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## **PEDAGOGICAL CONDITIONS FOR THE FORMATION OF AN EFFECTIVE INFORMATION AND LEARNING ENVIRONMENT IN HIGHER EDUCATION INSTITUTIONS**

**Abstract.** The article deals with the information and learning environment as a component of integral training system of the educational system in higher education institutions. The main function of the information and learning environment, which is ensuring the coordinated functioning of subjects of educational activity, has been established. The concept of «effective information and learning environment» has been introduced. It is defined as the ability to ensure high-quality, mutually coordinated functioning of students, teachers and information and learning environment as a network subject of the educational process. The pedagogical conditions for the effective functioning of the information and learning environment as a network subject of the educational process have been identified, namely: existence of vividly structured system of information and learning environment as the subject of the educational interaction with taking into consideration its hierarchical links to other components of the educational process in higher education institutions; purposeful training of students for the fluent operation of information and communication tools; improvement of the IT competence of research and teaching staff in the implementation of teaching methods based on modern information and computer technologies.

The effectiveness of the suggested methodological system for the improving the IT competence of research and teaching staff of higher education institutions has been developed and experimentally confirmed. The following approaches are considered to be dominant in its construction: holistic, competence-futurological, andragogical and narrative-digital. The core idea is the idea of content modelling based on the combination of key competences of the 21<sup>st</sup> century «4 C» (critical thinking, creativity, collaboration, communication) with digital competence and the ability to predict the possibilities of developing a modern educational environment in the future. The basis of the methodological system is the introduction of a scientific and methodological seminar on the topic «The Use of activity components and online communications of the Moodle system», which is considered to be an element of non-formal education of teachers. Criterion apparatus of the determining of the effectiveness of its introduction has been developed: subjective and objective

criteria and indicators. It has been determined that it is appropriate to use the «didactic quality» criterion to determine the quality of content.

**Keywords:** higher education institutions; information and learning environment; pedagogical conditions; IT competence; methodological system.

## 1. INTRODUCTION

**The problem statement.** Modern challenges in education, which are associated with informatization and globalization, the expansion of intercultural and economic ties at the world level, as well as with the military situation in Ukraine and the spread of viral diseases, have intensified the issue of implementing new hardware, software, information and communication tools of education. In addition, information society puts new demands before future research and teaching staff, namely: the ability to navigate in the constantly growing flow of information, the ability to find the necessary information quickly, mastery of digital technologies, the ability to analyze information and comprehend it critically, readiness for innovative activities, etc. Therefore, the leading vector of modernization of the process of providing educational services to students in the conditions of the new socio-cultural reality is the creation and ensuring the proper functioning of the information and learning environment (ILE) in higher education institutions. In addition, at this stage of our society development, in general, and educational system, in particular, the issue of gaining and improvement of IT competence of experienced teachers in the system of non-formal education arises. Its solving will help elderly specialists to adapt successfully to the requirements of today and improve considerably the quality of the educational process.

**The analysis of recent studies and publications.** Present-day higher education institutions are transforming the complex of information and communication learning tools into the concept of «electronic learning environment» [1] – [7] and others, which is managed by hardware, software and telecommunication tools to organize the educational process and plays an objective and instrumental role in the process of modelling the educational and professional activities of future specialists. It refers to the information component of the learning environment of higher education institutions as the one, which combines educational, methodological and information resources using modern computer devices, information and communication technologies (ICT), tools of interactive network cooperation.

The scientists [7] have determined the components of information and learning environment (content, didactic, managerial, technological and motivational); a didactic model of formation of information and communication competence (ICC) of future specialists in the learning environment of the university was developed, which combines motivational-targeted, informational-content, operational-action and diagnostic-resultative blocks; the criteria, indicators, and levels of the ICC formation (cognitive-informational, computer-technological, procedural-analytical, motivational-cognitive) have been specified.

In the interpretation of the concept ICT, we follow the opinion of scientists, that they are software, hardware and technical tools and devices that function on the basis of computer equipment, and are used for broadcasting information, information exchange and provide the following operations: collection, accumulation, storage, processing, transmission of information and the possibility of access to information resources of computer networks (including global ones). We refer them to the technological component of ILE.

Partly the problem of the improvement of ILE in education institutions using computer-oriented technologies, in particular, mobile devices and training teachers to use SMART technologies in the educational process was highlighted in the works [8], [9]. However, scientists regard the issue of the ILE formation partly isolated, without taking into

consideration its hierarchical links to other components of the educational process in higher education institutions. On the basis of conducted analysis of scientific works it has been found out that the process of the effective use of the ILE in higher education institutions needs the improvement of all its components (motivational, content, didactic, technological and managerial).

**The research goal.** The goal of our study is to find out the pedagogical conditions for the formation of an effective information and learning environment in higher education institutions, to develop and verify experimentally a methodological system for the improving of IT competence of research and teaching staff.

## 2. THE THEORETICAL BACKGROUNDS

Theoretical and methodological justification of the organization and conducting of distance learning in the conditions of continuous pedagogical education was carried out in modern regulatory documents [10], [11] and research of some scientists [13] – [24].

The following approaches are considered to be dominant in our study: holistic, competence-futurological, andragogical and narrative-digital.

Interpretation of information and learning environment as a subject of educational interaction in the multi-subjective educational space, that is as a network subject of the educational process is a conceptual basis for developing and theoretical justification of the singled out pedagogical conditions. At the same time, we keep to the statement regarding the multi-subjective educational paradigm, which is considered as open, self-developing and self-organizing, leading to a radical change in the behaviour and relationships of participants in the educational process. The principle of teaching concerning the inseparability of the organism from its environment is also decisive: «An organism is impossible without an external environment that supports its existence; therefore, the scientific definition of an organism should also include the environment that affects it. Since the existence of an organism is impossible without the latter, disputes about what is more important in life, either the environment or the body itself, do not make any sense» [27, p. 58]. The statement of synergetics about the non-additivity of the whole to the sum of its parts was also taken into account. The complex use of the mentioned approaches will provide the integral functioning of the educational system in higher education institutions and get the increase of the positive result, its emergence manifestation.

The position of foreign scientists [17] was also taken into consideration. According to this position the process of forming the students' information and communication competence should be built in two directions: 1) «learning-to-use» which refers to the acquisition of skills in the use of ICT and digital technologies for personal needs and professional activity, 2) «using-to-learn» which focuses on ways of integrating infocommunications and digital technologies into the educational process, improving the effectiveness of acquiring basic competences through the use of these technologies in future professional activities.

## 3. METHODS

To achieve the abovementioned objectives, a number of methods have been used, namely:

*theoretical* – comparative analysis to find out different views on the issue, identify areas of study, identification of pedagogical conditions for the effective functioning of ILE; *modelling* – to develop a model of a methodological system for the improving of IT competence of research and teaching staff in higher education institutions; *constructing* – to

develop a content component of the methodological system, criteria apparatus for the research; systematization and generalization – to formulate conclusions and recommendations for improving the educational process with the aim of improving ILE functioning in higher education institutions.

*empirical* – generalization of pedagogical experience, scientific observation, interviews, content analysis, questionnaires in order to determine the state of implementation of the issue in practice and to develop the content of experimental teaching methodology; pedagogical experiment, which provided verification of the effectiveness of the proposed methodology, methods of expert evaluation to identify didactic quality of the developed experimental materials.

Experimental research has been carried out on the basis of Ternopil V. Hnatiuk National Pedagogical University (TNPU) and Sumy A. Makarenko State Pedagogical University.

Effectiveness of the proposed methodology was checked during the forming experiment. Forming experiment lasted for two years (2019 – 2020 and 2020 –2021 academic years) in the process of future teachers professional training. The number of scientists and teachers of higher education institutions who participated in the experiment was 292 and the number of students comprised 433.

#### 4. FINDINGS

We understand an effective ILE as mutually coordinated functioning of all subjects of educational activity (students, ILE, research and teaching staff) and the formation of an effective ILE as the ensuring of mutually coordinated functioning of all subjects of educational activity with the aim to increase the quality of education. We interpret pedagogical conditions for the effective functioning of ILE as the complex of motivational, content, didactic, managerial and technological resources and initial principles, creation and realization of which will contribute to the improvement of the process of future specialists training.

We conducted a survey of both students and research and teaching staff with the aim to identify the pedagogical conditions for the effective functioning of ILE in higher education institutions (Questionnaire «Implementation of distance learning from the student's point of view» [25] and «Implementation of distance learning from the teacher's point of view» [26])

Students' answers to the question «Do you know the themes for your individual work?» proved that out of 440 respondents they are familiar to 35.5%, 45.5% are partially acquainted with them, and for 19.1% they are unknown. The quality of methodological support developed by teachers for independent work was rated by 438 students. Out of them 50.9% consider it to be excellent, 17.6% think that it is good, 22.8% consider it to be satisfactory, and 8.7% as unsatisfactory. The level of equipment of the classrooms with necessary tools for independent work was rated by 437 students. 20.8% of them evaluated it as excellent, 46.7 as good, 22.7% as satisfactory, and 9.8% as unsatisfactory. Herewith, out of 432 respondents, 12.7% do their independent work in the library, 18.1% in the classroom, 4.6% in the Internet cafe, 90.3% at home, 1.4% in the dormitory.

Results of the conducted questionnaire proved, that the readiness of electronic courses to ensure independent work, out of 432 students 9.3% evaluated as excellent, 48.1% as good, 25.5% as satisfactory, and 9.3% as unsatisfactory. Herewith, 36.8% of respondents give preference to printed resources and 63.2% prefer electronic resources. Search service Internet networks for independent work are often used by 86.5% of respondents, 11.6% use them sometimes, 1.9% of respondents use them rarely (430 answers).

Answering the question «How do you assess the level of readiness of the university for the introduction of distance learning?», out of 434 respondents, 34.3% consider it to be high,

52.3% – medium, and 13.4% – low. Out of 431 respondents, 50.6% have a positive attitude to distance learning, 29.7% – neutral, and 19.7% – negative. Herewith, 29.9% rated their readiness for distance learning (432 responses) as high, 56.3% as medium, and 13.9% as low. There are the following things that hinder the introduction of distance learning at the university: unsatisfactory state of the IT structure in the university (19.0%), teachers' non-readiness to work remotely (online) (44.4%), students' non-readiness to work remotely (online) (39.8%), insufficient number of educational resources (46.9%), low quality methodological support (29.4%) (405 responses).

The results of teachers' survey showed that they use the following services for online classes: Google Meet (42.4%), BigBlueButton (16.9%), Zoom (79.7%), Viber (1.7%) (59 respondents). Herewith, 49.2% of teachers use the Moodle mobile application during their work with the electronic server, and 50.8% do not use it.

Answering the question «What digital tools do you use when conducting online classes?» 317 teachers said as follows: Google documents – 62.1%, Google questionnaires – 17.4%, Interactive whiteboards – 15.5%, presentations – 91.2%. According to the teachers, the use of such tools ensures the effective functioning of the ILE in higher education institutions. The level of use of educational resources of the electronic course server (Moodle) by students (160 respondents) was assessed as high by 43.8% of them, satisfactory – 49.4%, unsatisfactory – 6.8%.

The conducted analysis of the information support of the educational process shows that teachers, first of all, use educational and methodological complexes of disciplines (EMCD) in electronic format (text files, presentation files for lectures, methodological recommendations for practical and laboratory work, and independent work of students). Students are often offered electronic textbooks, but as the analysis of their format and content shows they are, in the main, electronic analogue of printed editions (mostly \*pdf format), though they can be found on the web sites of departments, cloud storages, university repositories and they are placed there as electronic textbooks. Conversations with teachers prove that quite often users refer to digitized versions of paper books as electronic textbooks. Such attitude cannot be regarded as correct, since electronic textbook is not only an ordinary text that is given in a definite succession, but also additional determinants (for example, hypertext links), which are not common for a paper textbook.

Thus, the analysis of the practice of organization and support of the educational process in the training of students, normative requirements, scientific sources referring the outlined problem and our own pedagogical experience allowed us to single out such interconnected pedagogical conditions of the effective functioning of the ILE ; existence of vividly structured system of information and learning environment as the subject of the educational interaction with taking into consideration its hierarchical links to other components of the educational process in higher education institutions; purposeful raining of students for the fluent operation of information and communication tools; improvement of the IT competence of research and teaching staff in the implementation of teaching methods based on modern information and computer technologies.

We will reveal the essence of the identified pedagogical conditions for the formation of an effective ILE in higher education institutions.

*The first pedagogical condition* is the existence of vividly structured system of information and learning environment as the subject of the educational interaction with taking into consideration its hierarchical links to other components of the educational process in higher education institutions. We will consider it on the example of the structure of the ILE of distance (online) learning in TNPU (Figure 1)

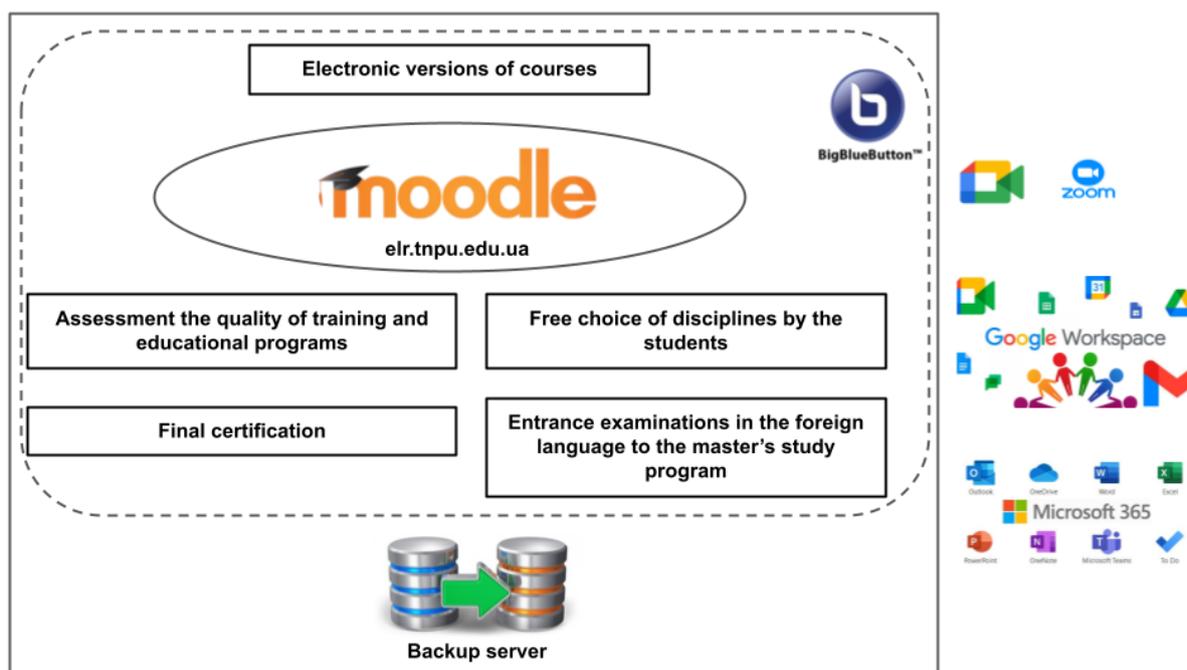


Figure 1. Structure of the information and learning environment of distance (online) learning in TNPU

Its IT infrastructure includes modern hardware and software, including computer classrooms, digital laboratories, high-speed Internet connection, Wi-Fi, developed ILE, etc. The central component of the ILE is Moodle learning management system. Today the functions of Moodle are not limited only by providing access to electronic versions of our courses to the students. It is an e-learning portal of full value that combines administrative resources such as an information portal, a service for assessment the quality of training and educational programs, a service for free choice of disciplines, resources for final certification and conducting entrance examinations in the foreign language to the master's study program.

Integration with online communication services ensures transparent creation and joining the planned online events. The backup service ensures the preservation of data of the previous day, which allows, in case of unpredicted situations, resume the work quickly. Services that are deployed in the domain elr.tnpu.edu.ua are fully under the control of the university and the centre of distance learning, and the external services, which are being used, only provide flexibility and new opportunities in the implementation of electronic (distance) learning. The basis of the educational environment is the LCM Moodle educational resource management system with installed additional modules for integration at the system level of services for conducting online meetings, in particular Google Meet, Zoom, BigBlueButton.

*The second pedagogical condition* is a purposeful training of students for the fluent operation of information and communication tools. It is realized by developing and implementing student's individual educational trajectory, taking into account the study of mandatory and elective educational components. The purpose of their including in the curriculum is the formation of IT competence. In addition, a combination of formal, non-formal and informal education is desirable.

Taking into consideration activity of students in the network environment, in particular, in social networks and the use of various servers of Internet resources, it can be stated that students are ready to use ICT. This conclusion is confirmed by the results of a survey of students regarding their readiness for online learning.

Since I and II conditions have been more or less formed in modern higher education institutions, we will focus more on the details of implementation of the *III pedagogical condition* for the effective functioning of the ILE in higher education institutions. Namely: improvement of IT competence of research and teaching staff in the implementation of teaching methods based on modern information and computer technologies. For this purpose, we have developed a methodological system for improving the IT competence of research and teaching staff.

Conducted analysis of literature sources and practical work of modern higher education institutions proved that teachers can improve their qualification according to this direction in formal, non-formal and informal education. For example, attending trainings, workshops, webinars, interactive courses on the use of ICT, digital technologies in educational activities, engaging in self-education (active independent research and study of Internet resources, participation in conferences, preparation of scientific papers, etc.). However, foreign scientists [28] believe that the IT competence of a teacher as his basic competence evolves most effectively in the process of developing and implementing a holistic model of further training while studying modern ICT and digital technologies in order to use them in the organization of the educational process (planning, didactic tools, knowledge control and diagnostics of the levels of formation of ICC of those who study). This incited us to develop the methodological system for improving of the IT competence of research and teaching staff.

The following approaches are considered to be dominant in its construction: holistic, competence-futurological, andragogical and narrative-digital. The basis of competence-futurological approach constitutes the idea of the expediency of methodological system modelling based on the combination of key competences of the 21<sup>st</sup> century «4 C» (critical thinking, creativity, collaboration, communication) with digital competence and the ability to predict the possibilities of developing a modern learning environment in the future. The necessity of this very approach is caused by the entry of modern life into the so-called «regime with exacerbations» that demands projecting all the components of the model taking into consideration possible specificity of their modification in the future educational process according to the probable needs of professional activity.

Andragogical approach to methodological system modelling emphasizes that it is based on the andragogical principles of learning: independent learning priority; cooperative activity principle; the principle of relying on life experience; individualization of education; systematic learning; contextuality of learning; the principle of updating learning results; the principle of elective education; the principle of development of educational needs; the principle of reflectivity.

Narrative-digital approach makes it possible to apply digital narratives in the methodological system which represent integrated combination of the narrative (narration) and information and communication technologies. Development and use of digital narratives in the practice of teachers' professional activity takes an important place in the realization of this approach.

In the research we heeded the necessity to follow the most important methodological principles of cognition, namely holistic and systematic approach to the object of study. They demand to consider the problem not in isolation, but in the context of realization of the holistic educational process in modern higher education institutions. That is why we checked the possibility of the realization of the defined third condition through the development and implementation of the methodological system for improving the IT competence of research and teaching staff. It consists of goal-oriented, operational and content, activity-reflective and result-oriented components. Its system creative factor is the aim to increase the quality of mutually coordinated functioning of the subjects of educational activity. The basis of the methodological system is the introduction of a scientific and methodological seminar on the

topic «The Use of Activity Components and Online Communications of The Moodle System»[29], which is considered an element of non-formal education of teachers. The final result is further training of research and teaching staff from different fields of knowledge on the plane of studying modern information and computer technologies in order to be able to use them in their professional activity.

The main intentions and ideas of the authors, which were supposed to be materialized during the construction of a methodological system for improving the IT competence of research and teaching staff, were previously discussed with students and scientific and pedagogical workers at the International Scientific and Practical Conference «Training of Physics, Chemistry, Biology and Natural sciences Teachers in the context of the requirements of the New Ukrainian School» (2020 – 2022), round tables, webinars, in individual conversations. Thus, the previous adaptation of conceptual ideas of the third pedagogical condition implementation into real educational process was carried out.

Based on the theoretical analysis of the essence of the problem, the educational needs of students and teachers, we identified eight topics, the study of which should be included in the cognitive component of the suggested system, namely:

1. *Conducting online training events. The use of LCM Moodle modules to ensure online teaching.*
2. *Didactic options of the module «Tasks» LCM Moodle.*
3. *Test control of knowledge by Moodle platform tools (Resource Test).*
4. *Digital tools for communication during the distance learning process (interactive online boards, Google documents, platforms for conducting online classes: Google Meet, Zoom, BigBlueButton).*
5. *Recording and publication of video lectures. Tools for editing video lectures. Converting of presentations into video lectures.*
6. *LCM Moodle game tools for organizing students' learning activities.*
7. *Digital tools for feedback during distance learning. Tools to conduct students questioning. Module Moodle Feedback.*
8. *Tools for interactive, adaptive teaching LCM Moodle.*

To assess the quality of the proposed training classes, an integrated criterion of «didactic quality» was used, which was determined by the method of expert assessments. We were prompted to choose it by taking into account the following concepts of the modern theory of the formation of the content of education:

- 1) It is necessary to evaluate the effectiveness and correctness of new ideas, methods and principles, first of all, theoretically;
- 2) The age-old experience of constructing the content of the basics of science shows that the expert method is the main method for selecting material, namely, the opinions of scientists-specialists [30, p. 326].

A group of experts was formed to conduct the research, which included scientists and lecturers of pedagogical higher education institutions from different regions of Ukraine, who agreed to participate in the examination. We deliberately chose a non-homogeneous expert group in terms of composition. It allows taking into account more fully existing opinions on the compliance of the proposed content with the needs and real conditions of practice in teaching and the current state of development of ICT. The quality of experts was high, as all of them were sufficiently characterized by such important features as:

1. Competence, that is they possessed a stock of necessary knowledge, which allowed them to create their own model of the issue under consideration based on the received information; to synthesize extraordinary conclusions. Their field of activity, specialization, and scientific interests border on the field to which the issue under analysis belongs.

2. Interest in the results of the examination.
3. Businesslike character.
4. Objectivity and impartiality [30, p. 327].

A group of specialists especially competent in the field of the studied issue (21 people) was selected out of the total number of experts. It comprised Informatics lecturers who have gained a scientific degree and teaching experience of more than 10 years, and those who participated in defining the main items of the scientific methodological seminar.

Indicators, according to which the main topics of classes had to be assessed, were agreed with this group of experts. As a result of collective discussion, the «weight» (K) of each of the six selected indicators was determined. The results are presented in Table 1.

*Table 1*

**The weight of indicators of the didactic quality of classes**

<b>№</b>	<b>Indicators</b>	<b>K</b>
1	Possibility to reveal and apply the effective information and learning environment in higher education institutions based on the existing material and technical support	10
2	Significance for the holistic educational process organization	25
3	Significance for the organization of interactive pedagogical interaction of participants in the educational process	25
4	Accessibility for perception	10
5	Expediency to use during future teachers professional training	20
6	Correspondence to the life experience of research and teaching staff and students	10

The examination was conducted in May 2019. The core content of classes was evaluated according to the integrated criterion «didactic quality» and also on the basis of «multi-factor ranking». The criterion of «didactic quality» was defined as the degree of correspondence of each class, submitted to the examination, to the totality of the mentioned indicators.

Invited experts were informed about the objective of the experiment and the rules of its conducting. They were given the information concerning general approaches to solving the problem. After that each expert individually filled in the questionnaire, which included a list of factors that were assessed. The questionnaires were studied and analyzed. Processing of the grades given by experts was carried out using statistical methods, which were based on the principle that the expert can be considered as a measuring device, the indicators of which have random and systematic errors.

The results of the expert assessment convincingly showed the possibility and expediency of including the suggested methodological system of the constructed content of training classes in the cognitive component. According to the experts, they are available on the whole, for perception by research and teaching staff and are important for improving the quality of their IT competence.

We will characterize the stages of the experimental implementation of the methodological system for the IT competence of research and teaching staff of higher education institutions: preparatory, organizational and methodological, procedural, reflexive and analytical (Figure 2).



*Figure 2. Stages of the implementation of methodological system*

Preparatory stage involves studying the needs of the subjects of educational interaction (students, teachers, the network subject of the educational process) in relation to the (ensuring) of the effective functioning of the ILE by means of questionnaires and analysis of educational information products (electronic courses).

For ensuring the revealed needs we concentrated on the detection of the effective tool for improving the IT competence of research and teaching staff. Research criterion apparatus was also defined.

Organizational and methodological stage involved defining priorities in educational activity and conducting organizational actions on studying the suggested course as a means of continuing education for the formation of IT competence of research and teaching staff.

Procedural stage involved conducting an online scientific and methodological seminar with teachers of higher education institutions. In order to study the content of classes independently, practice practical skills, video recordings of all classes were disposed at the bank of video lectures in TNPU.

Reflexive and analytical stage of our research involved the analysis of the results of experimental training in terms of objective (number of developed electronic courses, level of course content, activity of use – working time in Moodle) and subjective (diversity of used platforms, types and kinds of tasks, self-analysis of the level of readiness to conduct distance learning by the research and teaching staff, analysis of the level of teachers' readiness to organize distance learning by students) indicators.

Comparative analysis of the results of introduction of the suggested methodological system for improving the IT competence of research and teaching staff of higher education institutions according to the determined objective and subjective indicators convincingly proves its effectiveness. So, as of December 2019 (before experimental training), 2085 electronic courses were developed in all and after the completion of the experimental work there became 2889 electronic courses, that is, the number increased by 804. The number of active courses increased by 126. Their number was 1322 before the experiment and after the experimental training their number increased to 1567.

In general, the teachers noted the following difficulties and shortcomings that arose during the experimental activity: technical ones, related to the unstable Internet connection; weak technical equipment of students with means of communication, which reproduces their video presence and reduces the level of communication; electricity cuts, technical problems during online classes; the study of certain topics referring the teaching methods of disciplines is not effective in the conditions of distance learning; lack of strong personal motivation among students, insufficient level of knowledge to prepare presentations for students; it is difficult to establish feedback with students during discussions, the teacher's interference into the process of performing laboratory work is limited or impossible, etc.

The results of checking the efficiency of the suggested methodological system for the improving of the IT competence of research and teaching staff according to subjective indicators are shown in Table 2.

*Table 2*

**The level of the subjects of educational activity readiness for distance learning before (I examination) and after (II examination) of the forming experiment**

*(160 respondents)*

	Indicators Level of readiness	I diagnostic examination (%)			II diagnostic examination (%)		
		I	II	III	I	II	III
1.	Level of teachers' readiness to conduct distance learning (self-analysis)	49,4	40,4	10,2	51,9	44,4	3,7

2	Level of students' readiness for distance learning (students' assessment)	20,2	65,5	14,3	24,4	70	5,6
3.	Level of students' activity during online classes	20,0	67,7	11,3	22,5	70	7,5
4.	Level of use of educational resources at the electronic course server (Moodle) by students	36,6	35,2	28,2	43,8	49,4	6,8

(I – high level; II – satisfactory level; III – low level of readiness)

Data from Table 2 demonstrate that the teachers assessed the level of their readiness to distance learning after the conducting of forming experiment much higher. Thus, the number of respondents with a high level of readiness increased by 2.5%, and those with a satisfactory level by 4.0%. The number of teachers who assessed their level of readiness as low decreased by 6.5%.

The fact that students assess the level of teachers' readiness to distance learning much lower than the teachers themselves turned to be rather interesting. The contrast between the levels of readiness, obtained on the basis of teachers' self-analysis and students' assessment is the following during the first examination: for the I level – 29.2%, for the II + 25.1% and for the III level + 1.9%. During the second examination the contrast is as follows: for the I level – 27.5%, for the II + 26.5% and for the III level + 1.9%. However, the tendency to improve the level of teachers' readiness to conduct distance learning according to students' assessment is maintained. Thus, the number of respondents who assessed the teachers' readiness at a high level increased by 2.2%, and at a satisfactory level by 4.5%. The number of teachers whose level of readiness was assessed by students as low decreased by as much as 8.7%.

The indicator of the level of students' activity during online classes has also increased: high by 2.5%; satisfactory by 2.3%. The low level decreased by 3.8%. The introduction of the suggested methodological system for the improving teachers' IT competence was also reflected on the level of educational resources of the electronic course server (Moodle) use by the students. Thus, the number of students who are on the low level decreased by 21.4%, and those on the high and satisfactory levels increased accordingly by 17.2% and 14.4%.

The given results allow to come to the conclusion about the efficiency of the suggested methodological system for the improving teachers' IT competence, in particular, and the expediency of constructing ILE in higher education institution taking into consideration singled out pedagogical conditions, in general.

## 5. CONCLUSIONS AND PROSPECTS FOR FURTHER RESEARCH

To solve the issue of an effective information and learning environment formation qualitatively it is reasonably to consider it as a component of a holistic educational system in higher education institutions. The main function of information and learning environment is to ensure mutually coordinated functioning of the subjects of educational activity (students, teachers and ILE) as a network subject of the educational process.

Qualitative accomplishment of the main function is possible while implementing the complex of pedagogical conditions. Namely: existence of vividly structured system of information and learning environment as the subject of the educational interaction with taking into consideration its hierarchical links to other components of the educational process in higher education institutions; purposeful training of the students for the fluent operation of information and communication tools; improvement of the IT competence of research and teaching staff in the implementation of teaching methods based on modern information and computer technologies.

The mechanism of implementation of the third pedagogical condition is represented by the methodological system for improving the IT competence of research and teaching staff of higher education institutions. Its application allows ensuring of more effective mutually coordinated functioning of the subjects of educational activity within a holistic system of a higher education institution.

It has been established that to assess the content quality of the methodological system it is appropriate to use the «didactic quality» criterion according to the following indicators: possibility to reveal and apply the effective information and learning environment in higher education institutions based on the existing material and technical support; significance for the holistic educational process organization; significance for the organization of interactive pedagogical interaction of participants in the educational process; accessibility for perception; expediency to use during future teachers professional training; correspondence to the life experience of research and teaching staff and students. To assess the quality of teachers' IT competence formation within non-formal education it is appropriate to use subjective and objective indicators.

Organization of the educational process within non-formal education for the formation and improvement of teachers' IT competence allows improving the level of its formation considerably and increasing the quality of mutually coordinated functioning of the subjects of educational activity.

The formation of a high-quality information and learning environment in higher education institutions taking into account all the pedagogical conditions identified in the research, allows increasing the quality of providing educational services to students.

The prospects for further study consist in the modelling of the content and activity contents of continuous pedagogical education based on the combination of the key competencies of the 21st century «4 C» with digital competence and the ability to predict the possibilities of developing a modern learning environment in the future.

## REFERENCES (TRANSLATED AND TRANSLITERATED)

- [1] V. Yu. Bukov, "Modern tasks of informatization of education", *Information technologies and learning tools*, vol. 1, no. 15, 2010 [Online]. Accessed: May, 5, 2021. Available: <http://www.nbu.gov.ua/e-journals/ITZN/em15/emg.html>. (in Ukrainian).
- [2] V. Habrusiev, H. Tereshchuk, I. Tsidylo, S. Martyniuk and O. Kulyanda, "Monitoring The Quality Of E-Learning Implementation In Educational Institutions". *SHS Web of Conferences* 107, 10003 2021. Available: <https://doi.org/10.1051/shsconf/202110710003>, M3E2, 2021. (in English).
- [3] P. H. Luzan, Ed., "Information and educational environment of vocational schools", Kartashova L. A. et al. Kyiv: IPTO NAPN, 2017. (in Ukrainian)
- [4] N. V. Kononets, "The role of information and educational environment of higher education institution in resource-oriented education of students in higher education", *Zasoby navchalnoi ta naukovo-doslidnoi roboty*, Vyp. 51, Kharkiv: KhNPU imeni H. S. Skovorody, 2018, pp. 31–45. (in Ukrainian)
- [5] S. V. Titov and O. V. Titova, "Information and educational environment of the educational institution: development of means and methods of communication and information interaction", *Visnyk of Kharkiv State Academy of Culture*, Vyp. 43, 2014, pp. 144-150. (in Ukrainian)
- [6] M. O. Topuzov, "Development of the content of the design of the information and educational environment of the university in the system of the organizational and economic mechanism", *Bulletin of the Kyiv National University of Technologies and Design*, vol. 3, issue 65, 2012, pp. 210-215. (in Ukrainian)
- [7] V. O. Baliuk, "Didactic conditions for the formation of information and communication competence of future specialists of the economic profile in the educational environment of the university", Ph.D. dissertation, Poltava V.G. Korolenko National Pedagogical Univ., Poltava, 2020. (in Ukrainian)
- [8] Alla V. Stepanyuk, Liudmyla P. Mironets, Tetiana M. Olendr, Ivan M. Tsidylo. "Methods of Future Natural Sciences Teachers Training to Use Smart-technologies on the Basis of Learning Apps", *17th International Conference on ICT in Education, Research and Industrial Applications. Integration, Harmonization and Knowledge Transfer*, Vol. I: Main Conference, PhD Symposium, and Posters (ICTERI 2021). (Kherson, Ukraine, September 28 - October 2, 2021), pp. 411-418. Available: <http://ceur-ws.org/Vol-3013/> (in English).

- [9] Alla V. Stepanyuk, Liudmyla P. Mironets, Tetiana M. Olendr, Ivan M. Tsidylo, Oksana B. Stoliar. "Methodology of using mobile Internet devices in the process of biology school course studying". *Cloud Technologies in Education 2019. Proceedings of the 7th Workshop on Cloud Technologies in Education (CTE 2019)*, Kyyvyi Rih, Ukraine, December 20, 2019, pp.535-547. Available: <http://ceur-ws.org/Vol-2643/paper31.pdf> (in English).
- [10] National Strategy for the Development of Education in Ukraine for 2012-2021, 37 p. [Online]. Available: <http://www.mon.gov.ua/images/files/news/12/05/4455.pdf> (in English)
- [11] Requirements for higher educational institutions and institutions of postgraduate education, scientific, educational and scientific institutions that provide educational services in the distance form of training for training and advanced training of specialists in accredited areas and specialties, [Online], Jan. 22 2021. Available: <https://zakon.rada.gov.ua/laws/show/z1857-13> (in Ukrainian)
- [12] V. O Baliuk, "Didactic principles of formation of digital competence of future economists", *Science Review*, vol. 2, issue 29, 2020, pp. 20-24. DOI: 10.31435/rsglobal\_sr/28022020/6955(in Ukrainian)
- [13] Nadiia Balyk, Yaroslav Vasylenko, Galina Shmyger, Vasy Oleksiuk, Olha Barna. "The Digital Capabilities Model of University Teachers in the Educational Activities Context", *ICTERI 2020 ICT in Education, Research and Industrial Applications. Integration, Harmonization and Knowledge Transfer*, vol. VI, pp.1097-1112. (in English)
- [14] N. Balyk, G. Shmyger, Y. Vasylenko, V. Oleksiuk. "Digital Educational Environment of Teachers' Professional Training in Pedagogical University". In: *Proceedings of the 1st Symposium on Advances in Educational Technology*, 2022. vol. 1, pp. 154–166. DOI: 10.5220/0010922100003364 (in English)
- [15] Kaplan. "Lifelong learning: conclusions from a literature review". *International IDEONE Journal of Primary Education*, vol. 5, no. 2, pp. 43–50. (in English)
- [16] V. O. Baliuk and N. V. Kononets, "Modern approaches to the development of electronic educational resources for the formation of digital competence of future economists", *Kompiuter u shkoli ta simi*, vol. 4, issue 156, 2019, pp. 15-21. (in Ukrainian)
- [17] H. Perraton, B. Robinson, and C. Creed, "Teacher Education Through Distance Learning". *Technology Curriculum Cost Evaluation (Summary of Case Studies)*. Paris: UNESCO, 2001, pp. 33–34. (in English)
- [18] M. Laal, "Lifelong learning: what does it mean?" *Procedia Social and Behavioral Sciences*, issue 28, 2011, pp. 470-474. (in English)
- [19] N. Kononets, "Experience in implementing resource-based learning in Agrarian College of Management And Law Poltava State Agrarian Academy". *Turkish Online Journal of Distance Education-TOJDE*, April 2015, vol. 16, no 2, pp. 151–163. (in English)
- [20] Ibrahim Suleiman, Abdel Rahman. "Educational leapfrogging in the m-learning time". *Turkish Online Journal of Distance Education-TOJDE*, July 2014, vol. 15, no 3, pp. 10–17. (in English)
- [21] J. R. Hill and M. J. Hannafin, "Teaching and learning in digital environments: The resurgence of resource-based learning environments". *Educational Technology Research and Development*, vol. 49, no 3, 2001, pp. 37–52. (in English)
- [22] Hesti Wijaya, "Resource-based Learning: A Paradigm Shift in Materials Design". *Advances in Social Science, Education and Humanities Research (ASSEHR)*, vol. 330. 2019, pp. 119–125. (in English)
- [23] C. Armatas, D. Holt, and M. Rice, "Impacts of an online-supported, resource-based learning environment: Does one size fit all?" *Distance Education*, vol. 24, no 2, 2003, pp. 141–158. (in English)
- [24] S. R. Aragon, S. D. Johnson, "Emerging Roles and Competencies for Training in E-Learning Environments". *Advances in Developing Human Resources*, vol 4, issue 4, 2002, pp. 424–439. (in English)
- [25] Implementation of distance learning from the teacher's point of view, [Online]. Available: <https://forms.gle/yxbj7jrfryTgWmKH8> (in Ukrainian)
- [26] Implementation of distance learning from the student's point of view, [Online]. Available: <https://forms.gle/4RKM4vsYLeEHWhmZ9> (in Ukrainian)
- [27] K. O. Matsa, "The principle of unity and further development of environmental education", *Problemy osvity*, no 14, 1998, pp. 58-63(in Ukrainian)
- [28] J. Tondeur, K. Aesaert, B. Pynoo, N. Fraeyman and O. Erstad, "Developing a validated instrument to measure preservice teachers' ICT competencies: Meeting the demands of the 21st century". *British Journal of Educational Technology*, 2016. (in English)
- [29] Scientific and methodological seminars in TNPU. 2020-2021, [Online]. Available:<https://elr.tnpu.edu.ua/course/view.php?id=2378> (in Ukrainian)
- [30] A.V. Stepanyuk, "Methodological and theoretical grounds the formation of the integrity of the knowledge about the living nature", Dr. of Pedagogic Sciences dissertation, Instytut pedahohiky APN Ukrainy, Kyiv, 1999. (in Ukrainian)

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## ПЕДАГОГІЧНІ УМОВИ ФОРМУВАННЯ ЕФЕКТИВНОГО ІНФОРМАЦІЙНО-НАВЧАЛЬНОГО СЕРЕДОВИЩА В ЗАКЛАДАХ ВИЩОЇ ОСВІТИ

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**Анотація.** У статті розглянуто інформаційне освітнє середовище як компонент цілісної освітньої системи закладу вищої освіти. Встановлено головну функцію ІОС – забезпечення взаємоузгодженого функціонування суб'єктів освітньої діяльності. Введено поняття «ефективне ІОС». Воно визначається як здатність до забезпечення якісного взаємоузгодженого функціонування здобувачів освіти, викладачів та ІОС як мережевого суб'єкта навчального процесу. Виявлено педагогічні умови ефективного функціонування інформаційного освітнього середовища як мережевого суб'єкта навчального процесу. А саме: наявність чітко структурованої системи ІОС як мережевого суб'єкта навчальної взаємодії; цілеспрямована підготовка здобувачів освіти до вільного оперування інформаційно-комунікаційними засобами навчання; вдосконалення ІК-компетентності науково-педагогічних працівників щодо впровадження методів навчання, які базуються на сучасних інформаційно-комп'ютерних технологіях.

Розроблено та експериментально підтверджено ефективність запропонованої методичної системи вдосконалення ІТ-компетентності науково-педагогічних працівників ЗВО. Домінуючими при її конструюванні є такі підходи: холістичний, компетентнісно-футурологічний, андрагогічний та нарративно-цифровий. Системотвірним чинником є ідея моделювання контенту на основі поєднання ключових компетентностей ХХІ століття «4 С» (критичне мислення, креативність, колаборативність, комунікативність) з цифровою компетентністю та вміннями прогнозування можливостей розвитку певного освітнього середовища у майбутньому. Засвоєння матеріалу науково-методичного семінару на тему «Використання діяльнісних компонентів та онлайн-комунікацій системи Moodle» розглядається як елемент неформальної освіти викладачів. Розроблено критеріальний апарат визначення ефективності її впровадження (реалізація третьої умови): суб'єктивні та об'єктивні критерії та показники. Зазначено, що для визначення якості змістового контенту доцільно використовувати критерій «дидактичної якості».

**Ключові слова:** заклади вищої освіти; інформаційне освітнє середовище; педагогічні умови; ІТ-компетентність; методична система.

