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## **CRITERIA AND INDICATORS FOR SELECTING DIGITAL TOOLS OF VIDEO CONFERENCING FOR E-LEARNING IMPLEMENTATION IN THE INSTITUTION OF POSTGRADUATE PEDAGOGICAL EDUCATION**

**Abstract.** This article is devoted to one of the actual problems of today-the organization of the process of professional development in the institution of postgraduate pedagogical education by distance learning. In particular, the selection of digital tools of video conferencing for synchronous electronic learning the implementation. The criteria and indicators for the selection of the necessary digital media are identified and described by the educational institution, and based on the analysis of scientific publications, legal documents, relevant software applications. So, it is advisable to apply operational and functional criteria. The indicators of the first criterion include the following: requirements for user hardware and software; payment for using; duration of the communication session; security and confidentiality; conditions of connection of participants; language of interface; availability of an application for mobile devices. Among the indicators of the second criterion are the following: the number of functionalities of the moderator; the number of functional capabilities of the participant; availability of a virtual interactive whiteboard and its functionality; monitoring the activity of participants. The importance of the proposed criteria and indicators is confirmed by the method of expert

evaluation and appropriate calculations using the methods of mathematical statistics (Pearson's test), as well as the functions of the application Microsoft Office Excel (CHISQ.TEST). Further research on this issue may include refining the algorithm for evaluating the relevant digital video conferencing tools according to certain criteria and indicators to select the most effective software in the implementation of distance learning for distance learning in synchronous mode.

**Keywords:** professional development; postgraduate teacher education; E-learning; digital tools for videoconferencing.

## **INTRODUCTION / ВСТУП**

**Formulation of the problem.** The existing living conditions of Ukrainian society necessitate appropriate changes in the field of education. In particular, due to the introduction of martial law [1], quarantine restrictions related to COVID-19 [2] is organized the electronic learning (E-learning) studying of students – persons who receive additional or separate educational services in postgraduate education programs, including training in institutions of the system of postgraduate pedagogical education (PPO) [3]. Currently, such training is carried out by distance learning in asynchronous and synchronous modes. The last provides that all participants in the educational process can simultaneously collaborate in real time, exchanging instant messages and receiving instant feedback; this mode of educational interaction is implemented with the help of video conferencing software [4]. Therefore, the selection of appropriate digital tools of the system of postgraduate pedagogical education is an urgent problem. The solution of which will allow for the effective development of professional competencies of pedagogical staff of general secondary (ZSSO) and preschool education (ZDO), who are students in institutions of the air defense system, in the current conditions.

**Analysis of recent research and publications.** Identification and solution of problems related to the organization of the process of professional development of teachers, in particular in institutions of postgraduate pedagogical education, is reflected in the scientific works of a large number of domestic scientists: L. Bondarenko, N. Klokar, V. Oliynyk, T. Sorochan and others.

Theoretical and methodological foundations of distance learning, including in higher education institutions (ZVO) are presented in studies of domestic and foreign scientists [5]–[10]: T. Anderson, T. Bates, V. Bykov, D. Garrison, V. Kukharenko, J. Owens, N. Sirotenko and others.

In addition, the subject is reflected in the relevant legal documents: in the Concept of Digital Economy and Society of Ukraine [11] the priority is the

development of distance education using cognitive and multimedia technologies; in the "Regulations on distance learning" [4] presents the definition of basic concepts, describes the purpose, objectives of distance learning (DL), clarifies the provisions of the implementation of DL in ZVO, ZZSO, etc.

At the same time, the scientific works of L. Vasylychenko, P. Hrabovskyi, V. Oliynyk, N. Morse, L. Petrenko and others are specified the features of distance learning in the institutions of postgraduate pedagogical education.

In particular, in [12] the structural-functional model of the organization of the process of professional development of pedagogical staff of ZSSO and ZDO in the institution of the air defense system in a pandemic conditions on the basis of electronic distance learning is presented. In addition, the main stages of teacher training according to the proposed model are described and the relevant organizational and pedagogical conditions are determined.

There is also a list of digital tools for educational interaction of participants in the process of professional development, which includes the following: software applications for the preparation of electronic educational resources; learning management system (LMS); information system for monitoring the process of professional development of teachers in the institution of postgraduate pedagogical education, etc. In particular, with the help of expert evaluation it was determined that the most convenient to use and functional is LMS Moodle; Digital tools such as Big Blue Button, Google Meet, Skype, Zoom can be used to organize distance learning in synchronous mode. However, in order to select the most comfortable and functional video conferencing applications, it is advisable to specify the criteria and relevant indicators for their detailed evaluation.

So, the problem of choosing the appropriate digital tool for in-service training of pedagogical staff ZSSO, ZDO distance learning in the synchronous mode in the institution of the air defense system is not completely solved.

### **AIM AND TASKS / МЕТА ТА ЗАВДАННЯ**

The *aim of the study* is to determine and substantiate the set of indicators and relevant criteria that will allow the selection of the necessary digital tool for the implementation of synchronous educational interaction in the process of training students in the institutions of postgraduate pedagogical education by distance learning.

According to the defined purpose it is necessary to solve the following *tasks*:

- to analyze and summarize the conditions of use and functionality of the most widely used digital video conferencing tools for the implementation of a synchronous mode of educational interaction;

- to determine the criteria and indicators for the selection of these software, taking into account the theoretical and methodological foundations of the organization of the process of professional development in the postgraduate pedagogical studying, including distance learning;
- justify the importance of certain criteria and indicators through the expert evaluation.

## **THE THEORETICAL BACKGROUNDS / ТЕОРЕТИЧНІ ОСНОВИ ДОСЛІДЖЕННЯ**

Theoretical and methodological foundations of our research are the work of domestic and foreign scientists – S. Vershlovsky, P. Jarvis, S. Zmeev, L. Lukyanova, M. Knowles, V. Oliynyk, N. Protasova and other scientists who have studied various aspects of the adult learning.

So, we highlight the following principles of adult learning:

- general didactic (consciousness and activity, clarity, systematicity and consistency, strength, accessibility, scientificity and connection between science and theory), taking into account which contributes to the appropriate structuring of content, choosing positions and attitudes with which subjects of the educational process, finding its optimization;
- andragogical – the unity of three environments (educational, professional, social), openness of educational space, synthesis of three approaches to education (andragogic, personality-oriented, contextual), activity, constant support, professional motivation, elective learning, development of educational needs, reflexivity;
- fundamental – proactive focus on interdisciplinary synthesis and methodological integration, qualitative differences in andragogical and pedagogical education, ontological pluralism, which involves the formation of multiple types of thinking, evolutionary stability and stability of progressive social dynamics through the development of continuing education as a social institution [13].

Also, the relevant legal documents [3], [4], [14] concerning the organization of the process of professional development and distance studying in educational institutions, etc. In particular, it is determined that the process of professional development is the acquisition of new and / or improvement of previously acquired competencies within the professional activity or field of knowledge [3]; ZSSO teachers are required to undergo an annual in-service training of thirty hours, but the total amount may not be less than one hundred and fifty hours for five years [14]; ZDO staff – once every five years for one hundred and twenty hours [14]. It is specified that distance learning is "an individualized process of acquiring knowledge, skills, abilities and ways of

human cognitive activity, which occurs mainly through indirect interaction of distant participants in the learning process in a specialized environment based on modern psychological, pedagogical and informational. communication technologies" [4]; the latter are defined as "technologies for creating, accumulating, storing and accessing web resources (electronic resources) of academic disciplines (programs), as well as providing organization and support of the educational process with specialized software and information and communication tools, including number of the Internet" [4].

At the same time, V. Bykov defines the concept of "electronic distance learning" as "a type of distance learning in which participants in the educational process carry out mostly individualized educational interaction both asynchronously and synchronously in time, mainly using electronic transport delivery systems training and other information objects, media teaching aids and information and communication technologies" [7, p. 86]. In addition, the scientist clarified the principles of DL: scientific, systematic, individualization, virtualization of learning; identification; interactivity, modularity of its structure; humanistic learning; priorities of the pedagogical approach at designing of educational process of DL; pedagogical expediency of application of new information technologies; ensuring the security of information circulating in the DL system, etc. [7, p. 84–85].

## **RESEARCH METHODS / МЕТОДИ ДОСЛІДЖЕННЯ**

To achieve this goal, a set of theoretical and empirical research methods was used. In particular, the relevant legislative and regulatory documentation, scientific, methodological literature, as well as digital tools related to the problem are analyzed. Direct and indirect observation of the process of organizing the educational process in the postgraduate pedagogical studying, in particular in the conditions of pandemic and martial law. In addition, interviews were held with pedagogical and scientific-pedagogical employees of postgraduate pedagogical education institutions. The generalization of the relevant experience in the organization and implementation of the process of professional development of teachers ZZSO, ZDO in the municipal institution "Zhytomyr Regional Institute of Postgraduate Pedagogical Education" Zhytomyr Regional Council (KZ "ZHOIPPO" ZHOR).

Substantiation of the importance of certain criteria and indicators for the selection of digital means of videoconferencing was carried out on the basis of expert evaluation; mathematical statistics were used to analyze the participants' answers.

In particular, the expert evaluation was based on the scale presented in table 1.

Table 1

**Rating scale**

| Significance      | Mark |
|-------------------|------|
| Yes               | 3    |
| More yes than not | 2    |
| No more than yes  | 1    |
| Not               | 0    |

Given the above scale using V. Cherepanov's formula, it was determined that to conduct an expert assessment with a confidence level of 95% and an absolute error of 0,5% must take part in this process at least 18 experts (detailed description of the calculations is presented in the work of the author [15, p. 116]).

The selection of experts (20 people) was carried out from among the research and teaching staff, IT specialists in the institutions of the postgraduate pedagogical education, the institutions of the high education who are directly take part in the organization and implementation of distance learning taking into account their level of professional, in particular, digital competence, objectivity, efficiency, interest.

The conclusion about the significance of the studied indicators and criteria was made using the method of O. Smirnov, which involves the calculation of the relative frequency of choice ( $\nu$ ) by experts of relevant estimates (detailed description is presented in the author's work [15, p. 116]). Possible values of the value range from zero to one. If  $\nu \in (0,5; 1]$ , then the relevant criterion (indicator) in the opinion of experts is important in the selection of digital videoconferencing for the implementation of synchronous educational interaction in the process of training students in the institute of postgraduate studying (PPO) by distance learning.

The validity of this conclusion was confirmed by Pearson's test ( $\chi^2$ ). The necessary calculations were performed using the statistical function CHISQ.TEST Microsoft Office Excel application. The specified function determines the percentage of coincidence of the existing distribution of experts' evaluations of a certain indicator (criterion) with the most probable one, which would be the case in case of random selection of the corresponding values by the participants. Therefore, if the value of the CHISQ.TEST function is less than 0,05, then with a confidence probability of more than 95% it is possible to assert the validity of



the corresponding conclusion made in view of the value of ( $\nu$ ).

## **RESULTS OF THE RESEARCH / РЕЗУЛЬТАТИ ДОСЛІДЖЕННЯ**

In the modern dictionaries, the concept of "criterion" is defined as a measure (basis) taken as a basis for evaluating, defining or classifying something; and "indicator" – evidence, proof, sign, quality, property of something.

Direct and indirect monitoring of the process of E-learning in postgraduate pedagogical education institutions revealed that the following digital video conferencing tools are used to implement the synchronous mode: Big Blue Button, Google Meet, Zoom, Jitsi Meet, Cisco Webex and others. The analysis of the peculiarities of the application of these digital tools, the available functionality allowed to determine the list of relevant features and properties for their classification. In particular, these tools may be available for a fee or free of charge. For example, Big Blue Button is an open source software, so it is possible for PPO to use it for free on its own server. However, this tool can be operated as a cloud service and the issue of payment will depend on the conditions of the owner. At the same time, the Google Meet cloud app is available for educational institutions free of charge as a component of the Google Workspace for Education package. It should be noted that due to the COVID-19 pandemic, the developers of these digital tools have ensured their free use by teachers, including from Ukraine, with certain restrictions on the duration of the session, the number of participants, functionality. In particular, the minimum needs are met: 50–100 participants; duration up to several hours; with a chat of demonstration of the teacher's screen and his presentation, etc. Typically, it is the payment issue that determines the quantity and quality of available digital video conferencing capabilities. For example, the paid use of Cisco Webex tools, Google (Workspace for Education Plus package) will allow an educational institution to realize long-term conferences with tens of thousands of participants. Typically, it is the payment issue that determines the quantity and quality of available digital video conferencing capabilities. For example, the paid use of Cisco Webex tools, Google (Workspace for Education Plus package) will allow an educational institution to realize long-term conferences with tens of thousands of participants.

Among the functionalities of the researched digital tools are the following: demonstration of the speaker's presentation, display of his screen for participants, the presence of public and private chats, notes, surveys, "raising hands" by a participant to attract the moderator's attention, happy, like or dislike, left, etc.), the presence of a virtual interactive whiteboard with the

appropriate functionality, creating rooms for participants (organization of group work), saving the list of participants (names, surnames); viewing the results of the participants' activity (participation in surveys, speaking time, number of messages, etc.); video recording and / or demonstration on YouTube, etc. The last three of these functionalities allow us to assess the process of professional development implemented by distance learning in synchronous mode.

At the same time, the important features of video conferencing are the language of the interface, the availability of technical support from the developer and reference materials on the use of digital tools; security and confidentiality; availability of a mobile application for ease of use on smartphones, tablets; scalability and resilience (related to meeting the possible and current needs of hardware resources according to the number of simultaneous users); restrictions on downloaded files for sharing with other participants in communication; as well as whether the developer continues to support its project, makes changes to the functionality in according to current trends in the use of such software.

Like any software, the researched video conferencing applications have the appropriate system requirements for users' digital devices.

The above allows us to determine the following criteria for the selection of digital means of video conferencing for the implementation of electronic distance learning in the institution of postgraduate pedagogical education:

- operational – a set of features and properties related to the general conditions of use of the relevant software, including interface languages, payment, etc.;
- functional – a set of features and properties related to the direct implementation of educational interaction in the process of improving the skills of students by distance learning in synchronous mode.

The indicators of the operational criterion include the following: 1) requirements for user hardware and software; 2) payment for use; 3) the maximum number of participants in the communication session; 4) the duration of the communication session; 5) security and confidentiality; 6) conditions for connecting participants (by link, phone number, the need to register on the developer's website, etc.); 7) interface language; 8) availability of reference materials and technical support; 9) availability of an application for mobile devices; 10) the intensity of the software developer update.

It should be noted that the functionality of digital video conferencing tools is constantly updated and expanded in accordance with existing technological capabilities and the social order for the implementation of synchronous mode of educational interaction on a remote form. However, these functionalities can be



combined into blocks related to the moderator (presenter) together with other participants; as well as monitoring the activity of participants; video recording and / or video broadcast of meetings, etc. In general, the available digital video conferencing facilities provide opportunities to control the communication process of the presenter and demonstrate the screen or presentation of the speaker. These functionalities are basic, and we do not see necessity to choose such properties to evaluate the appropriate software.

Therefore, the indicators of the functional criterion include the following: 1) the number of functional capabilities of the moderator to implement a synchronous mode of educational interaction; 2) the number of functional capabilities of the participant; 3) the presence of a virtual interactive whiteboard and its functionality; 4) monitoring the activity of participants; 5) video recording (video broadcast) of a session of distance educational interaction in synchronous mode.

The significance of the defined criteria was investigated by means of expert evaluation (a detailed description is presented in the section "Research methods"). The results of the experts' selection of the appropriate assessment, according to the scale used (see table 1), for the defined criteria and numerical values of the calculations are presented in table 2.

*Table 2*

**Relative frequencies of experts' selection of assessments of the significance of the criteria for selecting digital video conferencing tools**

| №<br>з/п | Criteria    | Distribution of expert assessments |   |   |    | Σ  | ν    |
|----------|-------------|------------------------------------|---|---|----|----|------|
|          |             | 0                                  | 1 | 2 | 3  |    |      |
| 1        | Operational | 0                                  | 2 | 5 | 13 | 51 | 0,85 |
| 2        | Functional  | 0                                  | 0 | 4 | 16 | 56 | 0,93 |

The obtained data allow us to conclude about the significance of the proposed criteria, since all values of ν belong to the interval (0,5; 1]. The statistical function Microsoft Office Excel CHISQ.TEST was used to estimate the confidence probability α of the reliability of the conclusion.

Accordingly, for the first criterion α ≈ 100%, for the second – α ≈ 100%. These values satisfy the condition α ≥ 95%. Therefore, the expert opinion on the importance of the proposed criteria for the selection of digital video conferencing is reliable.

The results of expert assessment of the significance of the identified indicators for the performance criterion and the value of the confidence level α of the reliability of the conclusions are presented in table 3.

The obtained data indicate the significance of the described indicators except for the third ( $\alpha \approx 93,42\%$ ), eighth ( $\alpha \approx 92,14\%$ ) and tenth ( $\alpha \approx 94,5\%$ ). The credible probability of the weight of the latter indicator lies within the absolute error (0,5%). Therefore, this indicator is recommended for the selection of digital means of video conferencing for the implementation of a synchronous mode of advanced training of students in the remote form. At the same time, you can ignore such indicators as the availability of reference materials and technical support, the maximum number of participants in the communication session. Regarding the latter, the choice of experts can be explained by the fact that the most of the digital means of videoconferencing (including free use) popular in the PPO allow up to 100 people to participate in the session. This number is quite sufficient, given that the number of students in the study group is not more than 30.

*Table 3*

**Relative frequencies of experts' choice of significance assessments of performance criterion indicators and the value of the probability of reliability of the conclusion**

| № з/п | Indicators  | Distribution of expert assessments |   |    |    | $\Sigma$ | $\nu$ | $\alpha$ |
|-------|---|------------------------------------|---|----|----|----------|-------|----------|
|       |   | 0                                  | 1 | 2  | 3  |          |       |          |
| 1     | User' hardware and software requirements                      | 0                                  | 5 | 5  | 10 | 45       | 0,75  | 98,14%   |
| 2     | Payment for use   | 0                                  | 0 | 4  | 16 | 56       | 0,93  | 100%     |
| 3     | The maximum number of participants in a communication session | 0                                  | 6 | 8  | 6  | 40       | 0,67  | 93,42%   |
| 4     | Communication session duration                                | 0                                  | 5 | 9  | 6  | 41       | 0,68  | 96,16%   |
| 5     | Security and privacy  | 0                                  | 0 | 5  | 15 | 55       | 0,92  | 100%     |
| 6     | Terms of connection of participants                           | 0                                  | 1 | 10 | 9  | 48       | 0,8   | 99,91%   |
| 7     | Interface language  | 0                                  | 2 | 13 | 5  | 43       | 0,72  | 99,98    |
| 8     | Availability of reference materials and technical support     | 0                                  | 7 | 7  | 6  | 39       | 0,65  | 92,14%   |
| 9     | Availability of an application for mobile devices             | 0                                  | 3 | 5  | 12 | 49       | 0,82  | 99,86%   |
| 10    | Software developer update intensity                           | 2                                  | 2 | 9  | 7  | 41       | 0,68  | 94,5%    |

The results of expert assessment of the significance of the defined indicators of the functional criterion and the value of the confidence probability

$\alpha$  of the reliability of the conclusions are presented in table 4.

*Table 4*

**Relative frequencies of experts' choice of assessments of significance of indicators of functional criterion and value of probability of reliability of conclusion**

| № з/п | Indicators   | Distribution of expert assessments |   |   |    | $\Sigma$ | $\nu$ | $\alpha$ |
|-------|--|------------------------------------|---|---|----|----------|-------|----------|
|       |  | 0                                  | 1 | 2 | 3  |          |       |          |
| 1     | Number of functionalities of the moderator (presenter)                 | 0                                  | 0 | 8 | 12 | 52       | 0,87  | 99,99%   |
| 2     | Number of functionalities of the participant                           | 0                                  | 5 | 9 | 6  | 41       | 0,68  | 96,16%   |
| 3     | Availability of a virtual interactive whiteboard and its functionality | 0                                  | 4 | 8 | 8  | 44       | 0,73  | 96,79%   |
| 4     | Monitoring of the participants' activity                               | 0                                  | 3 | 9 | 8  | 45       | 0,75  | 98,71%   |
| 5     | Video recording (video broadcast) of a communication session           | 1                                  | 3 | 8 | 8  | 43       | 0,72  | 94,5%    |

The obtained data indicate the importance of certain indicators, except for the latter, for which  $\alpha \approx 94,5$ . This value is within a certain absolute error of 0,5%. Therefore, this indicator is recommended for the selection of digital video conferencing tools, but is not required to be considered. This choice of expert estimates can be explained by the availability of specialized digital recording tools with much greater capabilities than video conferencing software.

**CONCLUSIONS AND PROSPECTS FOR FURTHER RESEARCH / ВИСНОВКИ ТА ПЕРСПЕКТИВИ ПОДАЛЬШИХ ДОСЛІДЖЕНЬ**

So, the analysis of relevant legislative, scientific and methodological literature sources, software related to the implementation of electronic distance learning in the PPO (in the institutes of postgraduate studying) allowed to determine a set of criteria and relevant indicators for the selection of digital video conferencing for E-learning in synchronous mode. With the help of expert evaluation and appropriate calculations performed using the formula of mathematical statistics, the importance of these criteria and indicators is substantiated. In particular, operational with the following indicators: the requirements for user hardware and software; the payment for use; the duration of the communication session; the security and confidentiality; the conditions of connection of participants; the interface language; availability of an application

for mobile devices. And also functional, indicators of which are the number of functional capabilities of the moderator; the number of functional capabilities of the participant; the availability of a virtual interactive whiteboard and its functionality; the monitoring the activity of participants. However, such indicators as the intensity of the software update, the possibility of video recording (video broadcast) of the communication session are recommended but not required to be considered.

**Prospects for further research.** Further research on this issue may include refining the algorithm for evaluating the relevant digital video conferencing tools according to certain criteria and indicators to select the most effective software for the implementation of distance learning for distance learning in synchronous mode.

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## КРИТЕРІЇ ТА ПОКАЗНИКИ ДОБОРУ ЦИФРОВИХ ЗАСОБІВ ВІДЕОКОНФЕРЕНЦВ'ЯЗКУ ДЛЯ РЕАЛІЗАЦІЇ E-LEARNING У ЗАКЛАДІ ПІСЛЯДИПЛОМНОЇ ПЕДАГОГІЧНОЇ ОСВІТИ

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**Анотація.** Дану статтю присвячено одній із актуальних проблем сьогодення – організації процесу підвищення кваліфікації у закладі післядипломної педагогічної освіти за дистанційною формою. Зокрема, стосується добору цифрових інструментів відеоконференцзв'язку для реалізації синхронного режиму електронного навчання. На основі проведеного аналізу наукових публікацій, нормативно-правових документів, відповідних програмних застосунків визначено та описано критерії і показники для здійснення добору потрібних цифрових засобів закладом освіти. Зокрема, доцільно застосовувати експлуатаційний та функціональний критерії. До показників першого критерію відносимо такі: вимоги до апаратно-програмного забезпечення користувача; оплата за використання; тривалість сеансу зв'язку; безпека та конфіденційність; умови підключення учасників; мова інтерфейсу; наявність додатку для мобільних пристроїв. Серед показників другого критерію виділяємо такі: кількість функціональних можливостей модератора; кількість функціональних можливостей учасника; наявність віртуальної інтерактивної дошки та її функціонал; моніторинг активності учасників. Вагомість запропонованих критеріїв та показників підтверджена за допомогою методу експертного оцінювання та відповідних розрахунків із застосуванням методів математичної статистики (критерій Пірсона), а також функцій додатку Microsoft Office Excel (CHISQ.TEST). Подальші дослідження розглядуваної проблеми можуть стосуватися уточнення алгоритму оцінювання відповідних цифрових інструментів відеоконференцзв'язку за визначеними критеріями та показниками для добору найбільш ефективного програмного засобу для реалізації підвищення кваліфікації слухачів за дистанційною формою навчання у синхронному режимі.

**Ключові слова:** підвищення кваліфікації; післядипломна педагогічна освіта; електронне дистанційне навчання; цифрові інструменти відеоконференцзв'язку.

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