vision of the European Union's future ways of

society development: *"Council recommendation on Digital Education Action Plan"*, *"Council Recommendation on promoting common values, inclusive education, and the European dimension of teaching"*, *"Council recommendation on Key Competences for Lifelong Learning"* and others. The recommendations to Member Countries of the European Union (from January 2018) emphasize the need to support the right to quality and inclusive education and lifelong learning by providing opportunities through the development of key competences and basic skills for all, and the special attention must be paid to disadvantaged students [1]. Such students include people with social and economic disadvantages, migrants, people with special needs, as well as talented children [2].

The key competences, promoted by the European Commission, are [1]: literacy – as the basis for the next learning and communication in different social and cultural environments; languages – as a means to better handle the challenges of multilingual modernity; science, technology, engineering and mathematics (STEM) – improvement of achievements in such competences is important for the further education of scientific perception and understanding; digital – increasing confidence and critical use of digital technologies, including programming, as well as security and citizenship; personal, social and learning –as competences, important for active social life; civic – as an emphasis on the importance of democratic processes, European values, sustainable development and media literacy; entrepreneurship – to enable disclosure of its own potential, creativity and initiative; cultural awareness and extension – enhancing intellectual skills and abilities to express ideas in a variety of ways. Key competencies as a combination of knowledge, abilities, and skills, are necessary for personal development, social inclusion, employment and active citizenship [1].

The importance of the inclusive society is also declared in the European Union's Horizon2020 Program. This science and innovation funding program aims to become a key tool for resolving high-priority tasks for Europe. Promoting an inclusive society, Horizon2020 supports measures to overcome social inequality. The program emphasizes the need for innovative approaches to support individuals facing social and digital exclusion, such as older people, the unemployed and poorly educated, migrants, people in need of care, living in remote or poor areas, people with special needs and homeless [3] .

The problems of the European Union countries are relevant also for Ukraine. The need for the socialization of people with special needs, settlers, gifted children are the challenges of a nowadays. The authors payed attention to the inclusion of persons with special needs in Ukraine in the part that deals with the support of such education with information technologies.

2. Types of Information Technology of Education Support of People with Special Needs

The inclusive education is the comprehensive process of ensuring equal access to quality education for persons with peculiarities of psychophysical development, by organizing

their studies in *general* educational institutions with the use of personality-oriented teaching methods, taking into account the individual peculiarities of educational and cognitive activity of such persons and the proper medical, social, psychological, pedagogical, organizational and technological support, in the conditions of mass educational establishments in the place of residence [4]. The process consists of four successive stages, the implementation of each stage consists in the step-by-step realization of certain educational tasks related to the organization and support of the education of persons with special needs. In general, the stages of inclusive education are [4]:

Stage 1. Setting the features of the psychophysical development.

Stage 2. Personalization of the educational aims.

Stage 3. Formation of the personalized education trajectory.

Stage 4. The analysis of the realized education trajectory.

The development and implementation of modern comprehensive information technology support for all stages of inclusive education, taking into account the national specifics of such a process, will contribute to more complete and better access to education and social integration of people with special needs, what perfectly complies with the provisions of the framework program [1].

During the study of the support of the education of people with special needs in Ukraine, it was established that the primary institution to which the parents of the child refer, is the diagnostic and correctional institutions – psychological, medical and pedagogical consultations (PMPK). One of the functions of the PMPK, as defined in the Law of Ukraine, is advisory, when the PMPK acts as a source of information. The specialists of such an institution can and should provide advice to participants in the inclusive education process – those with special needs, their parents, inclusive school specialist, administration of the inclusive educational institution, etc. In some cases, the reference component of the operation of the PMPK is implemented, in particular, with the use of information technology.

In general, information technology support for the education of people with special needs varies by a number of factors, that determine the scope of their application. The main groups of this kind of information technology are 1) general-purpose technology, 2) special-purpose technology, 3) technology of communication support and 4) information and technological means of access. To the latter, include online learning management systems and multimedia learning environments, information technologies focused on the needs of the mass school and applicable to the education of people with special needs, mobile applications, and online reference resources. And exactly these online reference resources are the means of the PMPK`s advisory role.

3.   Online Reference Resources of State Psychological and Diagnostic Facilities

In Ukraine, the legally fixed structure of PMPK includes central PMPK, republican (AR Crimea), region, Kyiv and Sevastopol city, district (city) PMPKs. There are 618 psychological and medical-pedagogical consultations in Ukraine, of which 27 are

regional, including 1 republican, 2 city – Kyiv and Sevastopol) and 591 region (city). The concept of this structure is presented in the form structured tree (Fig. 1).
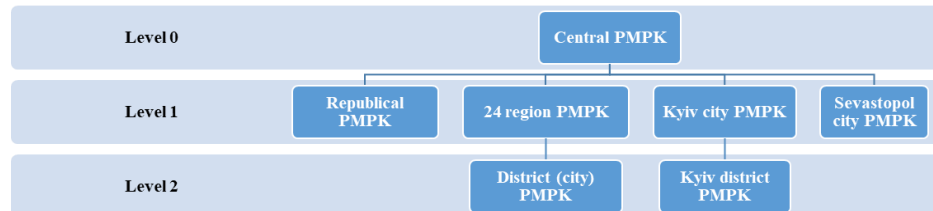

Fig. 1. Concept of Ukraine PMPK structure

4. Research Description

An important task in developing of a complex system of informational and technological support for inclusive education is the compliance with the requirements of availability, completeness, and connection between components of such a system, as well as the ergonomics of its components (in this study, the ergonomic is considered from the angle of perception convenience). Reference online resources of PMPK are an integral part of information and technology support for inclusive education. To assess the relationship between online resources, it is necessary to consider the links between such resources in two directions. According to the concept of the structure of PMPK from Fig. 1, in the horizontal direction there are PMPKs of the same level – for example, the republican PMPK – 24 regional PMPK – Kyiv city PMPK – Sevastopol city PMPK (level 1). In the vertical direction there are PMPKs of different levels, for example, the central PMPK – Vinnytsia Region PMPK – Bershadsky district PMPK.

We shall evaluate the availability of online reference resources to users using the following search criteria:

1. We use search service Google.
2. We use word-for-word information requests in Ukrainian language (for example, "центральна психолого-медико-педагогічна консультація (central psychological-medical-pedagogical consultation)", "Калинівська районна психолого-медико-педагогічна консультація (Kalinovsky district psychological-medical-pedagogical consultation)", etc.).
3. We will analyze the links on the first page of the search results offered by the search service (no more than 10 links).

Taking into account the above requirements, we will evaluate the availability and interconnections between such online resources using algorithm at Fig. 2.

5. The Availability of PMPKs` Online Reference Resources

According to the proposed algorithm, 17 facilities with their own sites were found (PMPKs from levels 0 and 1, according to Figure 1), including 16 regional PMPKs and central PMPK, more than 60% of PMPKs do not have their own online reference resource. Even if such sites exist, their search for the average user is difficult. That is, the sites searching, according to the algorithm proposed in Fig. 2, testified the availability of online reference resources for slightly more than half of PMPKs, conceptually located at levels 0 and 1 (fig. 1).

6. Interconnection of Online Reference Resources of PMPK

Table 1 shows the list of found PMPKs, sorted and grouped by the dates of site creation. The date of creation was determined by the Copyright mark on the site, and if it did not exist, then by the date of the first content placement. Sites are conventionally divided into 4 groups by date of creation: 2009-2012 – 5 sites, 2013-2015 – 4 sites, 2016 – 5 sites, 2017 – 3 sites. The last update was also specified.

Among the found sites of regional PMPK, only 6 resources (37%) have links to the central PMPK, and none of them links to PMPK of the region`s districts. That is, the search for sites according to the algorithm proposed in Fig. 2 witnessed the weak structuring of the system of PMPK`s online reference resources.

7. Analysis of Statistical Indicators of PMPK`s Online Reference Resources

Analysis of statistical indicators of regional PMPK`s sites

The analysis of the statistical indicators of the attraction of users of PMPK sites was carried out using the SimilarWeb Platform [5]. This information technology processes the big data to collect, measure, analyze the behavioral models of sites and users attract. The following characteristics of the PMPK sites were evaluated (in parentheses, the designation of a characteristic):
- Global worldwide rank according to traffic use (a_1).
- Country rank according to traffic use (a_2).
- Site category / rank in category (a_3).
- Total visits (a_4).

For example, for a group of sites created during 2009-2012 (these are the sites of the Central PMPK, as well as Odesa, Kherson, Rivne and Chernivtsi region PMPK) the platform SimilarWeb gave the following estimates (Fig. 3-6):

Fig. 2. Availability and interconnections between PMPK`s websites evaluation algorithm

For example, for a group of sites created during 2009-2012 (these are the sites of the Central PMPK, as well as Odesa, Kherson, Rivne and Chernivtsi region PMPK) the platform SimilarWeb gave the following estimates (Fig. 3-6):
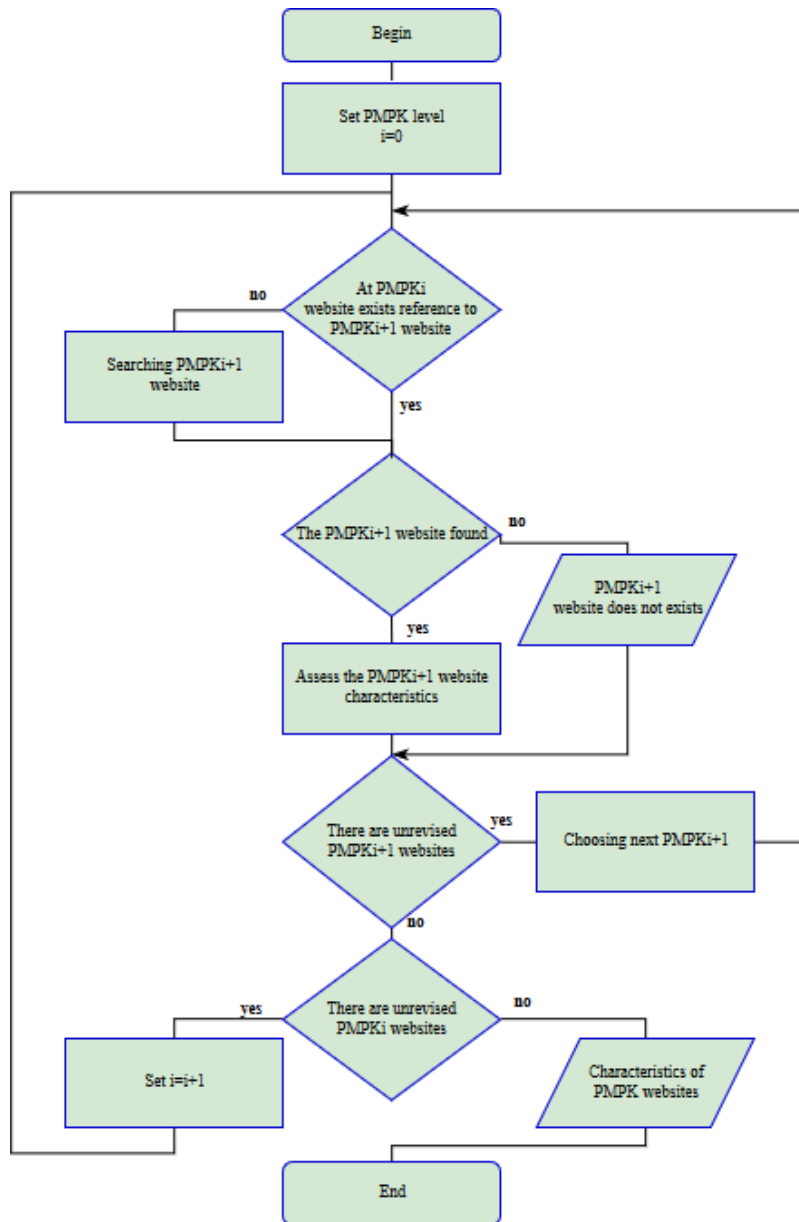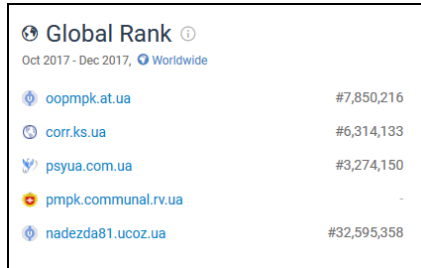
Fig. 3. The assets of the sites` global rank according to the traffic use (by SimilarWeb)
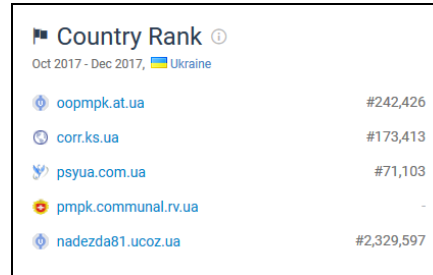

Fig. 4. The assets of the sites` country rank according to the traffic use (by SimilarWeb)
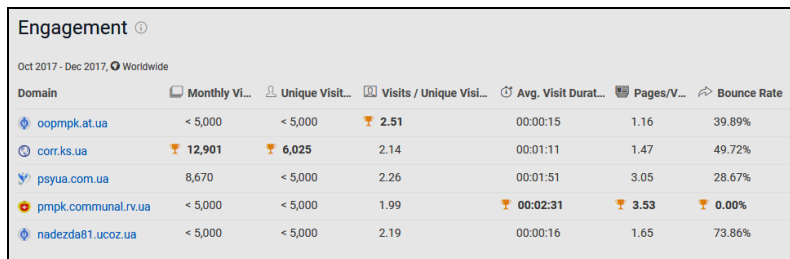

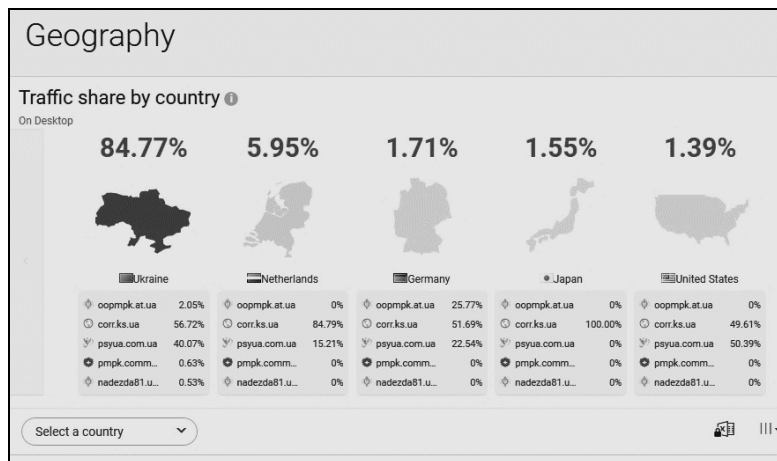**Fig. 5.** The assets of the sites` visits peculiarities (by SimilarWeb)

Fig. 6. The assets of the sites` traffic share by country (by SimilarWeb)

The assets of online reference resources for PMPK (level 0-1, fig.1) are summarized in Table 1.

Table 1. Summary characteristics of the sites of regional and central PMPKs (according to the SimilarWeb)

Region PMPK	Site created, year	Last update	a_1	a_2	a_3	a_4
Odesa	2009	2016	7 850 216	242 426	Social sciences / 18552	4 200
Kherson	2010	Jan. 2018	6 314 133	173 413	Social sciences / 15254	38 702
Central	2011	2017	3 274 150	71 103	Internet and communications / 132658	26 010
Rivne	2012	Nov. 2017	N/A	N/A	N/A	190
Chernivtsi	2012	Oct. 2017	32 595 358	2329597	N/A	786
Kirovograd	2013	Dec. 2017	N/A	N/A	N/A	12 100
Kharkiv	2013	Nov. 2017	9 757 084	334 995	Business and industry / 186684	1 800
Donetsk	2015	Apr. 2016	8 297 513	259 415	N/A	2 600
Zakarpattia	2015	Jun 2015	N/A	N/A	N/A	N/A
Vinnytsia	2016	Feb. 2017	N/A	N/A	N/A	391 100
Volyn	2016	2017	N/A	N/A	N/A	214
Dnipropetrovsk	2016	Jan. 2018	N/A	N/A	N/A	10 500
Khmelnytskyy	2016	Feb. 2017	N/A	N/A	N/A	N/A
Cherkasy	2016	Jan. 2018	1 1247 780	406471	News and media / 257359	26 900
Lviv	2017	N/A	N/A	N/A	N/A	38
Luhansk	2017	Oct. 2017	N/A	N/A	N/A	26
Ternopil	2017	Nov. 2017	N/A	N/A	N/A	N/A

From the results, presented in Table 1, it can be drawn the following conclusions.

- Most sites (13 out of 17), at mid-January 2018, content was updated over the past year, with three sites having updated content in 2018.
- For the most sites, created in 2016 and later, it was not possible to establish a global rank in the world and Ukrainian ratings for traffic usage (for October-December 2017).
- Most PMPK sites were not categorized (by SocialWorks), and among classified, there are Internet and telecommunications, Business and industry, News and media, social science categories.
- Number of sites visitors – an average is 32,000 people, with the largest number
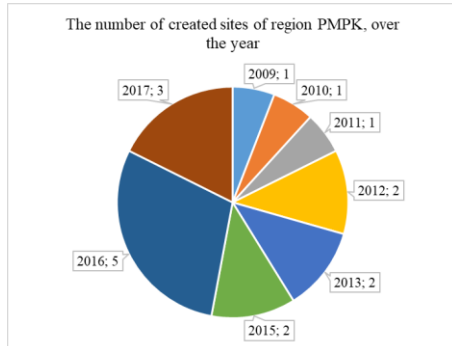
The number of created sites of region PMPK, over the year

Fig. 7. Comparison of the number of created sites of regional PMPKs

of visits registered for the Vinnytsia PMPK site (created in 2017); the site of Luhansk PMPK had 26 visitors (the site was created in 2017).

- Two of the three most visited sites (Kherson, Vinnitsa and Cherkasy Region PMPKs) were updated in January 2018.
- Starting from 2009, the number of sites, created by PMPK, gradually increased per year, the largest amount sites of PMPKs were created in 2016 (Figure 7).

Analysis of statistical indicators of regional PMPK sites

By the algorithm at Fig. 2, the search for the sites of district (city) PMPKs (level 2 at fig. 1) was performed. Such sites exist in eight regions of Ukraine. The characteristics of the sites of district PMPKs (according to the platform of the SimilarWeb) are presented in Table 2.

From the results presented in Table 2, we can draw the following conclusions.

- The own online reference resources were found for 0.03% of district PMPKs.
- Four regions of Ukraine have one site of the district PMPK.
- The leader in a number of online reference resources is the Kirovograd region, in which 5 of the six regional PMPKs have their own sites (see Fig. 8).
- For most sites, its ranking in the world and Ukrainian traffic usage ratings (for October-December 2017) was not set.
- The average number of visits to the site - 15 thousand visitors, and for the four district PMPK this indicator is zero.
- The biggest activity in creating sites was in 2013-2014, in 2017 no new sites of the district PMPKs were created (fig. 9).
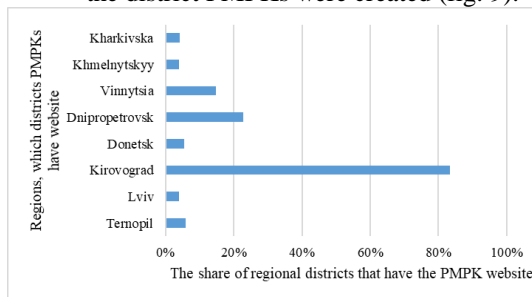

The number of created sites of regional PMPK, over the years

Fig. 8. The ratio of the number of districts of the region and the number of sites of district PMPK
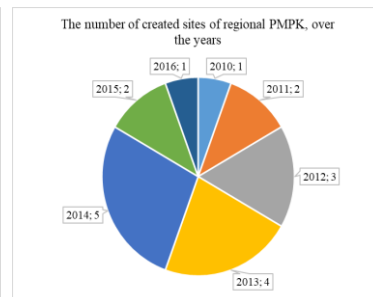
Fig. 9. Comparison of the number of created sites of district PMPK

Table 2. Characteristics of the sites of regional PMPK (according to the similarWeb)

Region	District (city) PMKP	Site created, year	Last update	a_1	a_2	a_3	a_4
Ternopil	Chortkiv	2013	Aug. 2017	N/A	N/A	N/A	38
Lviv	Sokal	2014	December 2017	N/A	N/A	N/A	173600
Kirovograd	Ustyniv	2015	2016	N/A	N/A	N/A	N/A
	Bobrynets	2013	2013	33 bln	2 bln	N/A	164
	Oleksandriya	2014	Dec. 2017	N/A	N/A	N/A	110
	Holovaniv	2015	Dec. 2017	N/A	N/A	N/A	0
	Novyy Myrghorod	2016	Jan. 2018	N/A	N/A	N/A	N/A
Donetsk	Bakhmut	2014	Jan. 2018	N/A	N/A	N/A	0
Dniepropet-rovsk	Dniprodzer-zhynsk	N/A	N/A	N/A	N/A	N/A	211
	Marganets	2012	Dec. 2017	N/A	N/A	People and society	859
	Pyatykhatky	2012	Jan. 2018	N/A	N/A	N/A	9600
	Ingulets	2013	Jan. 2018	N/A	N/A	N/A	3300
	Zhovti Vody	2010	Nov. 2011	N/A	N/A	N/A	
	Novomos-kovsk	2014	Jan. 2018	N/A	N/A	N/A	5500
Vinnytsia	Tyvriv	2011	2017	N/A	N/A	N/A	26
	Bershad	2013	May 2016	N/A	N/A	N/A	0
	Kalyniv	2015	Jan. 2018	N/A	N/A	N/A	0
	Nemuriv	2012	Jan. 2018	2 bln	59830	N/A	22900
Khmelnytsk	Stako-kostiantyniv	2014	Jan. 2018	N/A	N/A	N/A	1300
Kharkiv	Krasnyy Kut	2011	May 2017	N/A	N/A	N/A	50000

8. Assessment of the Ergonomics of PMPK`s Online Reference Resources

The investigated online resources were assessed according to graphic and responsive design demands [6-8] according to the characteristics $U_1 – U_6$:

U_1 – general composite rules for web sites creation, that are basic for UI / UX (modular content positioning system Modular Grid pattern, Golden Section rule and Fibonacci proportion), which allows to focus on the main and contributes to the perception of content;

U_2 – infographic (information graphics) filling of peculiar sections of the site with graphical visual representation of information, data or knowledge intended for the quick and accurate display of complex information;

U_3 – the presence of interactive animation and video content;

U_4 – a harmonious combination of color schemes (color schemes & palette) that must be presented so as not to violate the basic patterns of color influence on the psychological response of the user;

U_5 – responsive web design, that provides optimal mapping and interaction with the user regardless of the resolution and format of the device, the page is viewed at (tablet, smartphone, etc.);

U_6 – availability of convenient and intuitive forms of feedback, support for thematic forums.

Estimation of the available online reference resources by ergonomic indicators is given in Table 3 (the sign "+" means that the ergonomic characteristic was implemented, "-" its absence, "+/-" denotes the partial implementation of the characteristic). Graphic presentation of the results is at Fig. 10. The resources were also checked, using the Web Content Accessibility Guidelines (WCAG) 2.0 [9] (using http://www.atutor.ca/achecker/ open source as an evaluation tool).

Table3. The presence of ergonomic characteristics at PMPK sites

Region PMPK	U_1	U_2	U_3	U_4	U_5	U_6	Known problems	Potential problems
Odesa	-	-	-	-	-	-	18	191
Kherson	+/-	-	-	+/-	-	+/-	33	149
Central	-	-	-	-	-	-	58	308
Rivne	-	-	-	+/-	-	+/-	13	99
Chernivtsi	-	-	-	-	-	+/-	0	0
Kirovograd	+/-	-	-	+/-	+	+/-	18	359
Kharkiv	+/-	-	-	-	+	-	9	455
Donetsk	+/-	-	-	-	+	-	0	0
Zakarpattia	-	-	-	+/-	-	-	0	34
Vinnytsia	+/-	-	-	-	+	-	14	534
Volyn	-	-	-	-	-	+/-	0	34
Dnipropetrovsk	+/-	-	-	+/-	-	-	0	0
Khmelnytskyy	-	-	-	-	+/-	-	245	141
Cherkasy	+/-	-	-	-	-	+	17	168
Lviv	+/-	-	-	+/-	-	+/-	7	137
Luhansk	-	-	-	+/-	-	+/-	0	34
Ternopil	-	-	-	-	-	-	48	153

Concerning the ergonomics of the investigated sites, the authors reached the following conclusions:

- the vast majority of sites do not meet the modern requirements, relating to the design of the site at the stage of their creation;
- the most of the sites are non-adaptive, that is, they do not have mobile versions or versions for viewing on tablets;
- compliance with compositional rules and positioning content on a modular principle is conditional;
- the color schemes were not given appropriate attention;
- the infographical content and animation/video content is absent;
- the unification of the content of such sites is insufficient.

The number of known and potential problems, according to WCAG 2.0, evaluated for each site, shows that site developers in six regions were aware of the web content accessibility demands.
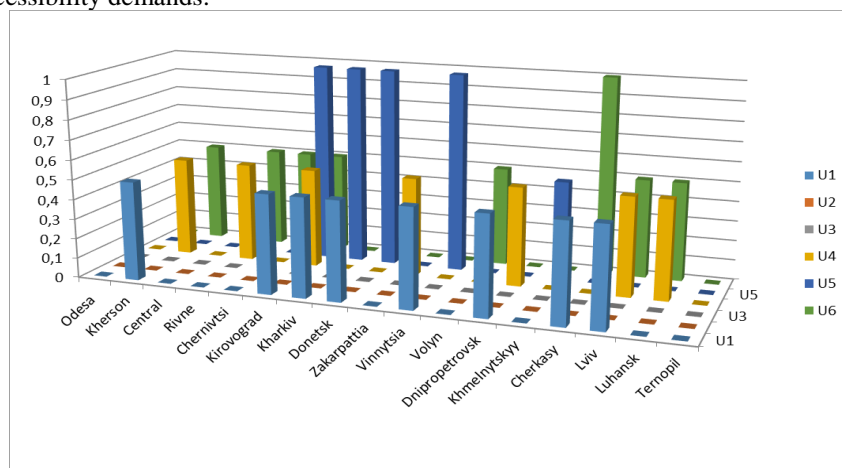

Fig. 10. Graphical representation of the results of the study of the ergonomics of PMPK sites

In view of the results, the authors consider it advisable to propose the development of a Wireframe for users with special needs (a general representation of the information structures of the site), followed by its prototyping. This will allow to get a highly distributed representation of the desired website (while taking into account general compositional techniques and modular content positioning), it is crucial to test the interaction of the user with the interface of the final product. The authors plan to develop and implement an adaptive site template based on HTML/CSS/JS with the ability to fill the content for the demands of people with special needs. It will be possible to choose harmonious color schemes, corresponding typographic styles. The developed technology will be adjusted to WCAG 2.0.

9. The Completeness of Inclusive Education Support by the Online Reference Resources of PMPK

On the sample of the regional PMPK sites, the authors performed the evaluation of the completeness of the support of inclusive education process – from the definition of the features of the psychophysical development of the person, the personalization of the purpose of teaching the person, taking into account the correctional component of the training, the formation of the personal trajectory of education, to the analysis of the outcomes of the implemented educational trajectory.

For each of the stages of the inclusive education, was identified the content of the PMPK website, which is needed to support the education of people with special needs [4]. Table 4 also has corresponding formal designations.

Table 4. Content at PMPK sites to support inclusive education

Stages of inclusive education	Content at PMPK sites to support inclusive education	Formal designation
Stage 1. Setting the features of the psychophysical development.	-Timetable of the PMPK and its specialists	w_{11}
	-Contacts, options for available transport connection	w_{12}
	-Information and contacts of the PMPK of the higher level	w_{13}
	-Road map of peculiarities of person's psychophysical development - by nosology, for specialists and non-specialists	w_{14}
	-Reference information about existing education formats	w_{15}
	-Innovations in the specifics of education for children with special needs	w_{16}
	-Legislative support for the education of people with special needs	w_{17}
Stage 2. Personalization of the educational aims.	-Typical curricula	w_{21}
Stage 3. Formation of the personalized education trajectory.	-Up-to-date events for people with special needs	w_{31}
Stage 4. The analysis of the realized education trajectory.	-Road map of peculiarities of person's psychophysical development - by nosology, for specialists and non-specialists	w_{41}
Characteristics of an online resource as an information portal	-Feedback available	w_a
	-Forums	w_b

Estimation of the available online reference resources by the presence of the content of the inclusive education support is given in Table 5 (the "+" sign means the presence of content on the site, "-" its absence). In the future, such evaluation will be provided using linguistic variables for natural language assessment for further application in computing systems.

From the analysis of the results, presented in Table 5, authors can draw the following conclusions about the functioning of the online reference resources of the PMPK in Ukraine:

- Existing websites contain disconnected, not unified information; the content is given at the subjective taste of website`s creator.
- There is no regional PMPK website, that would provide comprehensive background support for each stage of inclusive education;
- Almost all sites have no characteristics of information platforms – i.e. they do not support the ability to contact PMPK specialists and site authors;
- The common features of such sites are the availability of information about the timetable for the work of the PMPK, its specialists, as well as the contacts and variants of available transport links with the institution;
- There are no links between the sites in the horizontal direction, that is, the sites of regional PMPK do not contain links to sites of other regional PMPKs.

Region PMPK	Site created, year	w_{11}	w_{12}	w_{13}	w_{14}, w_{41}	w_{15}	w_{16}	w_{17}	w_{21}	w_{31}	w_a	w_b
Odesa	2009	+	+	-	-	+	+	-	-	-	+	+
Kherson	2010	+	+	+	+	-	+	-	-	+	+	-
Central	2011	+	+	-	-	-	+	-	-	-	-	-
Rivne	2012	+	+	+	+	+	+	+	-	+	-	-
Chernivtsi	2012	+	+	-	+	-	+	+	-	-	+	-
Kirovograd	2013	+	+	+	+	-	+	+	-	-	+	+
Kharkiv	2013	+	+	-	+	+	+	+	-	+	-	-
Donetsk	2015	+	+	+	+	+	+	-	-	+	-	-
Zakarpattia	2015	+	+	-	+	+	+	+	-	-	-	-
Vinnytsia	2016	+	+	-	-	-	+	+	-	+	+	-
Volyn	2016	+	+	-	+	+	+	-	-	-	+	-
Dnipropet-rovsk	2016	+	+	+	-	-	-	+	-	-	+	-
Khmelnyts-kyy	2016	+	+	+	+	+	-	+	-	-	-	-
Cherkasy	2016	+	+	-	-	+	-	-	-	-	-	-
Lviv	2017	+	+	-	-	-	-	-	-	-	+	-
Luhansk	2017	+	+	-	-	-	-	-	-	-	+	-
Ternopil	2017	+	+	-	+	-	+	+	-	-	-	-

- There are no links between the sites in the horizontal direction, that is, the sites of regional PMPK do not contain links to sites of other regional PMPKs.
- About one-third of available PMPK websites have links to top-level PMP sites (vertical direction).
- Although the central PMPK declares contact with regional PMPKs, however, it is only a reference to non-existent pages or to websites, where the PMPK and its activities are mentioned in passing;
- All of the above findings indicate a lack of a system-wide national approach to the information support system of the PMPK - as an integral part of IT support for education of people with special needs.

Creating of unified PMPK web-portals, which would provide full content to support the education of people with special needs and meet requirements, mentioned in the article, is an integral part of the development of a comprehensive nationwide system of information and technology support for inclusive education. It should also be taken into account that the components of information content can be divided into two groups. The first group include the stable, rarely changed components for the inclusive education process in Ukraine – i.e., this information should be identically presented in all PMPKs` websites: road map of peculiarities of person's psychophysical development e.g. by nosology, for specialists and non-specialists (w_{14}), reference information about existing education formats (w_{15}), legislative support for the education of people with special needs (w_{17}), typical curricula (w_{21}). The second group includes all other components of the information content of the PMPK sites, which are individual for each PMPK – its address, contacts, news, etc. Such features of the content of PMPK sites, due to the peculiarities of information

support for the education of persons in the format of inclusion, should be taken into account when improving the information resources of PMPK.

The reform of PMPK in Ukraine and its transformation to a level of institution, that would professionally care of information technology support of the education of persons with special needs, provides for the involvement of professionals with a wide range of knowledge, particularly in the field of information and communication technologies, methods and tools of Big Data analysis, as mentioned, in particular, in [10]. The complex data sets are accumulated at all the stages of inclusive education, and analysis such data using Big Data analysis techniques will allow to define the level of person`s psychophysical development, to develop personalized educational trajectory, as well as analyze both educational and correctional outcomes. Creating a nationwide platform of information technology support of the education of persons with special needs, according to the authors, should be performed using a wide range of mobile IT services, enabling quick and easy online access to shared information resources, including the results of psychophysical diagnosis, personal education trajectories, etc. with full-featured protection and privacy (authors agree with [10] which mentions the possibility of *blockchain* technology implementation). However, it seems ineffective to deploy computing infrastructures in PMPK facilities, instead of which will be better to use the technologies and services, based on cloud computing model. This approach would help to simplify and reduce significantly the cost, the organizational and operation deployment of a complex system of integrated information technology to support the processes of inclusion of people with special needs across the country.

Currently, the authors are actively researching the possibilities of building the architecture of such a comprehensive information and technology platform of national scale, and are working out possible ways to create software and algorithmic tools for its effective implementation.

10. Conclusions

One of the most up-to-date and powerful sources of information for people with special needs in Ukraine are online reference resources of state psychological and diagnostic facilities – psychological, medical and pedagogical consultations (PMPK). The PMPK`s sites are to be the most available online information resource for this category of users.

The results of the conducted research suggest that in the procedures of information and technology support of the education of people with special needs by means offered and/or available to PMPK specialists, there is no systematic approach to the implementation of the functions of informational and technological online support for inclusive education processes. Being disparate, the available IT support is realized with paying almost no attention to the existing ergonomic rules for the content presentation for people with special needs.

More than 60% of regional PMPK facilities have their own website, and it is less than half the percent of regional PMPKs, that have their website. Authors came into conclusion, that the development of such websites requires centralized management of

to unify the information, important for the education of people with special needs. It also makes it possible, in a certain way, to simplify the process of developing online resources for PMPKs of all levels, and especially for smaller facilities, less than a percent of which has such a site by now.

The proposed study on the availability, completeness, integrity, content availability and ergonomics of PMPK online information resources should be conducted periodically to track the dynamics of changes in the characteristics of support of education of people with special needs by information technologies.

Prospects for future research are the development of requirements for the creation of a system of online reference resources of correctional facilities, taking into account the WCAG 2.0 Web Content Accessibility Guidelines. To extend the completeness of the analysis of online PMPK resources, it is advisable to introduce additional characteristics of sites to determine the features of developing such resources. It is expedient to process the obtained empirical data, for example, by methods of data analysis or descriptive statistics. The use of cloud technologies for centralized accumulation, processing of information with next processing such Big Data can be a convenient approach for organizing and maintaining a complex system of holistic information and technology complex supporting of the processes of inclusive.

References

1. Annex to the Proposal for a Council Recommendation on Key Competences for Lifelong Learning, https://ec.europa.eu/education/sites/education/files/annex-recommendation-key-competences-lifelong-learning.pdf, last accessed 2018/01/29.
2. Council recommendation promoting common values, inclusive education, and the European dimension of teaching, https://ec.europa.eu/education/sites/education/files/recommendation-common-values-inclusive-education-european-dimension-of-teaching.pdf, last accessed 2018/01/29.
3. Horizon 2020 work programme 2014-2015, http://ec.europa.eu/research/participants/data/ref/h2020/wp/2014_2015/main/h2020-wp1415-societies_en.pdf, last accessed 2018/01/29.
4. Pasichnyk V., Shestakevych T.: The Model of Data Analysis of the Psychophysiological Survey Results. In: Shakhovska N. (eds) Advances in Intelligent Systems and Computing. Advances in Intelligent Systems and Computing, vol 512. Springer, Cham (2017).
5. SimilarWeb, https://www.similarweb.com/, last accessed 2018/01/10.
6. Müller-Brockmann J., Grid Systems in Graphic Design: A Visual Communication Manual for Graphic Designers, Typographers, and Three Dimensional Designers (6th edition; Zurich: Verlag Niggli AG, 2008).
7. Marcotte E.: Responsive web design. A Book Apart LLC, New York (2011).
8. Designing autism-friendly websites. The National Autistic Society, http://www.autism.org.uk/professionals/others/website-design.aspx, last accessed 2018/01/18.
9. Web Content Accessibility Guidelines (WCAG) 2.0, https://www.w3.org/, last accessed 2018/03/31.
10. Communication from the commission to the European parliament, the Council, the European economic and social committee of regions on the digital education action plan, https://ec.europa.eu/education/sites/education/files/digital-education-action-plan.pdf, last accessed 2018/01/29.