PERIÓDICO TCHÊ QUÍMICA
ARTIGO ORIGINAL

# DESENVOLVIMENTO SUSTENTÁVEL DE INSTITUIÇÕES EDUCACIONAIS NO CONTEXTO DA INTRODUÇÃO DE ELEMENTOS DA EDUCAÇÃO À DISTÂNCIA NO PROCESSO DE APRENDIZAGEM

# SUSTAINABLE DEVELOPMENT OF EDUCATIONAL INSTITUTIONS IN THE CONTEXT OF THE INTRODUCTION OF ELEMENTS OF DISTANCE EDUCATION IN THE LEARNING PROCESS

# УСТОЙЧИВОЕ РАЗВИТИЕ ОБРАЗОВАТЕЛЬНОГО УЧРЕЖДЕНИЯ В УСЛОВИЯХ ВНЕДРЕНИЯ ЭЛЕМЕНТОВ ДИСТАНЦИОННОГО ОБРАЗОВАНИЯ В ПРОЦЕСС ОБУЧЕНИЯ

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## RESUMO

A educação a distância é essencialmente a base para o desenvolvimento de instituições educacionais que fornecem serviços inovadores que não podem ser obtidos em outros lugares. Acredita-se que a educação a distância substitua a educação tradicional como parte da simplificação e barateamento do processo educativo. Ao mesmo tempo, as principais tendências mundiais indicam a necessidade do desenvolvimento de elementos de autoeducação e a expansão da natureza geográfica das propostas educacionais. A relevância do estudo reside no fato de ser necessário distinguir entre o uso de métodos de educação a distância na esfera tradicional e no campo da formação de profissionais. O artigo apresenta o conceito de necessidade de integrar os elementos da educação a distância no processo de formação de professores universitários. Os autores acreditam que os professores usam as mesmas técnicas na elaboração de cursos e na aplicação de tecnologias de treinamento que no ensino a distância. Portanto, o uso de tecnologias de educação a distância pode ser mostrado como base para o desenvolvimento de programas de educação continuada e educação profissional adicional. Os autores propuseram um estudo sobre a necessidade e suficiência do uso de tecnologias de educação a distância e as possibilidades de sua integração no processo de pós-graduação. A importância prática do estudo é determinada pelo fato de que são reveladas as possibilidades de desenvolvimento independente de professores não apenas como sujeitos do processo educacional, mas também como sujeitos de treinamento.

**Palavras-chave**: Educação a distância, professor, estrutura, desenvolvimento, treinamento.

## ABSTRACT

Distance education is essentially the basis for the development of educational institutions that provide innovative services, which cannot be obtained elsewhere. It is believed that distance education is a substitute for the traditional as part of simplifying and cheapening the learning process. At the same time, the leading global trends suggest the need for the development of elements of self-education and the expansion of the geographical nature of educational offers. The relevance of the study is that it is necessary to distinguish between the use of distance education methods in the traditional sphere and the sphere of training professionals. The paper presents the concept of the need to integrate elements of distance education in the process of preparing university teachers. The authors believe that teachers in drawing up courses and applying learning technologies use the same techniques as in distance learning. Therefore, the use of distance learning technologies can be shown as the basis for the development of advanced training programs and additional professional education. The authors proposed a study on the need and sufficiency of the use of distance education technologies and the possibilities for their integration into the process of postgraduate education. The practical significance of the work is determined by the fact that the possibilities of self-development of teachers





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are fully disclosed, not only as subjects of the educational process but also as subjects of training.

**Keywords**: Distance education, teacher, structure, development, training.

## АННОТАЦИЯ

Дистанционное образование по своей сути является основой для развития учебных заведений, которые оказывают инновационные услуги, которые не могут быть получены в других местах. Считается, что дистанционное образование является заменой традиционному как части упрощения и удешевления процесса обучения. При этом ведущие мировые тенденции говорят о необходимости развития элементов самообразования и расширении географического характера образовательных предложений. Актуальность исследования заключается в том, что требуется разграничить использование методики дистанционного образования в традиционной сфере и сфере подготовки профессионалов. В работе представлена концепция о необходимости интеграции элементов дистанционного образования в процесс подготовки преподавателей вузов. Авторы полагают, что преподаватели при составлении курсов и применении технологий обучения используют такие же приемы, как и при обучении в дистанционной сфере. Поэтому применение дистанционных образовательных технологий может быть показано как основа для развития программ повышения квалификации и дополнительного профессионального образования. Авторами предложено исследование о необходимости и достаточности применения технологий дистанционного образования и возможностей по их интеграции в процесс последипломного образования. Практическая значимость работы определяется тем, что полностью раскрыты возможности самостоятельного развития преподавателей не только как субъектов учебного процесса, но также и как субъектов обучения.

**Ключевые слова:** Дистанционное образование, преподаватель, структура, развитие, обучение.

## 1. INTRODUCTION

Among the trends in the development of distance education in pedagogical theory and practice, the leading ones are the following: deepening the connection with the modernisation of pedagogical education on a modern scientific basis; design and implementation for lifelong learning and education of population; usage as a means of ensuring a quick response to the results of globalisation and other global processes; improving the quality of teaching and methodological support of the organisation of distance education (Holmberg, 1989; Akhmetshin *et al.,* 2019; Aleksandrova *et al.,* 2018; Aleksandrova *et al.,* 2019).

The system requirements for the teacher in the conditions of distance education are: an innovative orientation of his/her personality and readiness for innovations in the professional and pedagogical being; readiness for interpersonal dialogue with an organiser and subjects of the educational distance process; comprehensive competence in matters of psychology and pedagogy of professional self-education and self-education, personality psychology and the theory and technology of distance education; the ability to expand and deepen the experience of creative self-developing activities. (Huett *et al.,* 2008)

The set of these requirements is directly related to the teacher's readiness category for distance education in the system of continuing education, the structure of which is defined as an integral personality property reflecting the holistic interaction of motivational and value (increasing awareness of the need to master the theory and technology of distance education by means of self-education at the self-value level), cognitive (formation of personally assigned knowledge of modern information technology training, the basics of its organisation in higher education, ways of professional activity based on information and communication technologies for the purposes of professional development and self-development) and operational (a set of actions and operations related to the use of distance education technologies in professional activities) components (Booker, 1998).

Often they reveal the main features of the organization of distance education in the system of continuing education of teachers, with an emphasis from teaching to the independent cognitive activity of teachers; increased demand for the formation of teachers' readiness for distance education (ensuring their compulsory computer literacy as subjects of the educational process); changes in the ways of interaction between the subjects of the educational process, due to the advent of appropriate means of distance education technologies; flexibility of organizational forms and methods in accordance with the levels of actual readiness of teachers for distance education, time and place of conducting

classes (Guri-Rozenblit, 1993). The fact of the absence of the systemic nature of the distance education of a teacher as a result of the unreasonableness of the corresponding system in the scientific and pedagogical theory (Fraser, 2017) is updated.

## 2. LITERATURE REVIEW

Defining the conceptual positions of the distance education model in the system of continuing education of teachers, we took into account the following methodological principles (Branon and Essex, 2001):

– a systematic approach that focuses on disclosing the integrity of pedagogical objects, identifying various types of communication in them and bringing them into a single theoretical picture (Wen *et al.,* 2019). In accordance with this approach, teachers in distance education in the system of continuous education explore as an integral system, ordered by a plurality of interrelated components, which is a holistic formation (Rabinovich *et al.,* 2017);

– the concept of enhancing the cognitive activity, aimed at obtaining new knowledge, new information, which is implemented in order to obtain new knowledge and consciously use them in practice (Guri-Rosenblit, 2005). Cognitive activity is manifested in the teacher's attitude to the content and process of activity, in the mobilization of volitional efforts to achieve learning objectives (Hermansson, 1988). That is, cognitive activity is associated with an interest in the learning process, a need for expanding one's own horizons, the intensification of cognitive activity is characterized not only by the features of the activity itself but also by the attitude of students to the activity process (Montoya and Soledad, 2013);

– personality-oriented approach, which is based on the leading ideas of the humanization of education, provides a broad view of the content of education of humanities students, ways of learning activities, the expected result; allows a teacher to perceive a student as a communicative person, to identify and reveal their own capabilities, their ego (Berge and Muilenburg, 2001). Its essential features are the subject-subject humane cooperation of all participants in the educational process; diagnostic and stimulation method of knowledge; activity-communicative activity of students, their development and self-development; designing by a teacher (and later by students) individual achievements in all types of activities, their sensitive developments; consideration of the range of personal needs and capabilities of a person in obtaining quality education in the content and methods (Walker and Fraser, 2005);

– modular approach: modular technology is based on maximum programmability, structural clarity in the organization of the pedagogical process (Hoppers, 2000). Learning objectives take into account the capabilities of students (teachers), and at each stage of education, they determine the basic level of knowledge and skills (Tabata and Johnsrud, 2008). Based on autonomous portions of adapted educational content to the intellectual characteristics of each, this approach allows to more independently or fully independently work with the proposed individual program (McVey, 2018). The learning process based on the modular approach allows to: differentiate and integrate the learning content by grouping educational modules that provide the development of the discipline's content is reduced, full or in-depth versions and corresponding structured content aimed at mastering knowledge and skills, solving specific learning tasks (Stella and Gnanam, 2004). There is a reorientation of focuses in the educational process, that is, the process of directed learning, and not the teaching process, becomes the main thing.

## 3. MATERIALS AND METHODS

A pedagogical experiment involved studying the state of distance learning in the continuing education system (Rovai and Lucking, 2003). Based on its results, theoretical principles, which naturally complement the theory and methodology of vocational education, have been formulated (Kerimbayev *et al.,* 2017). In the process of conducting a stating experiment, a number of tasks have been implemented:

– subjects of diagnosis have been highlighted;

– criteria, tools, methods, and levels of diagnosis have been substantiated;

– the current state of readiness of teachers for the organization of distance education in the system of continuing education has been determined;

– the state of development of professional and pedagogical competence has been determined;

– a cross-section, analysis, and interpretation of its data have been conducted;

– a training system in the continuing education system has been developed.

The pedagogical experiment provided for the introduction of the distance education system in continuing education in the educational process of educational institutions.

The statistical results of the surveys have been summed up taking into account the number of questions, the maximum possible number of points received for answering the question, and the sum of points in accordance with the level of formedness of the readiness criterion. The result summarised in the table helped to determine indicators of the levels of formedness of the relevant criteria for the readiness of teachers to organize distance education in the system of continuing education. The points for each readiness criterion were added and the achieved level was calculated by the formula (Equation 1). Wherein $P$ – the level of readiness to distance education, $\sum n$ – total sum of points of a respondent, $\sum m$ – maximum sum of points.

Having qualimetric indicators on the methods of diagnostics of the identified levels of readiness (motivational and value, cognitive and operational) of teachers to organisation of distance education in the system of continuing education, we correlated the amounts of points received into the relevant component of competence with the total number of points earned and converted to percentages. Then we compared the results to identify the components which will require more attention. Statistical analysis of the results was carried out using Microsoft Excel spreadsheets.

The general level of teachers' readiness for the organization of distance education in the system of continuing education of teachers was calculated as the arithmetic mean of all the criteria according to the formula (Equation 2). Wherein Σ – initial level of preparedness; a – number of participants at the appropriate level of readiness criteria, n – the number of readiness criteria (motivational and value, cognitive and operational).

In order to assess the effectiveness of approbation of the methodological system, the experiment toolkit was conducted to determine levels of teachers for organizing distance education in the system of continuing education of teachers after the experiment was determined (Lee, 2003). Having obtained as a result of the final cross-section of the data on shifts in the levels of formedness of the main criteria of readiness among teachers, we estimated the significance of these changes and made conclusions regarding the effectiveness of the introduction of the corresponding system.

## 4. RESULTS AND DISCUSSION:

At the beginning of the experiment, testing was carried out according to the adapted method. This method allowed to show changes in the motivational and value criteria of readiness for distance education. As a result of this survey, we obtained such data (Figure 1), namely: 90% of respondents chose No. 1 – to be a highly qualified specialist, No. 3 – to successfully continue their educational activities, No. 4 – to successfully carry out scientific activities and No.10 – to ensure success of professional activity; 75% chose No. 6 – to master new professional knowledge; 33% chose No. 7 – to be constantly ready for innovation, No. 2 – to receive a certificate, No. 8 – not to skip classes of the training cycle, and No. 12 – to achieve respect among colleagues.

The following motives were not chosen: No. 5 – to receive a cash bonus; № 9 – to keep up with colleagues; No. 11 – to # meet pedagogical requirements; No. 13 – to be an example for colleagues; No. 15 – to avoid conviction and administrative penalties; No. 16 – to get intellectual satisfaction.

Comparison of the data showed that the majority of teachers increased the number of cognitive motives – to be a highly qualified specialist and get a certificate (by 5%), to successfully continue their educational activities (by 55%), to successfully carry out research activities (by 17%), to ensure the success of their professional activities (by 55%). This indicates the effectiveness of the introduction of a system of continuing education for teachers.

After statistical processing of the results of the experiment according to the levels of formation of the criteria of teachers' readiness to organize distance education in the system of continuing education of teachers, we were convinced of significant achievements. This is evidenced by the combined experimental data of Table 1. The results of the formative stage of the experiment on the motivational and value criterion showed that 4.2% of teachers lack a steady cognitive interest in organizing distance education in the system of continuing education of teachers, these teachers do not understand the advantages that distance learning technologies provide them in comparison with

traditional teaching methods.

In the process of observation, the interest of teachers in the development of their own distance courses, the use of cloud services was detected, but when designing an e-learning course, some teachers needed help and did not strive for self-improvement. Also, they were not trying to master modern distance education opportunities in the organization of their professional activities. However, the number of teachers with a sufficient level of readiness (by 60.5% compared with the ascertaining stage) and high (by 16.6%) increased significantly. The dynamics of the development of motivational and value criterion of teachers' readiness at the formative stage has significantly increased in comparison with the ascertaining one. The graphic interpretation of the results before and after the experiment is shown in Figure 2.

The study of the level of teachers' readiness for tutoring activities according to the level of formedness of operational criteria showed an increase in the number of respondents with sufficient and high levels. This is evidenced by the data in Table 1. Observations demonstrated that teachers, after the introduction of the developed methodological system, not only have improved their skills to use various forms and methods of organizing distance education in universities, but also have learned how to work in the information-educational environment and the system of continuing education of teachers. Thus, the best teachers have coped with the development of e-learning courses for teachers, which, in our opinion, is due to the activation of their intrinsic motivation, and therefore there are no low and average points, there are a small number of points above the average, the overwhelming number is high.

Data analysis showed that the number of teachers with a sufficient level of readiness (by 56.2% compared with the ascertaining stage) and high (20.8%) increased significantly. The histogram presented in fig. 4 reflects the dynamics of teachers' readiness to organize distance education in the system of continuing education of teachers according to the levels of formation of the operational criterion before and after the experiment.

So, the results of the pedagogical experiment showed that in terms of the motivational and value indicator of readiness almost all teachers changed their attitude towards the problem of distance education in the system of continuing education of teachers in a positive way. In accordance with the cognitive indicator of readiness, teachers have developed a steady knowledge of the theory of distance education, the use and development of distance education technologies in working with teachers. According to the operational indicator of readiness, the necessary skills for developing and implementing distance education technologies have been formed for the respective functional competence.

The data in Table 1 and Figures 2, 3 show the advantage of a high and sufficient level of teachers' readiness to organize distance education in the system of continuing education of teachers according to all defined criteria, which confirms the effectiveness of the developed methodological system. The general level of teachers' readiness for the organization of distance education in the system of continuing education of teachers was calculated as the arithmetic mean of all the criteria according to the formula (Equation 2). Wherein Σ – the initial level of preparedness; a – number of participants at the appropriate level of readiness criteria, n – the number of readiness criteria (motivational and value, cognitive and operational).

The final state of formedness of teachers' readiness for tutoring activities was determined. The generalized results of the experiment are summarised in Table 2, and the graphical interpretation is shown in Figure 4.

The effectiveness of teacher training for tutoring activity is indicated by the efficiency coefficient, which was calculated using the formula (Equation 3). Wherein Rafter – medium, sufficient and high indicator of preparedness of teachers to tutoring activity after the experiment (in %); Before – medium, sufficient and high indicator of preparedness of teachers to tutoring activity before the experiment (in %).

The effectiveness of the developed methodological system can be discussed in the case when K > 1.

In our study, K = 95.8 / 37.5≈58.38 (motivation and value criterion of readiness);

K = 97.9 / 37.5≈60.4 (cognitive);

K = 97.9 / 41.7≈56.2 (operational);

K = 97.9 / 39.6≈58.3 (total level of readiness).

The final stage of the experiment showed that the majority of teachers have risen to the highest level of readiness for tutoring activities. According to the results of the statistical processing of the questionnaires of participants in

the experiment, a significant increase in the parameters of all indicators of the levels that were measured was stated. The data testifies to the effectiveness of the developed methodical system of training teachers for the organization of distance education in the system of continuous education.

For the final statistical confirmation of the effectiveness of the experiment, it is necessary to compare the experimental data before and after the experiment, therefore, to calculate the Pearson criterion. The empirical value of the motivational and value criterion is 58.62, of the cognitive one is 61.05, of the operational one, is 59.37, and the general level of readiness is 59.68, which exceeds the critical value $\chi crit^2$ = 7.81 for the degree of freedom v = 3 and α = 0,05. Disagreements between ascertaining and forming stages of the experiment can be considered reliable. So, the effectiveness of the developed teaching and methodical subsystem, with the help of which it is possible to form motivational and value, cognitive and operational components of teachers' readiness for organizing distance education in the system of continuous education, is statistically confirmed.

The experimental subsystem of the professional and pedagogical improvement of organizers of distance education has confirmed its effectiveness and suggests the continuation of work on improving the professional competence of modern teachers of pedagogical universities and disseminating the experience we have gained. In order to assess the effectiveness of the above-mentioned system, a toolkit of the ascertaining stage of the experiment was used to verify the efficient changes in the levels of formation of motivational and value, cognitive and operational criteria of readiness for the implementation of distance education in the system of continuing education.

As a result of this survey, we received the following data (Figure 5): 87% of respondents chose No. 1 – to be a highly qualified specialist, No. 3 – to successfully continue their educational activities and No. 4 – to successfully carry out scientific activities; 78% chose No. 6 – to acquire new professional knowledge, and No. 10 – to ensure the success of their professional activities; 45% chose No. 7 – to be constantly ready for innovation, and number 8 – not to skip classes of the training cycle; 38% chose No. 2 – to get a certificate, No. 13 – to be an example for colleagues, and No. 16 – to get intellectual satisfaction.

The following motives were not chosen: No. 5 – to receive a cash bonus; № 9 – to keep up with colleagues; No. 11 – to meet pedagogical requirements; No. 12 – to achieve respect among colleagues; No. 15 – to avoid conviction and administrative penalties. Comparison of data with the ascertaining stage of the experiment showed that the majority of teachers increased the number of cognitive motives – to be highly qualified specialist (by 17%), to successfully continue their educational activities (by 24%), to successfully carry out scientific activities (by 100%), to master new professional knowledge (by 35%), to ensure the success of professional activity (by 23%). This indicates the effectiveness of the implementation of a distance education system in continuing education.

After statistical processing of the results of the formative stage of the experiment according to the levels of formation of the criteria of teachers' readiness for the introduction of distance education in the system of continuous education, we were convinced of significant achievements. The results of this work are reflected in Table 3.

Data analysis (Figure 6) on the motivational and value criterion of readiness shows (average value) that 27.1% of the respondents of the experimental groups lack a steady cognitive interest in distance education in the system of continuing education. These teachers do not understand the advantages provided by technology distance education compared to traditional teaching methods.

Also, they are not trying to master modern distance education opportunities in the organization of their professional activities. In the process of observation, we recorded the interest of teachers in the use of distance learning courses, cloud technologies, but in designing an individual plan they need the help of a teacher and do not strive for self-improvement. We recorded no need to use elements of distance education in the educational process of the university. However, the number of teachers with an average level of readiness (by 23.9%) and sufficient (6.6%) increased significantly. In our opinion, this is the influence of irreversible processes in the computerization of society and education as well. Experts understand the advantages of distance education, but in solving professional problems, they partially apply traditional methods.

In our opinion, the next indicator of the effectiveness of experimental work is positive

changes regarding the levels of teachers' readiness for distance education in the system of continuing education by levels of the formedness of cognitive criteria. As in the study of the motivational and value criterion of teachers' readiness for distance education in the system of continuous education, significant dynamics in the cognitive criterion of experimental groups in comparison with the ascertaining stage is observed.

Analysis of the data from Table 3 shows that after the introduction of the appropriate methodology, 32.5% (average value) of the respondents in the experimental groups experienced a low level of cognitive criterion formedness. These teachers have almost no knowledge of the use of existing distance learning software, webinar software, cloud technology capabilities, and the capabilities of remote education hardware. Teachers do not know the features of online services in the organization of distance education in the system of continuing education. However, the number of respondents with a high level of readiness (by 2.4%), sufficient (by 4.7%) and medium (by 24.0%) increased significantly. This indicates that teachers have in-depth knowledge of hardware, software, and methodological support in organizing distance education, their integration to develop their own information resources, personal cloud environment, as well as knowledge of the theoretical foundations of the use of distance education and its organization.

The statistical data of the input and output controls on the cognitive criterion convincingly proved that the subsystem introduced by us is rather efficient. The quantitative results of the study in the experimental and control groups are presented in Figure 7.

The study of the level of teachers' readiness for distance education in the system of continuing education by the levels of formedness of the operational criterion showed an increase in the number of respondents with medium, sufficient and high levels. This is evidenced by the data in Table 3. Thus, the respondents of the experimental groups, after the introduction of the relevant system, not only improved their skills and abilities to use various distance education technologies but also learned how to work in the information-educational environment and in the system of continuing education of teachers.

Data analysis showed that the number of respondents with a high level of readiness (by 4.0%), sufficient (by 10.1%) and medium (by 14.2%) increased significantly. However, on average low is 20.5%. Observations showed that the teachers coped with the individual plan best of all as regards the creation of a personal blog and an electronic portfolio, which, in our opinion, is due to the activation of their intrinsic motivation; the overwhelming amount is high. This indicates the presence of experience of teachers with the site of the system of continuous education.

The histogram presented in Figure 8, reflects the dynamics of teachers' readiness for distance education in the system of continuous education by the levels of formedness of the operational criterion.

So, the results of the pedagogical experiment showed that in terms of the motivational and value indicator of readiness almost all teachers changed their attitude towards the problem of distance education at the university and in the system of continuing education.

Accordingly, according to the cognitive readiness indicator, teachers have developed a steady knowledge of the theory of distance education, the use of distance education technologies in high school and in the system of continuous education. According to the operational readiness indicator, the necessary skills and skills of distance education technologies in the university and in the system of continuing education are formed for the respective functional competence.

The data in Table 3 and Figures 8-10 show the advantage of a sufficient and average level of teachers' readiness for distance education in the system of continuing education on all defined criteria that confirm the effectiveness of the implementation of the proposed educational and methodical system. The general level of teachers' readiness for distance education in the system of continuous education was calculated as the arithmetic mean of all criteria using (Equation 1). The final state of the preparedness of teachers for distance education in the system of continuous education was determined. The generalized results of the experiment are summarized in Table 4, and the graphical interpretation is shown in Figure 9.

The effectiveness of the methodological system of training teachers for distance education in the system of continuous education determines the efficiency ratio, which was calculated by the formula (Equation 4). Wherein $R_{EG}$ is the medium, sufficient and high readiness of the

respondents of the experimental groups (in%, it was calculated as the arithmetic average);

$R_{KG}$ is an average, sufficient, and high readiness indicator of respondents of control groups (in %, it was calculated as an arithmetic average).

It is possible to speak about the effectiveness of a methodical system in the case when K> 1.

In our study, K = 70.9/38.3≈32.6 (motivational and value criterion of readiness);

K = 67.4 / 36.3≈31.1 (cognitive);

K = 79.4 / 50.1≈29.3 (operational);

K = 73.2 / 41.6≈31.6 (total readiness level).

The data testifies to the effectiveness of the methodological system developed by us for preparing teachers for distance education in the system of continuous education.

Similar diagnostic methods were used to identify the readiness status of respondents in control groups. Analysis of the state of readiness of teachers for distance education in the system of continuous education by the levels of formation of the criteria is given in Table 5.

In the control groups during the experiment, there were positive changes in the aspects of enhancing the readiness of teachers for distance education and increasing their psychological-pedagogical competence. These changes should be explained by the activity of a small number of members of control groups in self-education and non-formal education. Moreover, in some higher educational institutions and institutes of advanced education, it already corresponds to the course for computerization and advanced training of teachers, although the corresponding process has not yet gained an appropriate character, and it significantly activates specific teachers and practitioners who have increased their readiness for distance education.

For the final statistical confirmation of the effectiveness of the experiment, it is necessary to compare the data of the ascertaining stage with the formative stages of the experiment by calculating the Pearson criterion for motivational and value, cognitive, operational criteria and the general level of readiness. The empirical value of the EG1 criterion is 69.30, respectively; 61.63; 54.53; 60.14; EG 2 – 84.91; 58.21; 72.80; 68.75; EG 3 – 80.64; 68.57; 84.54; 73.96. Discrepancies between experimental and control groups can be considered significant. This exceeds the critical value $\chi 2kr = 7.81$ for the degree of freedom $v = 3$ and $\alpha = 0.05$.

So, the pedagogical experiment showed the effectiveness of the developed system of distance education for teachers. The final stage of the experiment showed that the majority of teachers have risen to the highest level of readiness for distance education in the system of continuous education. According to the results of the statistical processing of questionnaires of participants in the experiment, a significant increase in the parameters of all indicators of measurable levels was found. The effectiveness of the introduction of the developed system of distance education in the continuing education of teachers in the development of professional and pedagogical competence was checked taking into account the comparative method of scientific research, the essence of which is to compare the results of the ascertaining stage with what is forming during experimental work. The total number of respondents remained unchanged.

At the formative stage of the experiment, similar methods were used to diagnose the development of the professional and pedagogical competence of teachers, which were used at the ascertaining stage. The same diagnostic evaluation parameters and levels are used. Having qualimetric indicators on the methods of diagnostics of the identified levels of development of professional and pedagogical competence of teachers with diagnostic units, we correlated the amounts of points received into the appropriate component of competence with the total number of points earned and converted to percentages that were calculated using formula (Equation 4). Then we compared the results to identify the components which will require more attention. Statistical analysis of the results was carried out using Microsoft Excel spreadsheets.

The data in Table 6 indicate an increase in the level of development of the professional and pedagogical competence of teachers in the formative stage of the pedagogical experiment. The most effective was the level of development of the professional and pedagogical competence of teachers of experimental groups, where the system of distance education was fully implemented in the continuing education of teachers.

To build a histogram, the indicators of professional and pedagogical competence of teachers at each stage of the study from table 1-6 were chosen. According to the results, histograms 11-13 could be constructed. So, the dynamics of the development of levels of

professional and pedagogical competence of teachers in accordance with the blocks is clearly seen.

Analysis of the data (Figure 10) demonstrates that after the introduction of the corresponding model of a teacher, the experimental groups almost do not have a low level of theoretical and methodological training (on average, 5.6%). However, the number of teachers with a sufficient level (by 5.0%) and high (by 3.9%) increased.

Such results indicate that the respondents of the experimental groups better mastered the theoretical and methodological knowledge, which are stable and complex. In addition, sufficient and medium levels of theoretical and methodological training demonstrate that teachers are capable of consciously transforming professional and theoretical knowledge in accordance with their specialty; systematically exhibit targeted independent cognitive activity, which, in turn, expands the pedagogical potential of specialists, predetermines an active search for ways to learn new things, comprehension of new information, its theoretical interpretation.

The statistical data of input and output testing on theoretical and methodological blocks have convincingly proved that the introduced system of distance education in the continuing education of teachers is quite effective. We consider positive changes in the levels of development of professional and pedagogical competence of teachers in psychological and pedagogical blocks as another indicator of the effectiveness of experimental work. As in the study of the theoretical and methodological block of professional and pedagogical competence of teachers, significant dynamics in the psychological and pedagogical training of respondents in experimental groups is observed: a high level increased by 5.0% on average; sufficient by 3.0%. However, the low level is almost absent – 5.4% (Figure 11).

The data in table 6 and figures 10, 11 show the advantage of a sufficient and medium level of development of professional and pedagogical competence of teachers in all defined blocks, which confirms the effectiveness of the introduction of the developed distance education system in the continuing education of teachers. Such results make it possible to state that EG respondents are much better able to practically direct and effectively adapt their knowledge and skills in solving specific psychological and pedagogical problems based on comparison, analysis, synthesis, generalization, systematization, and forecasting. The increase in the manifestations of psychological and pedagogical training in the EG indicates positive changes in the development of professional and pedagogical competence of teachers, their ability to transform professional and life experience at a level higher than reproductive.

The general level of development of professional and pedagogical competence of teachers was calculated as the arithmetic average of all diagnostic blocks according to Equation 3. The final state of professional and pedagogical competence in the experimental groups was determined. The generalized experimental results are summarised in Table 7, and a graphical interpretation of the results of the forming experiment is presented in Figure 12.

The effectiveness of the distance education system in the continuing education of teachers is evidenced by the efficiency coefficient, which was calculated by Equation 4. Wherein $R_{EG}$ is a sufficient and high level of development of professional and pedagogical competence of teachers after the experiment (in %); $R_{KG}$ – a sufficient and high level of development of professional and pedagogical competence of teachers before the experiment (in %).

It is possible to speak about the effectiveness of the developed system in the case when $K > 1$.

In our study, K = 94.3 / 83.7≈10.6 (theoretical and methodological preparation);

K = 94.6 / 85.6≈9.0 (psychological and pedagogical);

K = 94.7 / 84.9≈9.8 (general level of professional and pedagogical competence).

The data indicate the effectiveness of the distance education system that we developed in the continuing education of teachers in experimental groups.

For final statistical confirmation of the effectiveness of the experiment, it is necessary to compare the experimental data of the ascertaining stage with the formative by calculating the Pearson criterion from the data for the theoretical, methodological, psychological and pedagogical blocks and the general level of development of the professional and pedagogical competence of teachers. The empirical value of the EG 1 criterion is 19.25, respectively; 12.07; 16.11; EG 2 – 17.58; 18.78; 18.93; EG 3 – 18.84; 18.39; 19.47.

Discrepancies between experimental and control groups can be considered significant. This exceeds the critical value $\chi^2 kr = 7.81$ for the degree of freedom $v = 3$ and $\alpha = 0.05$.

## 5. CONCLUSIONS:

So, the pedagogical experiment showed the effectiveness of the developed distance education system in the continuing education of teachers. The experiment demonstrated that most teachers increased the level of professional and pedagogical competence.

The essential characteristics of the basic definitions of scientific research determined by the analysis of philosophical, psychological, pedagogical and methodological literature, indicate that the appeal to distance learning is a reaction of scientists to the needs of society in the training of specialists capable of learning throughout their lives, ready to work in conditions of fierce competition in an informationally colored educational space.

Distance learning in the system of lifelong education is an interdisciplinary pedagogical category that characterizes the degree of individualization, intensity and controllability subordinated to the goals of professional development of teachers' independent cognitive activity by means of information and communication technologies via indirect interaction (synchronous and asynchronous) with participants of the educational process remote from each other under the guidance of a tutor. The leading essential characteristics of distance learning are: its basic competence in the use of information and communication technologies for their own professional development and overall development; individualized independent nature of the process of increasing the level of readiness for the organization of personality-oriented distance learning; indirect interaction (diverse communication links) of distance learning organisers with participants in the educational process using electronic means.

The research concept corresponds to the specifics of the problem of the effectiveness of the theoretical and methodological support of distance learning, which requires an optimal combination of systemic, competent, personal and active, and technological methodological approaches to its solution, the choice of a modelling method as the leading tactical means of searching for patterns, principles, content and operating conditions of a particular system. Its technological component has provided the basis of scientific research on the search for distance learning technology, professional components that contributed to the creative nature of this process and increasing of the level of professional and pedagogical competence of teachers to the planned level, and in general – the functioning of the developed system at the required level of quality.

The distance education model in the system of continuing education is such an ideal object that makes it possible to identify the relations within a subject of modeling, display them graphically, focus on solving basic problems, and logically predict distance learning as a systemic formation. The designed corresponding model is an integrated set of interconnected blocks of components: methodological (main approaches: competency-based, personal and active, technological); theoretical (principles of the functioning of the distance education system, the content of distance learning, the matrix of communicative relations of its organizers, organizational and pedagogical conditions for the effectiveness of distance learning as a system); educational and methodological support (educational and methodological support of the process of formation of readiness for distance learning, educational and methodological subsystem of professional and pedagogical improvement of distance learning organizers); effective (increasing the level of professional and pedagogical competence as a consequence of the quality functioning of the distance learning system).

The distance learning system meets the needs of an individual in continuing education as a means of professional development throughout life and has such holistic characteristics: the ability to stimulate the process of acquiring a professional-pedagogical and information and communication culture; the presence of two orientation vectors (promoting creative processes in society and the development of a personality of a teacher in educational and professional environments); readiness for self-organization of movement in the general system of higher education as relatively autonomous and multicomponent.

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$$P = \frac{\sum n 100\%}{\sum m} \quad \text{(Eq. 1)}$$

$$\sum = \frac{(a_1 + a_2 + a_3)}{n} \quad \text{(Eq. 2)}$$

$$K = \frac{R_{after}}{R_{before}} \quad \text{(Eq. 3)}$$

$$K = \frac{R_{EG}}{R_{KG}} \quad \text{(Eq. 4)}$$

***Table 1.*** *The state of readiness of teachers for the organization of distance education in the system of continuing education of teachers (final cross-section, in %)*

| Criterion of readiness | Levels | Ascertaining stage | Formative stage |
|---|---|---|---|
| Motivational and value | High | 4.2 | 20.8 |
| | Sufficient | 6.2 | 66.7 |
| | Medium | 27.1 | 8.3 |
| | Low | 62.5 | 4.2 |
| Cognitive | High | 4.2 | 22.9 |
| | Sufficient | 4.1 | 62.5 |
| | Medium | 29.2 | 12.5 |
| | Low | 62.5 | 2.1 |
| Operational | High | 4.2 | 25.0 |
| | Sufficient | 6.3 | 62.5 |
| | Medium | 31.2 | 10.4 |
| | Low | 58.3 | 2.1 |

***Table 2.*** *General characteristics of the levels of teachers' readiness for the organization of distance education in the system of continuing education of teachers (final cross-section, in %)*

| Level of readiness | Ascertaining stage | Formative stage |
|---|---|---|
| High | 4.2 | 22.9 |
| Sufficient | 6.2 | 64.6 |
| Medium | 29.2 | 10.4 |
| Low | 60.4 | 2.1 |

***Table 3.*** *General characteristics of the levels of teachers' readiness for the organization of distance education in the system of continuous education (final cross-section, in %)*

| Criterion of readiness | Levels of readiness | EG 1 | | EG 2 | | EG 3 | |
|---|---|---|---|---|---|---|---|
| | | Ascertaining stage | Formative stage | Ascertaining stage | Formative stage | Ascertaining stage | Formative stage |
| Motivational and value | High | 2.4 | 6.4 | 3.3 | 7.6 | 2.4 | 6.4 |
| | Sufficient | 7.1 | 13.3 | 8.3 | 15.1 | 7.6 | 14.4 |
| | Medium | 28.4 | 50.3 | 26.8 | 51.9 | 28.5 | 53.2 |
| | Low | 62.1 | 30.0 | 61.6 | 25.4 | 61.5 | 26.0 |
| Cognitive | High | 1.2 | 3.6 | 2.3 | 4.1 | 1.6 | 4.5 |
| | Sufficient | 7.1 | 11.0 | 7.0 | 12.0 | 6.3 | 11.5 |
| | Medium | 27.0 | 51.2 | 29.1 | 52.2 | 27.5 | 52.3 |
| | Low | 64.7 | 34.2 | 61.6 | 31.7 | 64.6 | 31.7 |
| Operational | High | 1.2 | 6.1 | 2.3 | 7.6 | 1.6 | 6.5 |
| | Sufficient | 7.1 | 15.2 | 7.0 | 18.6 | 6.9 | 17.6 |
| | Medium | 39.8 | 52.6 | 43.9 | 55.9 | 40.5 | 58.3 |
| | Low | 51.9 | 26.1 | 46.8 | 17.9 | 51.0 | 17.6 |

***Table 4.*** *The general level of teachers' readiness for distance education in the system of continuous education (final slice, in%)*

| Levels of readiness | ER 1 | | ER 2 | | ER 3 | |
|---|---|---|---|---|---|---|
| | Ascertaining stage | Formative stage | Ascertaining stage | Formative stage | Ascertaining stage | Formative stage |
| High | 1.5 | 5.4 | 2.6 | 6.4 | 1.9 | 5.8 |
| Sufficient | 7.1 | 13.1 | 7.6 | 15.2 | 6.9 | 14.5 |
| Medium | 32.0 | 51.4 | 32.8 | 53.4 | 32.4 | 54.6 |
| Low | 59.4 | 30.1 | 57.0 | 25.0 | 58.8 | 25.1 |

***Table 5.*** *The state of readiness of the participants of control groups for distance education in the system of continuous education (final cross-section, in %)*

| Criterion of readiness | Level of readiness | CG 1 | CG 2 | CG 3 |
|---|---|---|---|---|
| Motivational and value | High | 2.8 | 2.6 | 2.6 |
| | Sufficient | 8.5 | 8.9 | 8.7 |
| | Medium | 27.7 | 29.0 | 28.2 |
| | Low | 61.0 | 59.5 | 60.5 |
| Coginitive | High | 2.4 | 2.5 | 1.9 |
| | Sufficient | 7.3 | 7.4 | 6.7 |
| | Medium | 26.2 | 29.1 | 27.3 |
| | Low | 64.1 | 61.0 | 64.1 |
| Operational | High | 1.4 | 2.1 | 1.8 |
| | Sufficient | 7.2 | 7.6 | 6.9 |
| | Medium | 40.2 | 43.5 | 40.1 |
| | Low | 51.2 | 46.8 | 51.2 |

***Table 6.*** *The results of pedagogical diagnostics of the assessment of the levels of development of professional and pedagogical competence of teachers in diagnostic units (final cross-section, in%)*

| The focus of vocational teacher training | Levels | EG 1 | | EG 2 | | | EG 3 |
|---|---|---|---|---|---|---|---|
| | | Ascertaining stage | Formative stage | Ascertaining stage | Formative stage | Ascertaining stage | Formative stage |
| Theoretical and methodological training | High | 14.6 | 18.8 | 13.4 | 17.0 | 12.9 | 16.7 |
| | Sufficient | 42.7 | 47.9 | 44.3 | 49.1 | 44.5 | 49.4 |
| | Medium | 25.9 | 27.3 | 26.4 | 28.3 | 26.5 | 28.5 |
| | Low | 16.8 | 6.0 | 15.9 | 5.6 | 16.1 | 5.4 |
| Psychological and pedagogical training | High | 14.3 | 20.6 | 12.4 | 16.0 | 11.3 | 16.0 |
| | Sufficient | 47.0 | 48.2 | 45.5 | 48.7 | 43.9 | 48.1 |
| | Medium | 27.1 | 26.1 | 26.5 | 29.9 | 29.0 | 30.1 |
| | Low | 11.6 | 5.1 | 15.6 | 5.4 | 15.8 | 5.8 |

***Table 7.*** *The general level of development of professional and pedagogical competence of teachers (total cross-section, %)*

| Levels | EG 1 | | EG 2 | | EG 3 | |
|---|---|---|---|---|---|---|
| | **Ascertaining stage** | **Formative stage** | **Ascertaining stage** | **Formative stage** | **Ascertaining stage** | **Formative stage** |
| High | 14.7 | 20.3 | 12.8 | 16.7 | 12.2 | 16.7 |
| Sufficient | 45.6 | 48.5 | 44.9 | 48.7 | 44.4 | 48.7 |
| Medium | 26.0 | 26.1 | 26.7 | 29.3 | 27.6 | 29.2 |
| Low | 13.7 | 5.1 | 15.6 | 5.3 | 15.8 | 5.4 |

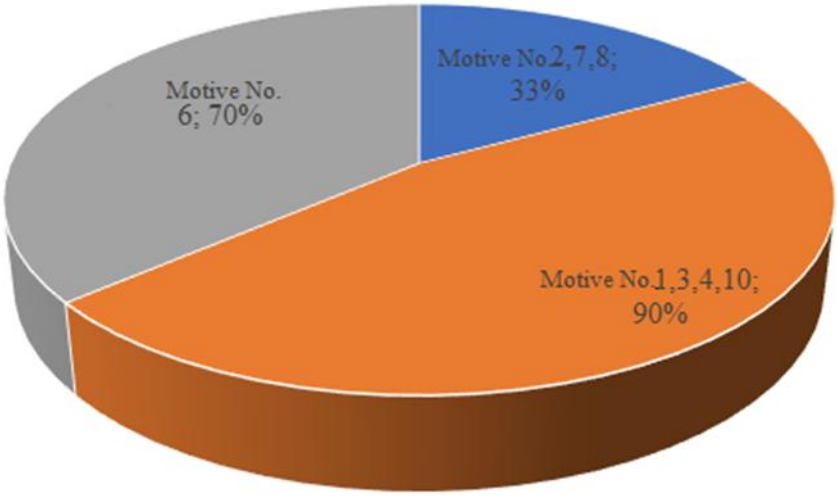


***Figure 1.*** *The result of the final diagnosis of motivational and value criterion of teachers' readiness for distance education in the system of continuing education of teachers*

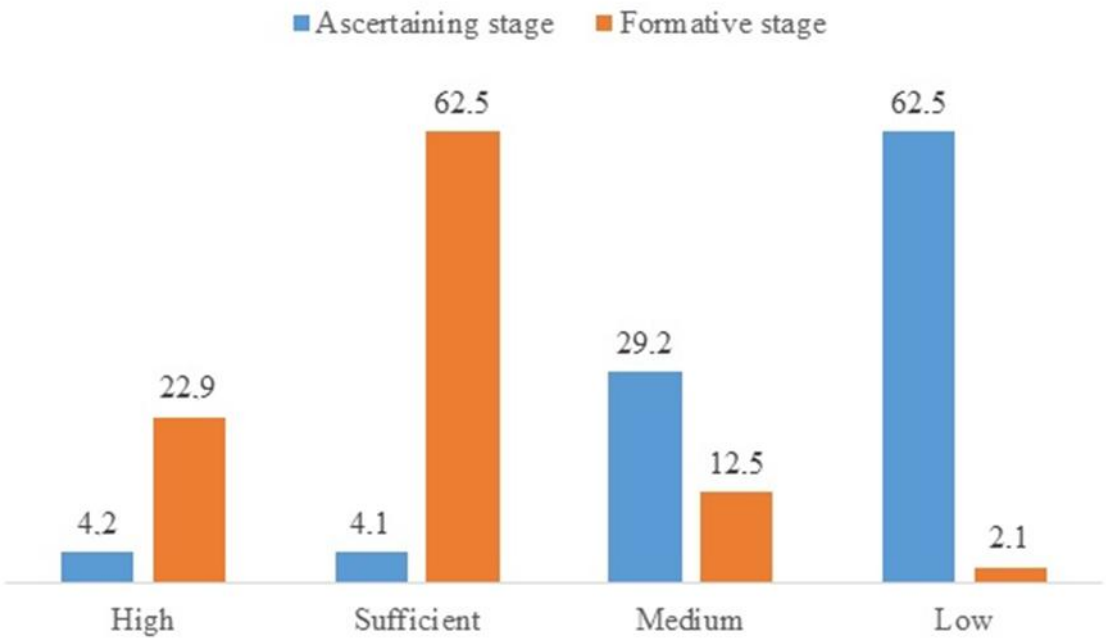


***Figure 2.*** *The state of readiness of teachers for the organization of distance education in the system of continuing education of teachers by levels of formedness of cognitive criteria (final cross-section, in%)*

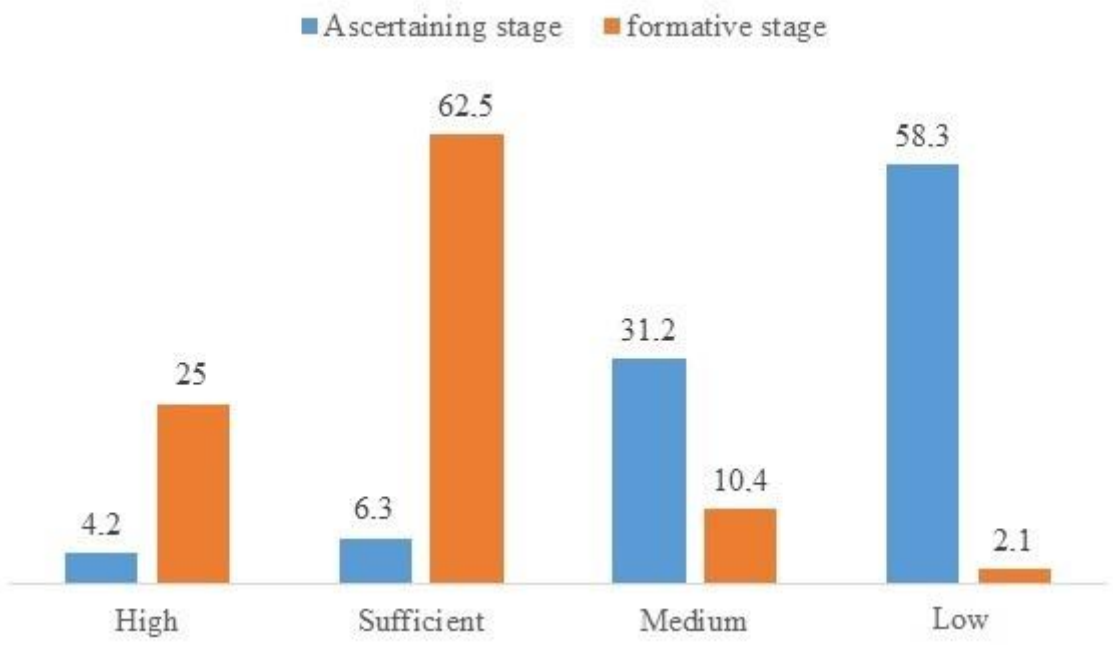


***Figure 3.*** *The state of readiness of teachers for the organization of distance education in the system of continuing education of teachers by the levels of formation of operational criteria (final cross-section, in %)*

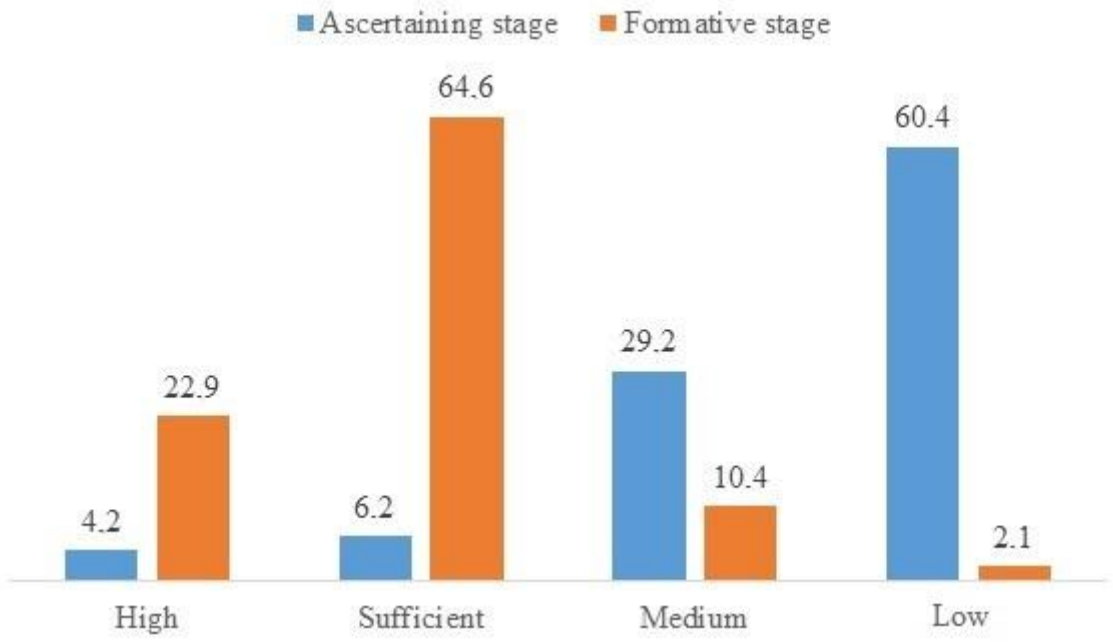


***Figure 4.*** *General characteristics of the levels of teachers' readiness for the organization of distance education in the system of continuous education (total cross-section, %)*

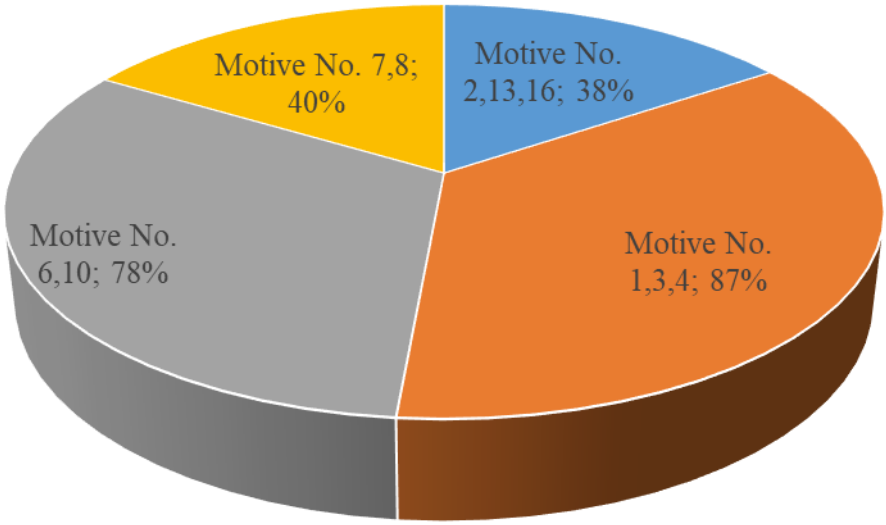


***Figure 5.*** *The result of the final diagnosis of motivational and value criterion of readiness for distance education in the system of continuing education*

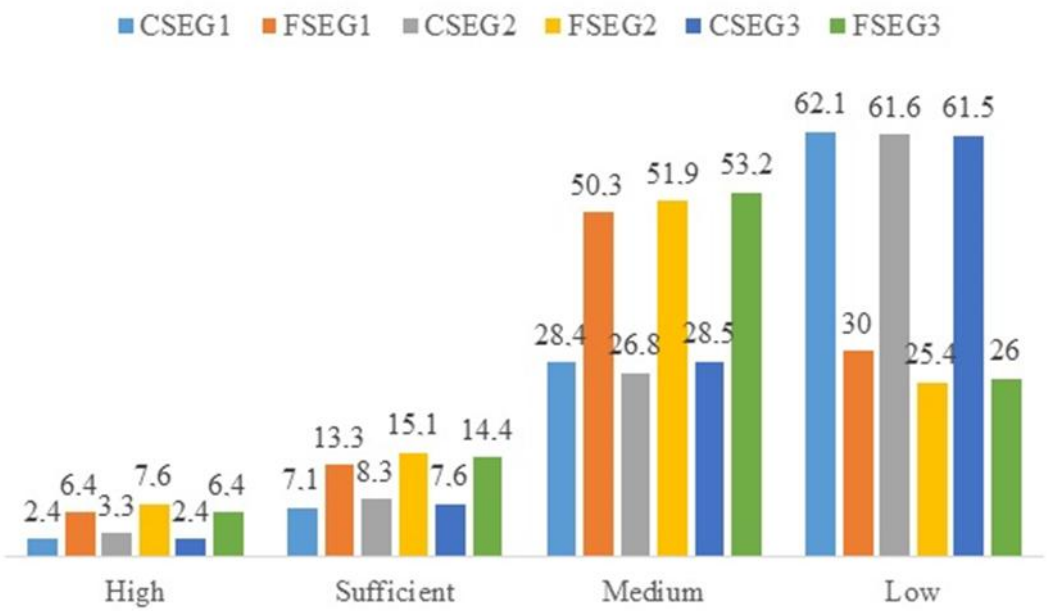


***Figure 6.*** *The state of readiness of teachers for distance education in the system of continuous education by levels of formedness of motivational and value criteria (final cross-section, in %)*

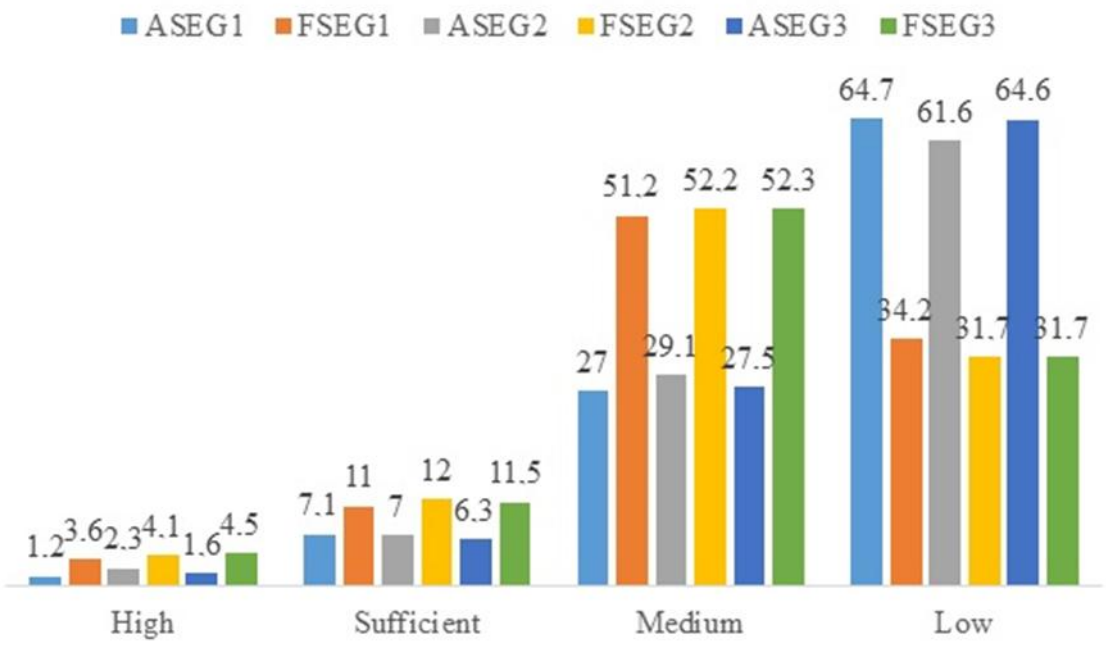


***Figure 7.*** *The state of readiness of teachers for distance education in the system of continuous education by levels of formedness of cognitive criteria (final cross-section, in %)*

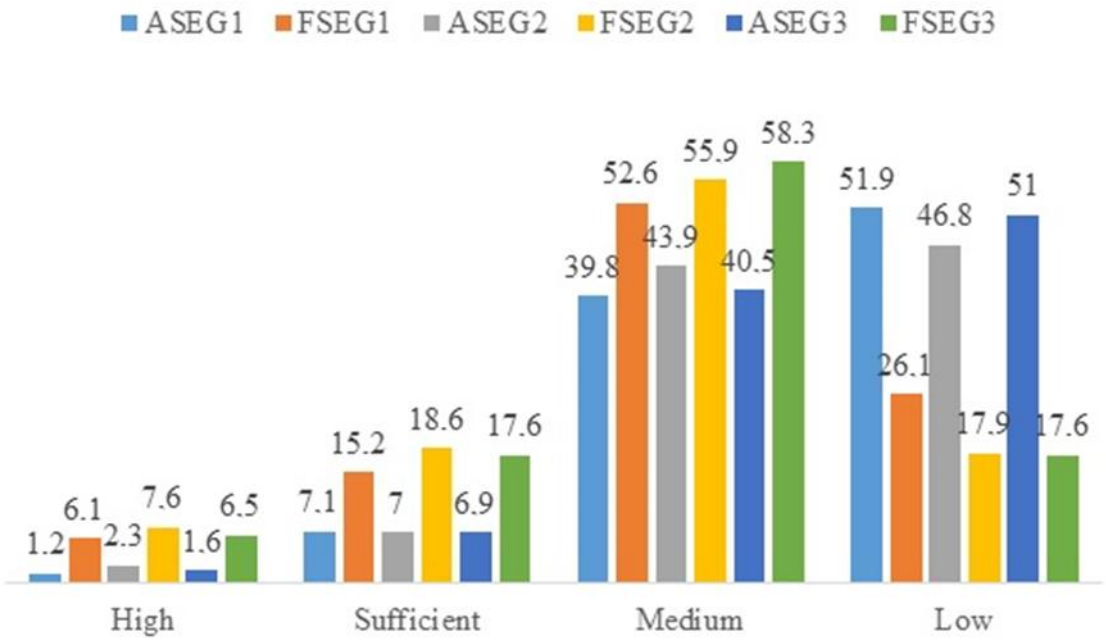


***Figure 8.*** *The state of readiness of teachers for distance education in the system of continuous education by levels of formedness of operational criteria (final cross-section, in %)*

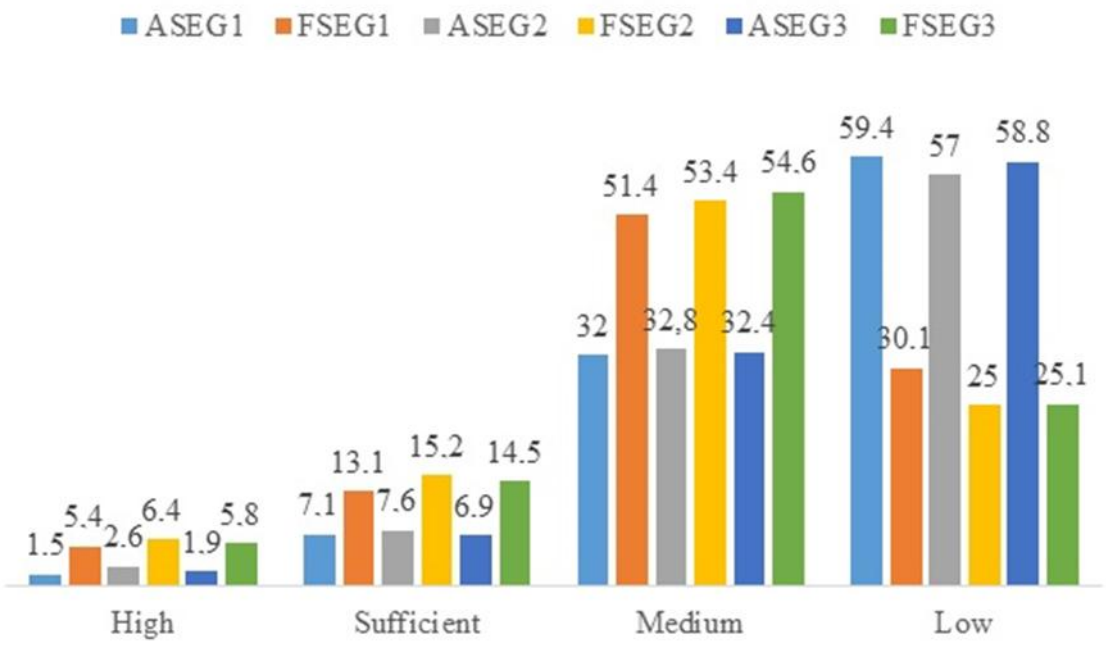


***Figure 9.*** *General results of teachers' readiness levels for distance education in the system of continuing education (final cross-section,%)*

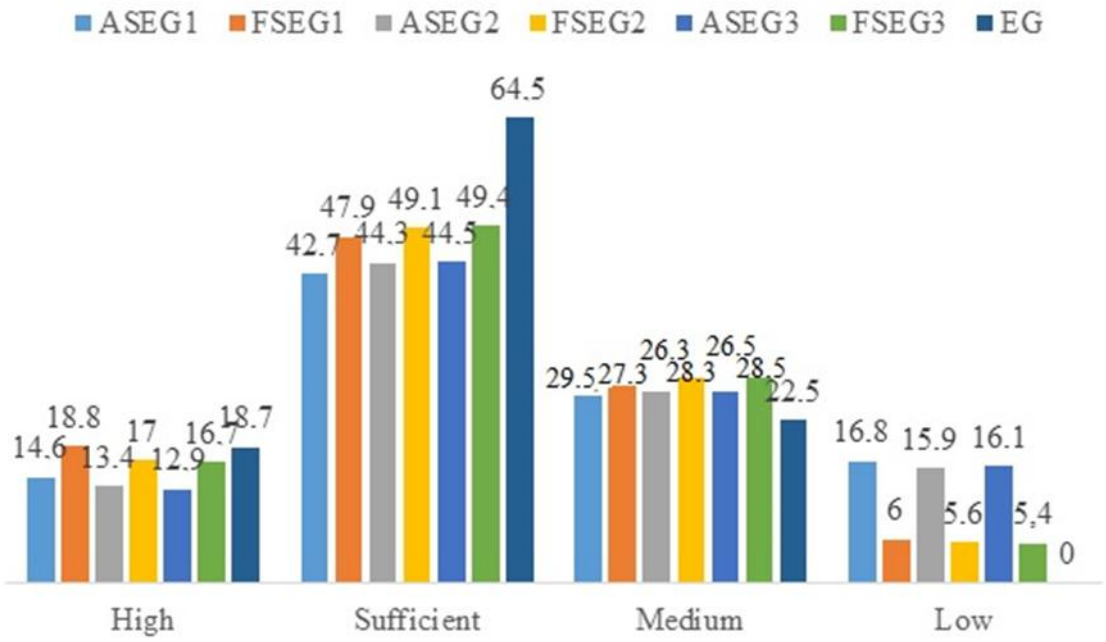


***Figure 10.*** *A diagram on the comparison of the development levels of the theoretical and methodological training of teachers (final cross-section,%)*

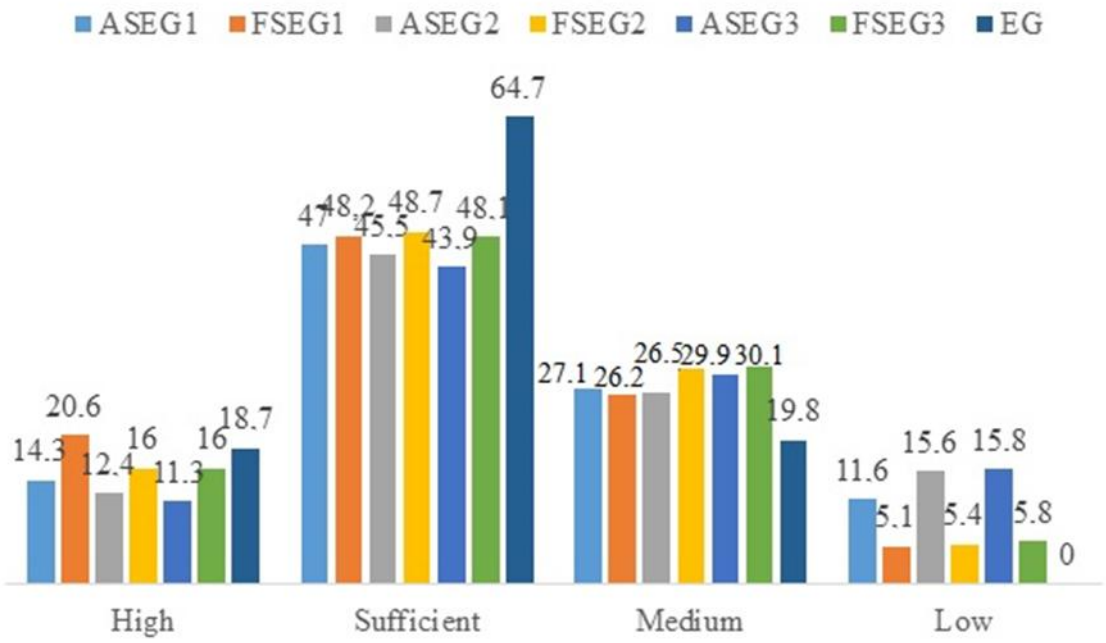


***Figure 11.*** *A diagram on the comparison of the levels of development of psychological and pedagogical training of teachers (final cross-section, %)*

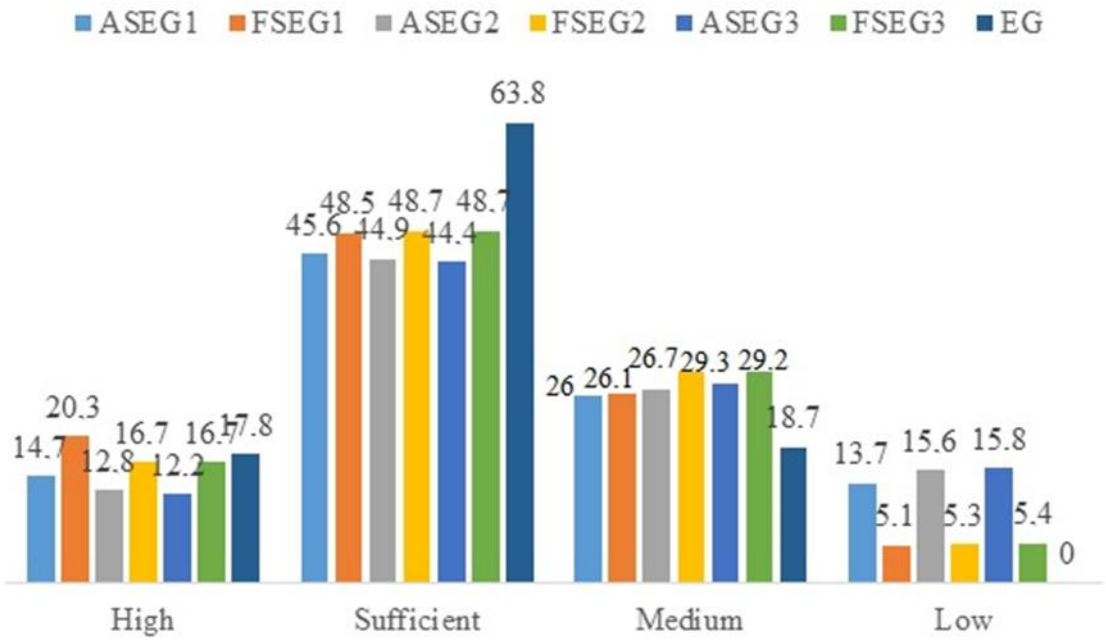


**Figure 12.** *A diagram on the comparison of the levels of development of professional and pedagogical competence of teachers (final section, %)*