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THE MODEL OF PROFESSIONAL DEVELOPMENT OF NATURAL SCIENCE TEACHERS OF RURAL SCHOOLS IN THE CONDITIONS OF DISTANCE EDUCATIONAL PROCESS

Abstract. The article substantiates the concept and the need to introduce a model of professional development of natural sciences teachers in rural schools in the context of distance educational process in the conditions of digitalization of the domestic school education system, the risks associated with the pandemic, determining its impact on the educational process in rural schools in today's realities. The article reveals the pedagogical conditions of professional development of natural science teachers of rural schools in the conditions of distance educational process. The structural-functional model of this study is developed and experimentally checked, which contains three interconnected blocks.

The methodological-target block reflects: purpose; concepts; methodological approaches; general pedagogical principles; specific principles.

The content-technological block contains pedagogical conditions of professional development of natural science teachers of rural schools in the conditions of distance educational process (online coordination of the process of professional development of natural science teachers of rural schools in the conditions of remote work of centres of professional development of pedagogical workers based on technology "DDI" (disclosure, development and implementation); intensification of activity of the centres of professional development of pedagogical workers on the basis of pedagogical technologies of resource-oriented training of natural science teachers of rural schools and network cooperation; introduction of the author's special course "Digitalization of the educational process" as an open learning environment for the continuous development of natural science teachers of rural schools), as well as forms and methods of teaching pedagogues and their professional development.

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The diagnostic-effective block reflects certain criteria (*cognitive-digital*, *activity-effective* and *personal-evaluative*); low (reproductive), medium (reproductive-creative), high (productive-creative) levels of professional development of natural science teachers in rural schools in the conditions of distance educational process and the expected result from the implementation of the structural-functional model.
The results of the study allowed to state the positive, statistically significant dynamics of professional development of natural science teachers of rural schools in the conditions of distance educational process in the experimental group.

Keywords: professional development; rural schools; distance learning; structural-functional model; pedagogical conditions; digitalization.

1. INTRODUCTION

The problem statement. Modern rural school is multivariable, mostly few in number, which requires a special approach to its operation, creating appropriate conditions for quality education, upbringing and development of students, especially in the conditions of distance learning. The urgency of the problem of creating optimal starting conditions for the full development of the personality of rural school students orients the educational system to solve an important socio-economic and socio-political problem: ensuring sustainable development of rural school as a social institution that provides basic general secondary education and is a factor of stability, social, economic and cultural development of the state. On the other hand, the challenges of the time associated with the pandemic have led educators to pay special attention to improving the quality of distance learning in rural schools and, consequently, to shaping their ability to create and develop a digital educational environment in rural school. Currently in Ukraine, rural schools are in a difficult situation of restructuring and modernization, due to the following facts: school closure due to understaffing; loss of school its socio-cultural significance; reducing the quality of rural education; limited acquisition of social experience by students. In addition, rural education cannot compete with urban education for many reasons, including: insufficient logistical and educational support for rural schools; low knowledge quality of rural school graduates and their competitiveness in the market of educational services; low qualification and professional competence of teachers in the context of the implementation of quality distance learning process. The challenges of the time associated with the pandemic direct educators to pay special attention to improving the quality of distance learning in rural schools and, consequently, to developing their ability to create and develop a digital educational environment in rural school. Therefore, there is a question of rethinking and improving the process of developing the professional competence of natural science teachers working at rural schools, its pedagogical basis in accordance with today's conditions.

Analysis of recent research and publications. In recent decades, domestic and foreign pedagogy has established an understanding of new opportunities for distance education. Scientists emphasize that information and communication technologies become the basis for designing and modelling a new development environment and learning space, which are called "information space", "information environment", "information-learning environment", "information-educational environment", "digital educational environment". Various scholars in their works call the information-educational environment (or digital educational environment) as:

- integrated environment of information-educational resources (electronic libraries, educational systems and programs) of hardware-software and telecommunication tools, rules of their support, administration and use, providing unified technological

means of information, information support and organization of educational process, scientific researches, professional consulting [1];

- open system that combines intellectual, cultural, program-methodological, organizational and technical resources; a system that combines information, technical, educational and methodological support, inextricably linked with the subject of the educational process [2];
- system-organized set of means of data transmission, information resources, interaction protocols, hardware-software and organizational-methodical support, focused on meeting the educational needs of users[3].

Researchers Yu. Bohachkov, V. Bykov, O. Pinchuk, A. Manako, O. Volnevych, V. Tsarenko, P. Ukhan, I. Mushkause use the concept "E-learning environment" − a kind of learning environment, which is a purposefully built simulation-forming, educational-cognitive, organizational-technological and information-communication space, which provides the necessary and sufficient conditions for effective achievement of the goals of e-pedagogical systems[4].

During the scientific research it was found out that among the scientific publications of recent years there are those devoted to the organization of distance learning and the creation of digital educational environment: organization of the educational process using distance learning technologies in 2020/2021 academic year [5], [6], [7], [8]; experience of Kyiv educators in organizing distance learning [9];emergency distance learning in Ukraine [10] professional growth of pedagogues in the context of digital education and their motivation to master digital technologies[11],[12]etc. and others. On the websites of regional institutes of postgraduate pedagogical education, we can find a significant number of methodological recommendations on how to create a digital educational environment for the organization of distance learning.

At the same time, the problem of professional development of natural science teachers of rural schools in the conditions of distance educational process has not received a holistic and systematic coverage.

The purpose of the article. The purpose of the article is to develop and experimentally test the effectiveness of the model of professional development of natural sciences teachers in rural schools in the context of distance educational process.

2. RESEARCH METHODOLOGY

The study is based on clarifying the defining characteristics of professional development of natural science teachers of rural schools. Previously, a structural-logical analysis of the essence of professional development of natural science teachers was held. The method of modelling is used to form a holistic view of professional development of natural science teachers in rural schools in the distance educational process.

To confirm the reliability of the obtained results Pearson's criterion χ^2 was used.

The idea of the article belongs to O. Topuzov: he formulated the goal, clarified the task and determined the conceptual provisions of the structural-functional model of professional development of natural science teachers of rural schools in the conditions of distance educational process. M. Grynova defined pedagogical conditions of professional development of natural science teachers of rural schools in the conditions of distance educational process. A. Barbinova presented a diagnostic-effective block of the model of professional development of natural science teachers of rural schools in the conditions of distance educational process, as well as a generalization of the results of statistical testing. O. Kharchenko described and carried out the pedagogical experiment of the implementation of model of development of natural science teachers of rural schools in the conditions of distance educational process.

N. Kononets developed and implemented an author's special course "Digitalization of the educational process".

3. RESULTS OF THE RESEARCH

The relevance, complexity and multidimensional nature of the problem of our study necessitate the modelling of professional development of natural science teachers of rural schools in the conditions of distance educational process as one of the most optimal ways to solve it.

The model considers that in the specific conditions of a rural school a natural science teacher can teach students physics, geography, chemistry, computer science and mathematics, and sometimes even subjects of humanities or physical culture, and the teacher has to use different forms of work: individual, collective, group, etc. Thus, the model orients the construction of the trajectory of professional development of natural sciences teachers in rural schools in the context of distance educational process, taking into account the multifaceted professional activity of teachers

Structural-functional model of professional development of natural science teachers of rural schools in the conditions of distance educational process should reflect the training of pedagogues in the system of its relations with the social and information environment and imitate the behaviour of a particular system [13].

Determining the conceptual provisions of the structural-functional model of professional development of natural science teachers of rural schools in the conditions of distance educational process, we considered the following *methodological principles*:

- *the concept of the development of continuing pedagogical education of Ukraine*, which aims to implement the basic principles of continuing pedagogical education (continuity; combination of national educational traditions and best world experience; flexibility in responding to social changes and predictability; innovation) and to improve the content of this education and the organization of the educational process in order to develop the professional competence of each teacher;
- *the concept of continuing education* as an education, unlimited in time, space, forms and methods of teaching, which combines all the activities and resources of the education sector; as a promising way to solve the problem of professional development of natural science teachers of rural schools in the conditions of distance educational process; focus on lifelong learning;
- *the concept of a virtual online community of natural science teachers*, which necessitates the development and use of a distance course to provide means of Internet services open discussions, participation in public discussions, interactive group communication [14];
- *the concept of resource-basedlearning (RBL)*, which necessitates the use of pedagogical technologies *RBL*, of nature science teachers in the conditions of distance educational process: web-quest technology, educational project, Web2.0, mindmapping, cloud technologies and kaizen technology;
- *competency approach* as the focus of the educational process on achieving results, which are the professional development of natural science teachers in rural schools in the conditions of distance educational process, as well as on the formation of skills to operate such technologies and knowledge that meet the needs of modern digital society;
- *acmeological approach* or the pedagogy of success, that ensures the priority of practice-oriented forms of organizing the training of nature science teachers,

designed to develop professionalism as a basic category of acmeology; accumulates a set of methods, forms, means of organizing their educational activities, focused on the development of their professional competence, a high level of productivity and professional maturity, meeting the needs of creative growth;

- *activity approach*, that allows to consider the process of professional development of natural science teachers of rural schools in the conditions of distance educational process as the maximum stimulation of teacher self-education, the mechanism of transfering teachers to the position of the subject of cognition, activity and communication, which ensures the effectiveness of this process;
- *synergetic approach* in natural education contributes to a fuller implementation of the basic didactic conditions of the educational process organization, taking into account its basic principles (scientific, systematic, the connection of theory with practice, etc.) and the integration of knowledge from different natural sciences (the development of multifunctional competence of nature science teachers, who work at rural schools), strengthening interdisciplinary links, for a deeper understanding of the unity of the nature laws, society, and hence the development of professional competence of teachers; determines the development and application in the process of training teachers ideas about the openness of the world, the integrity and relationships of human, nature and society;
- *personality-oriented approach* as the highest form of humanization of the educational process makes it possible to take into account the subjective experience of natural science teachers of rural schools, the working practice of professional development centres for pedagogical workers and to create comfortable conditions for pedagogues' self-education, to provide construction of an individual trajectory of professional development of each teacher, the development of his personal potential, to promote formation of individual author's style of the teacher in the conditions of distance educational process [15];
- *technological approach* is based on mastering by the natural science teacher of rural schools of variable technologies, digital technologies and their use in educational process for the purpose of achievement of a high level of development of the professional competence which considerably depends on its digital component;
- *system approach* indicates the structure and multicomponent of professional competence of natural science teachers of rural schools; contributes to a holistic view of the problem of professional development of natural science teachers of rural schools in the conditions of distance educational process and allows us to consider it, firstly, as a step towards continuing education, and secondly – to ensure unity, integrity and functionality of all components of the structural-functional model [16].

On the basis of results of psychological-pedagogical researchesas well as taking into account the best practices of distance learning [17], [18], [19] and practical experience of work of the centres of professional development of pedagogical workers, pedagogical conditions of professional development of natural science teachers of rural schools in the conditions of distance educational process are defined and theoretically substantiated.

The first pedagogical condition is online coordination of the process of professional development of natural science teachers of rural schools in the conditions of remote work of centers of professional development of pedagogical workers on the basis of "DDI" technology (disclosure, development, implementation)– is considered as a process of managed, purposeful partnership of centers of professional development of pedagogical workers with the regional institute of postgraduate pedagogical education, which includes a system of measures to ensure orderliness, continuity, coherence in space and time and

combining actions of centres of professional development of teachers in scientific-methodological activities aimed at achieving a common goal.

The technology "DDI" is understood as the gradient of the professional competence development of natural science teachers of rural schools in the conditions of centres of professional development of pedagogical workers, which depends on the implementation of three conditions: *the disclosure* of personal potential of teachers, their *development* and *implementation* for successful organization of distance educational process in rural school, as well as for the good of society and themselves [13]. It is substantiated that the technology "DDI" is implemented in the following stages: adaptive, activity-active, didactic-methodical, dissemination.

The second pedagogical condition is the intensification of the activity of the centres of professional development of pedagogical workers on the basis of pedagogical technologies of resource-oriented training of natural science teachers of rural schools and network cooperation. It was found that the activation of remote activity of centres of professional development of pedagogical workers is based on the concept of innovation activity, which is the result of the interaction of various factors: the environment where the creativity of teachers is encouraged; presence of like-minded teachers - first of all, creative personalities; the presence of incentives - from material to moral-psychological. The key role in the process of intensification of the activity of the centres of professional development of pedagogical workers belongs to the system of motivation and stimulation of teachers' creativity. The basis of creativity of the natural science teacher as productive pedagogical activity is the maximum stimulation of his self-education which is carried out in 4 levels: diagnostic-prognostic, realization, approbation, final.

In pedagogical technologies of *resource-oriented training* we include web-quest technology, educational project, Web2.0,Web3.0, Web4.0, mindmapping, cloud technologies and kaizen technology.

Resource-oriented training of natural science teachers of rural schools in the conditions of distance educational process should be considered as a holistic dynamic process of organizing and stimulating teachers' self-education, mastering the skills of active transformation of information-educational environment in order to develop their professional competence and lifelong learning orientation.

Network cooperation of centres of professional development of pedagogical workers, rural schools and various educational institutions is interpreted as a communication system provided by modern Internet services that allows to develop, test and offer the professional pedagogical community innovative models of education content, management of the education system and promotes the dissemination of pedagogical experience of natural science teachers. The main characteristics of network cooperation of centers of professional development of pedagogical workers are determined: independence of network members; plurality of leaders in the network; unifying goal; voluntary connections; multiple levels of interaction.

The third pedagogical condition is the introduction of the author's special course "Digitalization of the educational process" as an open learning environment for the continuing development of natural science teachers of rural schools. The author's special course "Digitalization of the educational process" is designed for a flexible, mobile system of training biology teachers, geographically distant from each other, based on the use of modern pedagogical and information-communication technologies that provide effective interaction "listener-advisor".

It was revealed that under the condition of the focus on distance learning of natural science teachers within the limits of a special course, the constant development of their professional competence is possible, as the author's special course is taught to the pedagogues

on the basis of the Moodle platform. This provides the author's specialized course with the status of an open learning environment for the continuing development of teachers.

The distance course, implementing the concept of a virtual educational community, solves the problem in the process of developing the professional competence of natural science teachers of rural schools on such aspects:

- *theoretical-practical*: theoretical study and practical application of modern digital educational technologies by natural science teachers of rural schools; development of skills in working with e-mail, Google services, video communication tools for classes, online chat communication; conducting thematic virtual consultations, etc;
- *methodical*: methodical support and professional development of natural science teachers of rural schools in the conditions of distance educational process due to wide use of digital technologies;
- *dissemination*: exchange of information, work experience, dissemination of successful distance pedagogical practices; possibility of communication of natural science teachers of rural schools, advisers of a special course for the purpose of discussion of various pedagogical problems, actual questions of school natural education in the conditions of quarantine;
- *globalization*: as a result, the creation of a single digital educational environment for professional development, accessible to every member of the community.

In order to provide a holistic view of the professional development process of natural science teachers of rural schools in the conditions of distance educational process a structural-functional model is developed, it reflects the features of its structure, the relationship between three blocks: *methodological-target*, *content-technological* and *diagnostic-effective* (Fig.1).

As it can be seen from this figure, ***the methodological and target block*** reflects: purpose; concepts; methodological approaches (competence, acmeological, activity, synergetic, personality-oriented, technological, systemic); general pedagogical principles (universality, information approach, practical orientation, individualization, humanization, mobility); specific principles (dissemination, analytical-diagnostic, participatory, variability).

The content-technological block contains pedagogical conditions as one of the important components of the structural-functional model, reflecting the set of internal (providing personal development of natural science teachers of rural schools) and external (promoting the realization of procedural aspect of the model) elements that ensure its effective functioning and further development.

This block contains the author's special course "Digitalization of the educational process" (distance course is created and implemented on the Moodle platform), as well as forms and methods of training pedagogues and their professional development: Internet self-education, Interactive workshop, «Information Day», virtual round tables, video lectures, webinars, virtual excursions, binary classes, web-quests, creative projects in natural sciences to develop electronic educational resources, online meetings with pedagogues and scientists, participation of students in online conferences, etc.

We emphasize that each of the defined pedagogical conditions logically determines the functioning of others, without which it can not be realized; they exist within a holistic structural-functional model and ensure the successful professional development of natural science teachers of rural schools in the conditions of distance educational process.

The diagnostic-effective block reflects certain criteria (*cognitive-digital, activity-effective* and *personal-evaluative*); low (reproductive), medium (reproductive-creative), high (productive-creative) levels of professional development of natural science teachers in rural schools in the conditions of distance educational process and the expected result from the implementation of the structural-functional model.

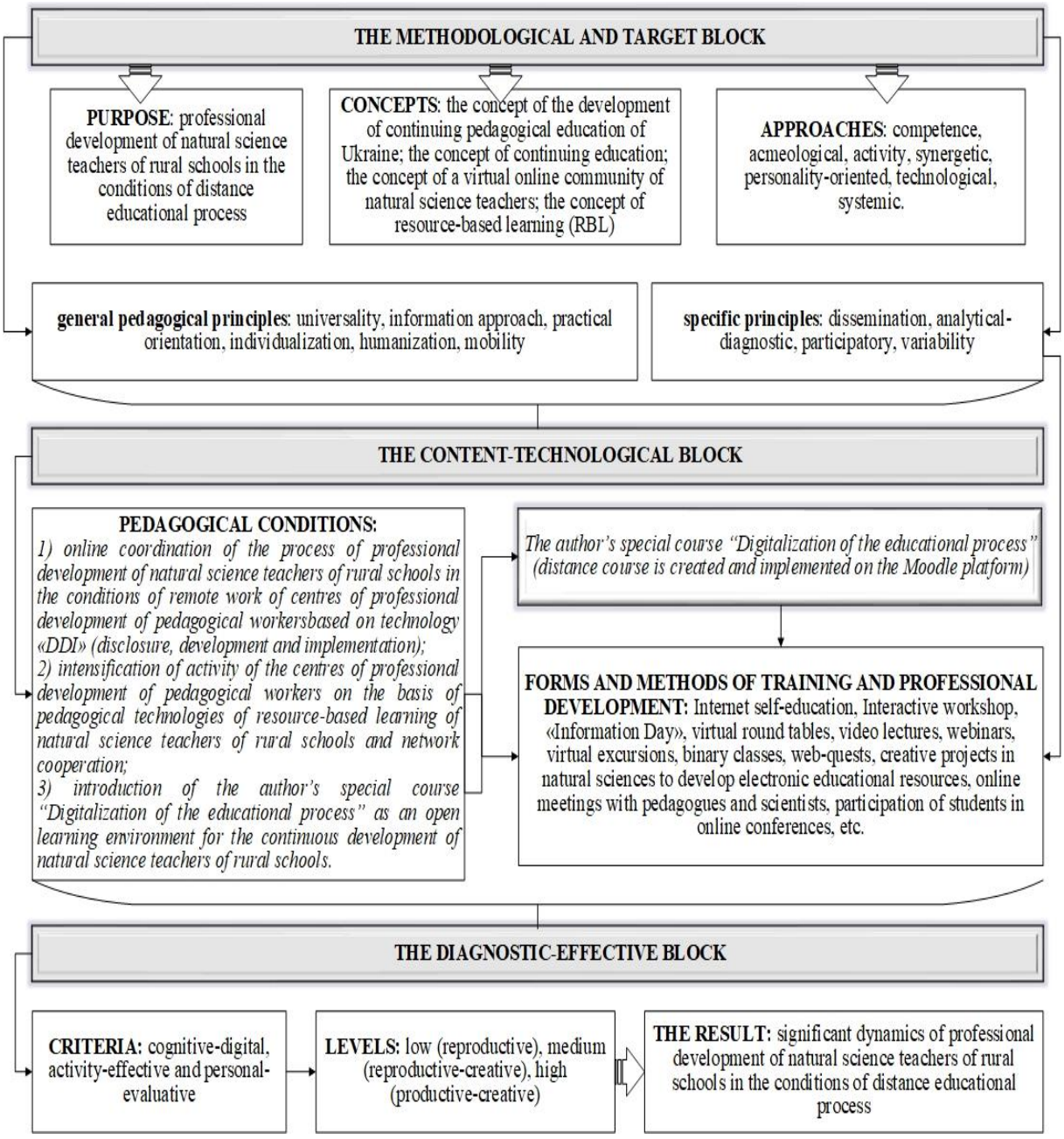

Fig.1. Structural-functional model of professional development of natural science teachers of rural schools in the conditions of distance educational process

Thus, for the evaluation of the levels of professional development of natural science teachers of rural schools in the conditions of distance educational process the criteria *cognitive-digital*, *activity-effective* and *personal-evaluative* are defined.

The cognitive-digital criterion demonstrates the system of knowledge that must be possessed by a natural science teacher of rural schools in order to better carry out the distance educational process, engage in self-education and self-improvement of own pedagogical activities in the conditions of digitalization of educational space by implementing individual trajectory of teacher development, transition to a more perfect state of pedagogical productivity. The system of knowledge of a biology teacher provides psycho-pedagogical knowledge of the peculiarities of psycho-physiological development of rural students,

knowledge of the theoretical foundations of natural sciences, mastery of methods of organizing experimental and research work of students [20].

Activity-effective criterion characterizes the ability of a natural science teacher to use the system of knowledge that he has in practice at rural school; ability to engage in self-education and self-improvement of their own pedagogical activities; ability to take an active part in the work of centres of professional development of pedagogical workers and other educational institutions online, evaluate and analyse its results. Indicators of this criterion are the ability to organize lessons of natural sciences at a high methodological level, mastery of modern pedagogical technologies for organizing lessons of the natural cycle, the ability to implement STEM-technologies in lessons of the natural cycle, integrate interdisciplinary links, etc.

Personal-evaluative criterion reflects the natural science teacher's presence of professionally important personal qualities, general and business, which affect the result of pedagogical activity at a rural school and in the process of work in the centre of professional development of pedagogical workers; characterized by the ability to self-diagnose their own pedagogical activities.

According to the selected criteria and indicators, three levels of professional development of natural science teachers of rural schools in the conditions of distance educational process are defined: low (reproductive), medium (reproductive-creative), high (productive-creative).

In our research, the low (reproductive) level of professional development of teachers of natural sciences in rural schools in the distance educational process is characterized as follows: a teacher has a basic set of knowledge (knowledge of modern techniques, forms, methods, tools and digital technologies for effective didactic, methodological, diagnostic and prognostic, educational, scientific, organizational activities of a teacher) and skills, they use them in the educational process, including in the distance format, but they do not seek (cannot and do not want to) acquire new knowledge, do not engage in self-education and self-improvement of their own pedagogical activities by implementing the individual trajectory of professional development of a teacher; poorly formed professionally important personal qualities (general and business) and they have a weak manifestation in work; pedagogical activity of a teacher is characterized by passivity, spontaneity, traditionalism, disorganization; they do not take part in the activities planned by the centers of professional development of pedagogical workers.

Medium (reproductive-creative) level of professional development of teachers of natural sciences in rural schools in the distance educational process: a teacher of natural sciences has a basic set of knowledge and skills and they use them in the educational process of rural schools, including in the distance format, but they do not strive or they are not able to acquire new knowledge; they are sometimes engaged in self-education; self-improvement of own pedagogical activity by realization of an individual trajectory of professional development is not dominant in work of a teacher, and it carries situational display of the creative approach to pedagogical activity; the capacity and ability to correct their behavior in teaching are underdeveloped; pedagogical activity of a teacher of natural sciences is characterized to a greater extent by tradition and situational use of pedagogical innovations; a teacher is aware of the importance of their pedagogical activity, but they do not see the need to constantly take an active part in the activities planned by the centers of professional development of pedagogical workers, they sometimes participate in the activities planned by the centers of professional development of pedagogical workers.

High (productive-creative) level of professional development of teachers of natural sciences in rural schools in the distance educational process: a teacher has the basic set of knowledge and skills and they use them in educational process of rural school, they aspire, they are able to get new knowledge; they show steady creative activity in the development of

methodological knowledge and their application in practice, including in the distance format; they are constantly engaged in self-education, self-improvement of own pedagogical activity by realization of an individual trajectory of professional development of a teacher (they know, want, are able to and aspire to develop the professional competence); they always participate actively in the activities planned by the centers of professional development of pedagogical workers, and they can act as their initiator.

The experimental research procedure was based on the use of the following methods: questionnaires on "Education in the online space", "Digital challenges of education", testing "Theoretical aspect of the use of information and communication technologies (ICT) in education" (author's questionnaires and tests developed by M. Grynova for our research), conversations on "Modern requirements for the teaching profession", "Organization and conduct of educational classes online", pedagogical observation, qualimetric models, online seminar "Digital competence of the teacher", interactive workshop "Creation of electronic educational resources", computer modeling and statistical methods.

The pedagogical experiment on the implementation of the model of professional development of natural science teachers of rural schools in the conditions of distance educational process lasted from April 2020 to March 2021, as the challenges of time forced teachers to carry out the educational process online. The beginning of the experiment was characterized by the unwillingness of teachers to distance learning, therefore, there was an urgent need to ensure that teachers acquire a system of knowledge and skills to organize qualitative distance learning of students in rural schools, as well as to create conditions for professional development of natural science teachers of rural schools in the conditions of distance educational process.

A total of 225 natural science teachers of Poltava region took part in the pedagogical experiment (teachers who, first of all, teach physics, chemistry, biology, astronomy, integrated course “Natural Sciences” at rural schools). From them the Control Group (CG) of 110 teachers, and Experimental Group (EG) of 115 teachers, were formed.

Within the framework of the experiment, certain pedagogical conditions were introduced for the EG of natural science teachers:

1) online coordination of the process of professional development of natural science teachers of rural schools in the conditions of remote work of the centres of professional development of pedagogical workers on the basis of “DDI” technology (disclosure, development, implementation);

2) intensification of the activity of centres of professional development of pedagogical workers on the basis of pedagogical technologies of resource - based learning of natural science teachers of rural schools and network cooperation;

3) introduction of the author’s special course “Digitalization of the educational process” as an open learning environment for the continuing development of natural science teachers of rural schools (author of the experimental course N. Kononets).

Diagnosis of the levels of professional development of natural science teachers of rural schools in the conditions of distance educational process at the beginning of the experiment (April, 2020) recorded the results (in%), which are presented in Table 1:

Table 1

Level of professional development of natural science teachers of rural schools in the conditions of distance educational process before the experiment

Criterion	Cognitive-digital criterion		Activity-effective criterion		Personal-evaluative criterion	
Groups	CG	EG	CG	EG	CG	EG
Low	40,91	41,74	32,73	28,70	23,64	25,22
Medium	48,18	48,70	53,64	56,52	56,36	54,78
High	10,91	9,57	13,64	14,78	20,00	20,00
	100	**100**	**100**	**100**	**100**	**100**

Diagnosis of the levels of professional development of natural science teachers of rural schools in the conditions of distance educational process after the experiment (March, 2021) recorded the results (in %), which are presented in Table 2:

Table 2

Level of professional development of natural science teachers of rural schools in the conditions of distance educational process after the experiment

Criterion	Cognitive-digital criterion		Activity-effective criterion		Personal-evaluative criterion	
Groups	CG	EG	CG	Groups	CG	EG
Low	31,82	13,04	25,45	9,57	14,55	9,57
Medium	44,55	35,65	48,18	33,91	57,27	51,30
High	23,64	51,30	26,36	56,52	28,18	39,13
	100	**100**	**100**	**100**	**100**	**100**

A comparative analysis of the dynamics of the levels of professional development of natural science teachers of rural schools in the conditions of distance educational process testified that after the experiment there were positive changes:

according to the cognitive-digital criterion, the high (productive-creative) level in the CG of teachers increased by 12,73%, and in EG – by 41,74%; the medium (reproductive-creative) level in CG decreased by 3,64%, in EG – by 13,04%; the low (reproductive) level in CG decreased by 9,09%, and in EG – by 28,70%;

according to the activity-effective criterion,the high (productive-creative)level in the CG of teachers increased by 12,73%, and in EG – by 41,74%; the medium (reproductive-creative) level in CG decreased by 5,45%, in EG – by 22,61%; the low (reproductive) level in CG decreased by 7,27%, and in EG – by 19,13%;

according to the personal-evaluative criterion, the high (productive-creative) level in the CG of teachers increased by 8,18%, and in EG – by 19,13%; the medium (reproductive-creative) level in CG increased by 0,91%, in EG – decreased by 3,48%; the low (reproductive) level in CG decreased by 9,09%, and in EG – by15,65% (Figure2).

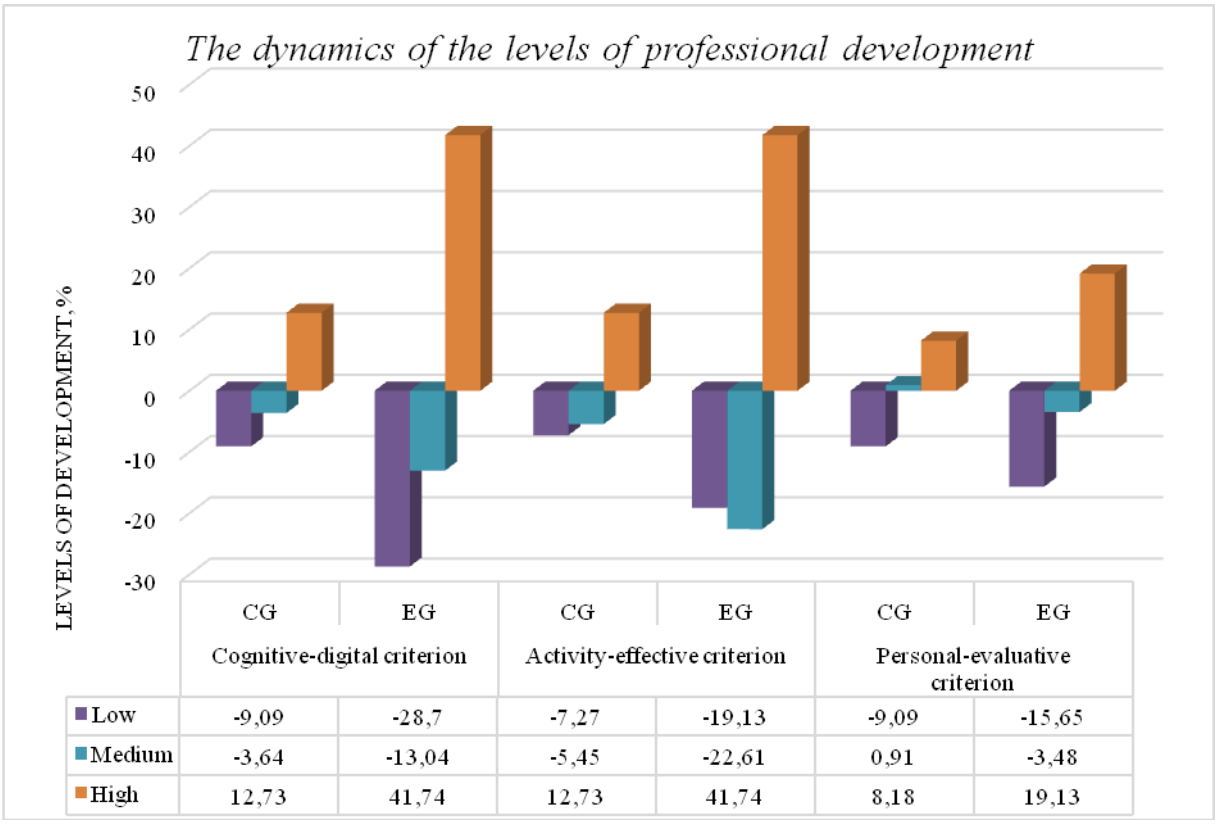

Fig. 2. The dynamics of the levels of professional development of natural science teachers of rural schools in the conditions of distance educational process

The probability of the results of experimental work is confirmed by Pearson's criterion($\chi 2$). Zero and alternative hypotheses were formulated to test the identified differences in the levels of professional development of natural sciences teachers of rural schools in the conditions of distance educational process of control and experimental groups of teachers.

Thus, according to the hypothesis H_0, the levels of professional development of natural sciences teachers of rural schools in the conditions of distance educational process of CG and EG are not fundamentally different. According to the hypothesis H_1, the levels of professional development of natural sciences teachers of rural schools in the conditions of distance educational process of CG and EG are not fundamentally differ from each other.

The results of statistical verification for comparative analysis are shown in Table 3.

Table 3

Statistical verification of the results of the pedagogical experiment

Before the experiment		
Samples of CG and EG	Valueχ^2_{emp}	χ^2_{crit}
Cognitive-digital criterion	0,11	<7,81
Activity-effective criterion	0,43	
Personal-evaluative criterion	0,08	
After the experiment		
Samples of CG and EG	Valueχ^2_{emp}	χ^2_{crit}
Cognitive-digital criterion	21,42	>7,81
Activity-effective criterion	23,23	
Personal-evaluative criterion	13,52	

4. CONCLUSIONS AND FURTHER RESEARCH PROSPECTS

A structural-functional model consisting of three blocks is proposed (*methodological-target, content-technological* and *diagnostic-effective*),it canbeconsidered as a basis of original strategy of professional development of natural science teachers of rural schools in the conditions of distance educational process. At the same time, its effectiveness has been proven experimentally. Within the limits of experiment for EG of natural science teachers certain pedagogical conditions were introduced (online coordination of process of professional development of natural science teachers of rural schools in the conditions of the remote work of the centres of professional development of pedagogical workers on the basis of "DDI" technology); intensification of activity of the centres of professional development of pedagogical workers on the basis of pedagogical technologies of resource-basedlearningof natural science teachers of rural schools and network cooperation; introduction of the author's special course "Digitalization of the educational process" as an open learning environment for the continuous development of natural science teachers of rural schools), which confirm its effectiveness.The probability of the results of experimental work is confirmed by Pearson's criterion($\chi 2$).

According to the results of the experimental test, after the experiment there were positive changes: according to the cognitive-digital criterion, the high (productive-creative) level in the CG of teachers increased by 12.73%, and in EG – by 41.74%; according to the activity-performance criterion, the high (productive-creative) level in the CG of teachers increased by 12.73%, and in EG – by 41.74%; according to the personal-evaluation criterion, the high (productive-creative) level in the CG of teachers increased by 8.18%. The probability of the results of the experimental work was confirmed by Pearson's test ($\chi 2$).

We see prospects for further research in expanding the range of pedagogical conditions for professional development of natural sciences teachers in rural schools in the context of distance learning process, considering educational reforms.

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МОДЕЛЬ ПРОФЕСІЙНОГО РОЗВИТКУ ВЧИТЕЛІВ ПРИРОДНИЧИХ НАУК СІЛЬСЬКИХ ШКІЛ В УМОВАХ ДИСТАНЦІЙНОГО ОСВІТНЬОГО ПРОЦЕСУ

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Анотація. У статті обґрунтовано поняття та необхідність упровадження моделі професійного розвитку вчителів природничих наук сільських шкіл в умовах дистанційного освітнього процесу за умов цифровізації вітчизняної системи шкільної освіти, ризиків, пов'язаних з пандемією, визначення її впливу на освітній процес у сільських школах у реаліях сьогодення. У статті розкрито педагогічні умови професійного розвитку вчителів природничих наук сільських шкіл в умовах дистанційного освітнього процесу. Розроблено та експериментально перевірено структурно-функціональну модель професійного розвитку вчителів природничих наук сільських шкіл в умовах дистанційного освітнього процесу, яка містить три взаємопов'язані блоки: *методологічно-цільовий, змістово-технологічний* та *результативний*.

Методологічно-цільовий блок відображає мету; концепції; методологічні підходи; загальнопедагогічні принципи; специфічні принципи.

Змістово-технологічний блок містить педагогічні умови професійного розвитку вчителів природничих наук сільських шкіл в умовах дистанційного освітнього процесу (онлайн координація процесу професійного розвитку вчителів природничих наук сільських шкіл в умовах дистанційної роботи центрів професійного розвитку педагогічних працівників на основі технології «3Р» (розкриття, розвиток, реалізація);активізація діяльності центрів професійного розвитку педагогічних працівників на основі педагогічних технологій ресурсно орієнтованого навчання вчителів природничих наук сільських шкіл та мережевого співробітництва; впровадження авторського спецкурсу «Цифровізація освітнього процесу» як відкритого навчального середовища для неперервного розвитку вчителів природничих наук сільських шкіл, а також форми і методи навчання педагогів та їх професійного розвитку.

Діагностико-результативний блок відображає визначені критерії (*когнітивно-цифровий, діяльнісно-результативний* та *особистісно-оцінювальний*); низький (репродуктивний), середній (репродуктивно-творчий), високий (продуктивно-творчий) рівні професійного розвитку вчителів природничих наук сільських шкіл в умовах дистанційного освітнього процесу та очікуваний результат від реалізації структурно-функціональної моделі.

Результати проведеного дослідження дали змогу констатувати позитивну, статистично значущу динаміку професійного розвитку вчителів природничих наук сільських шкіл в умовах дистанційного освітнього процесу в ЕГ.

Ключові слова: професійний розвиток; сільські школи; дистанційне навчання; структурно-функціональна модель; педагогічні умови; цифровізація.

МОДЕЛЬ ПРОФЕССИОНАЛЬНОГО РАЗВИТИЯ УЧИТЕЛЕЙ ЕСТЕСТВЕННЫХ НАУК СЕЛЬСЬКИХ ШКОЛ В УСЛОВИЯХ ДИСТАНЦИОННОГО ОБРАЗОВАТЕЛЬНОГО ПРОЦЕССА

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Аннотация. В статье обосновано понятие и необходимость внедрения модели профессионального развития учителей естественных наук сельских школ в условиях дистанционного образовательного процесса в условиях цифровизации отечественной системы школьного образования, рисков, связанных с пандемией, определение ее влияния на образовательный процесс в сельских школах в реалиях сегодняшнего дня.

В статье раскрыты педагогические условия профессионального развития учителей естественных наук сельских школ в условиях дистанционного образовательного процесса. Разработана и экспериментально проверена структурно-функциональная модель профессионального развития учителей естественных наук сельских школ в условиях дистанционного образовательного процесса, которая содержит три взаимосвязанных блока.

Методологически-целевой блок отражает цель; концепции; методологические подходы; общепедагогические принципы, специфические принципы.

Содержательно-технологический блок содержит педагогические условия профессионального развития учителей естественных наук сельских школ в условиях дистанционного образовательного процесса (онлайн-координация процесса профессионального развития учителей естественных наук сельских школ в условиях дистанционной работы центров профессионального развития педагогических работников на основе технологии «3Р» (раскрытие, развитие, реализация); активизация деятельности центров профессионального развития педагогических работников на основе педагогических технологий ресурсно-ориентированного обучения учителей естественных наук сельских школ и сетевого сотрудничества; внедрение авторского спецкурса «Цифровизация образовательного процесса» как открытой учебной среды для непрерывного развития учителей естественных наук сельских школ, а также формы и методы обучения педагогов и их профессионального развития/

Диагностико-результативный блок отражает определенные критерии (когнитивно-цифровой, деятельно-результативный и личностно-оценочный); низкий (репродуктивный), средний (репродуктивно-творческий), высокий (продуктивно-творческий) уровни профессионального развития учителей естественных наук сельских школ в условиях дистанционного образовательного процесса и ожидаемый результат от реализации структурно-функциональной модели.

Результаты проведенного исследования позволили констатировать положительную, статистически значимую динамику профессионального развития учителей естественных наук сельских школ в условиях дистанционного образовательного процесса в ЭГ.

Ключевые слова: профессиональное развитие; сельские школы; дистанционное обучение; структурно-функциональная модель; педагогические условия; цифровизация.

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