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SCIENTIFIC RESEARCH COMPONENT OF TRAINING FUTURE PhDs IN THE CONDITION OF GRADUATE EDUCATION

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The article actualizes the problem of improving the quality of scientific-pedagogical research and further description and systematization of the obtained results and data by applicants for higher education of the third (educational-scientific) level. An important way to solve the issue of organizational principles of pedagogical experiment in terms of training applicants for the third (educational-scientific) level of higher education specialty 015 Vocational education, fields of knowledge 01 Education / Pedagogy on educational and professional programme "Theory and methods of vocational education" for new educational scientific programmes determine the necessity of graduate students to study the relevant specialty of the discipline "Methods of organization and mathematical methods of processing the results and data of pedagogical experiments." Peculiarities of structure of the mentioned course are analyzed, as well as its practice-oriented context, educational and organizational measures of introduction in the conditions of preparation of applicants of the third (educational-scientific) level of higher education are outlined. The general strategy of teaching the course, based on the semantic and comparative characteristics of the concepts "methods of organizing a pedagogical experiment" and "methods of pedagogical experiment", is revealed. The implementation of this approach is established on the allocation of three conceptual spaces ("pedagogical experiment", "organization", "methodology") and their pairwise coordination through the following concepts: "experiment", "pedagogical experiment", "organization of pedagogical experiment", "method of organization of pedagogical experiment", "methods of pedagogical experiment". Based on a comparative analysis of the concept of "pedagogical experiment organizing methods" on strategic (programmatically-organized historical, logical, technical, organizational, informational, procedural and other tools aimed at achieving the goals and objectives of pedagogical research) and tactical (complex of theoretical and empirical methods, combination of which allows to investigate the pedagogical process in its structural units and parts, comprehensively review the problem under research, all its aspects and parameters) levels diluted didactic tasks of the discipline. Effective mastering of methods of planning of experimental work, mathematical methods of modeling and optimization of research processes by postgraduate students is predicted.

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ДОСЛІДНИЦЬКИЙ КОМПОНЕНТ ПІДГОТОВКИ МАЙБУТНІХ ДОКТОРІВ ФІЛОСОФІЇ В УМОВАХ АСПІРАНТУРИ

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У статті актуалізовано проблему підвищення якості науково-педагогічних досліджень та опису їх результатів здобувачами вищої освіти третього (освітньо-наукового) рівня. Важливим шляхом розв'язання питання організаційних засад педагогічного експерименту в умовах підготовки здобувачів третього (освітньо-наукового) рівня вищої освіти спеціальності 015 Професійна освіта, галузі знань 01 Освіта/Педагогіка за освітньо-професійною програмою "Теорія і методика професійної освіти" за новими освітньо-науковими програмами визначено вивчення аспірантами відповідної спеціальності дисципліни "Методика організації та математичні методи обробки результатів педагогічного експерименту". Проаналізовано особливості побудови названого курсу, окреслено його практико орієнтований контекст, навчально-організаційні заходи впровадження в умовах підготовки здобувачів третього (освітньо-наукового) рівня вищої освіти. Загальну стратегію викладання курсу розкрито з опорою на змістову та порівняльну характеристику понять "методика організації педагогічного експерименту" та "методика педагогічного експерименту". Реалізація такого підходу здійснено на основі виділення трьох понятійних просторів ("педагогічний експеримент", "організація", "методика") та їх попарного узгодження через поняття: "експеримент", "педагогічний експеримент", "організація педагогічного експерименту", "методика організації педагогічного експерименту", "методика педагогічного експерименту". На основі порівняльного аналізу поняття "методика організації педагогічного експерименту" на стратегічному (програмно впорядковані історичні, логічні, технічні, організаційні, інформаційні, процедурні та інші засоби, спрямовані на досягнення цілей і завдань педагогічного дослідження) та тактичному (комплекс теоретичних та емпіричних методів, поєднання яких дозволяє з найбільшою імовірністю досліджувати педагогічний процес у підрозділах і частинах, всебічно вивчити досліджувану проблему, усі її аспекти й параметри) рівнях розведено дидактичні завдання навчальної дисципліни. Прогнозовано ефективне оволодіння аспірантами методиками та методами планування експериментальної роботи, математичними методами моделювання та оптимізації процесів дослідження.

Ключові слова: аспірантура, підготовка майбутніх докторів філософії, дослідницький компонент науково-педагогічних досліджень, експеримент, педагогічний експеримент, організація, методика організації педагогічного експерименту.

Introduction of the issue.

Approximation to European practices in the field of national education has identified the need to reform the postgraduate system, which began in Ukraine in 2016 in accordance with the Laws of Ukraine "On Education", "On Higher Education" (2014), Doctor of Science in Higher Education Institutions (Scientific Institutions), approved by the Resolution of the Cabinet of Ministers of Ukraine № 261 of March 23, 2016. In this context,

modern requirements for the quality of scientific and pedagogical research and description of the results by third (higher education) levels increase significantly.

Current state of the issue.

Significant importance in the formation of scientific and intellectual potential of society in postgraduate and doctoral studies is acquired by the works of O. Dubaseniuk, I. Ziaziun, N. Nychkalo, Z. Kurliand, S. Lisova, A. Sbruieva, etc. According to the studies of S. Vitvytska,

S. Kolomiets, O. Synekop, I. Lytniova, Ye. Nikolaieva, O. Spirin, perfect knowledge of the methodological foundations of scientific and pedagogical experiment is an important component of the professional competence of the researcher, as well as the necessary tool in his/her daily professional activity.

Outline of the unresolved issues brought up in the article. However, the problem of specially organized preparation of future doctors of philosophy (PhDs) for the implementation of a scientific experiment according to modern requirements remains virtually undeveloped, which determines the need to find new forms and methods of its organization.

Solving these objectives in terms of training applicants for the third (educational-scientific) level of higher education specialty 015 vocational education, fields of knowledge – 01 Education / Pedagogy in the educational-professional programme "Theory and methods of vocational education" for new educational and scientific programmes involves mastering the discipline "Methods of organization and mathematical methods of processing the results of pedagogical experiment" by the students.

Aim of research. The article aims at clarifying peculiarities of the structure of the course "Methods of organization and mathematical methods of processing the results of pedagogical experiment", as well as to determine its practice-oriented context, which is based on the semantic characteristics of the concepts "methods of organizing a pedagogical experiment", "methods of pedagogical experiment".

Results and discussion. For a long time, the training of graduate students in domestic research and higher education institutions, including two components – scientific and educational, was carried out with an

emphasis on practice-oriented implementation of scientific research. [1]. Such a distribution of educational-scientific programmes identified a number of problems, among which both graduate students and their scientific supervisors pointed out lack of theoretical and educational development of the scientific experiment, as well as the limited (time criterion included) educational-scientific communication, when the graduate student is able to acquire experience within a group of young researchers while presenting preliminary results of his/her experimental work, etc. [3].

New educational-scientific programmes aimed at obtaining the PhD degree contain additional sufficiently developed educational component, thus, for the specialty 015 vocational education in the educational and professional programme "Theory and methods of vocational education (sphere of knowledge 01 – Education / Pedagogy)", for example, it includes: 1. General training cycle – 11 credits; 2. Cycle of professional training – 20.5 credits; 3. Practice – 3 credits; 4. Assessment and certification – 1.5 credits. As the practice of implementing such structured educational-scientific training programmes for doctors of philosophy and their content indicates that the existing distribution of the graduate students' workload ensures a balance of scientific theory and practice. Moreover, the educational component implies conscious performance of scientific research, analysis, systematization and generalization of the data obtained.

Thus, the issues of preparation and organization of pedagogical experiment by applicants of the third (educational-scientific) level of higher education specialty 015 vocational education in the educational-professional programme "Theory and methods of vocational education (sphere of knowledge 01 – Education / Pedagogy)"

are considered during the study of methods of processing the results of pedagogical experiment as one of the components of the variable part of the relevant educational-scientific programme. The course is designed for 3 ECTS credits (10/6 hours of lectures for full-time / evening and distance learning; 20/10 hours of seminars respectively; 60/74 hours of independent work accordingly). Its implementation at Zhytomyr Ivan Franko State University was carried out on the basis of the Department of Pedagogy (since 2019 – Department of Pedagogy, Vocational Training and Management of Educational Institutions) through the introduction of a number of educational and organizational measures:

- development of perspective lines of study of educational discipline, which provide achievement of the major goal with a support on the theoretical, practical, and the block of individual work of graduate students;

- selection and systematization of practice-oriented forms and methods of interaction between the educator and the graduate student during the educational process (lecture with audiovisual content, analysis of educational and methodological sources on the subject under study, compiling a syllabus based on the processed material, performance, discussion and correction of individual tasks, etc.).

In this context, *the aim of studying the above mentioned discipline is to improve the training of future PhDs* in terms of organizing and conducting a pedagogical experiment by mastering modern methods of planning and maintaining initial, main and final stages of scientific research, as well as enabling them to properly design, preplan and find the suitable technological and organizational solutions for the upcoming experimental procedures. Moreover, it will help establish links between the theoretical context of the discipline and

its use in real conditions of scientific research experiment.

There are the following *objectives* of mastering the academic discipline:

- mastering by graduate students of the third (educational-scientific) level of higher education methodological bases of scientific work;

- acquisition by graduate students of the third (educational-scientific) level of higher education of knowledge about the scientific organization of the modern experiment and the techniques of its realization; experiment planning and optimization of research processes; experimental work criterion selection and adjustment; mathematical methods of modeling and conducting a pedagogical experiment; the latest methods and technologies for the implementation of the experiment; methods of processing the obtained results of observations;

- mastering by graduate students of the third (educational-scientific) level of higher education the skills to comprehensively plan and organize research; to collect and process information, to develop research programs, to analyze the obtained results, as well as to present the received materials in the form of a scientific report;

- formation of readiness of an individual for research work, search activity, productive research behavior, steady aspiration to creative scientific search, a complex of individual psychological features providing high efficiency of professional functioning of the young scientist.

The aim and objectives are directed at achieving a series of *program results*, among which there are the following groups:

- to show the ability to organize theoretical and experimental research in professional activities; to determine the tasks of research and effectively plan time to obtain the necessary results; design, construct, organize and analyze one's research activities;

- identify knowledge, searching skills, processing and analysis of information in scientific and methodological literature using various resources: journals, monographs, databases, online resources, archival materials;

- to be able to conduct and discuss the results of one's scientific, educational, educational-organizational work in oral and written form in state and foreign languages in accordance with the specifics and requirements of the specialty;

- adhere to the ethical norms of

formation of communication strategy with the subjects of interaction; apply democratic technologies of individual and collective decision-making;

- demonstrate leadership qualities, interpersonal skills, ability to work in a team of researchers, communicate effectively at the professional and social levels, adhering to the principles of scientific ethics.

In accordance with the aim and objectives, the topics of lecture and practical courses have been determined (Table 1).

Table 1

**Topics of lecture-practical course of the discipline
"Methods of organization and mathematical methods of processing the results of pedagogical experiment"**

№ of topic	Lecture topic	Seminar topic
Content module № 1. Experiment organizing methods		
Topic 1.	L. 1. Organization of pedagogical experiment and its methods.	Seminar 1. Stages of preparation and organization of pedagogical experiment.
Topic 2.	L. 2. General characteristics of the organization of pedagogical experiment.	Seminar 2. Pedagogical experiment and its organizational principles.
		Seminar 3. Planning a pedagogical experiment.
Topic 3.	L. 3. Criteria for pedagogical experiment.	Seminar 4. The basic criterion of the phenomenon under study.
		Seminar 5. Criteria and indicators of the phenomenon under study: development methodology.
		Seminar 6. Levels of manifestation of the phenomenon under study.
Content module № 2. Theoretical and practical foundations of evaluation of efficiency of pedagogical experiment		
Topic 4.	L. 4. Analysis of the results of a pedagogical experiment.	Seminar 7. Basics of measurements and quantitative description of data.
Content module № 3. Mathematical methods of pedagogical research		
Topic 5.	L. 5. Mathematical methods of processing the results of a pedagogical experiment.	Seminar 8. Formalized and informal (author's) methods of processing the results of a pedagogical experiment.
		Seminar 9. Classical mathematical methods of processing the results of a pedagogical experiment.
		Seminar 10. Methods of statistical inference.

The development of the content of the discipline presupposed the

disclosure of the general characteristics of the "method of organizing a

pedagogical experiment" concept. In the process of educational material review the implementation of this approach was based on the allocation of three conceptual spaces ("pedagogical experiment", "organization", "methodology") and their pairwise coordination through the following concepts: "experiment", "pedagogical experiment", "organization of pedagogical experiment", "methods of organizing a pedagogical experiment".

Thus, the starting point for solving the task was to outline the concept of "*pedagogical experiment*". In general, it is identified as a certain attempt, a piece of speculative theory-based data that needs confirmation or refutation; as a form of cognition; as one of the main methods of scientific research, in which the study of a particular phenomenon takes place in appropriately selected or artificially created conditions that ensure the emergence of those processes, the observation of which is necessary to establish regular links between phenomena. [2; 3]. Thereafter, assigning the concept of "*experiment*" educational orientation, we introduce the concept of "*pedagogical experiment*", which is characterized as a *form of knowledge* of pedagogical facts in specially created conditions in order to ensure *the study of the basic provisions* of the problem, *implementation and verification of specifically organized* pedagogical influences.

During the process of teaching the above mentioned course, it is emphasized that the following interpretation of the concept of "pedagogical experiment" allows us to structure the material of scientific work, which will be used by the graduate students (dissertation). Thus, the following sequence of sections is applied:

- I section – theoretical;
- II section – analytical-experimental;
- III section – project-recommendation.

At the same time, graduate students must clearly understand that ensuring the procedural nature of scientific and pedagogical experimental work is done by building a holistic methodologically oriented concept of the organization of pedagogical experiment, thus, its consideration is based on the "organization" category.

It is known that the concept of "*organization*" derives from the ancient Greek word "*organon*", which denotes a tool or instrument, and appeared due to the necessity of cooperation of efforts in order to achieve personal and common goals of the subjects of mutual activity(ies) in connection with a number of physical, biological, psychological and social constraints. Its other derivatives are the concept of "organ", later – "organism", and finally – "organization" [8].

During the discussion of the educational material it is emphasized that in the theory and practice of human activity the concept of "organization" is viewed in three dimensions: a) the organization itself (organization in statics); b) activities for streamlining the organization (organization of the organization); c) activities to streamline the process of managing the activities of the organization (organizing management of the organization) [7: 14-17].

Specifying the concept of "*organization*" in the classroom is carried out through the prism of existing in modern scientific fields of knowledge (philosophy, mathematics, economics, sociology, etc.), the practical range of its application based on a wide range of interpretations:

- association (unification) of people, social groups, states on the basis of common interests, goals, action programs, etc.;

- a collectivity of people or set of groups, united to achieve any goal, solving a problem based on the principles of division of labor and responsibilities, as well as subjected to

hierarchical layering, public association, government agency;

- an action with the meaning "to organize" or "be organized";

- an integral part of management, the essence of which is to coordinate the actions of individual elements of the system, to achieve mutual compliance with the functioning of its parts; features of structure, composition of something, structure as the interaction of components;

- physical and mental peculiarities of an individual;

- a set of measures aimed at coordinating the actions of individual elements of the system [3: 679].

Under such conditions, the nature of the application of the term "organization" allows us to identify a number of basic markers for its semantic interpretation: the association of people whose joint activities are aimed at implementing established programs based on certain rules and procedures; internal order, coherence of interdependent elements of the whole (system); a set of processes or actions that ensure the achievement of system goals.

Designing organizational measures on the reality of scientific and pedagogical research, *the organization of pedagogical experiment* is considered as a *set of processes* related to the knowledge of pedagogical reality or *actions* that lead to the *formation* or *improvement* of interconnections between parts of the whole – structural components of the studied pedagogical phenomenon.

Particular attention was paid to the connection between the concept of "methodology" and "organization of pedagogical experiment", which we describe as the relationship between the answers to the questions "how?" ("Methodology") and "what?" ("Organization of a pedagogical experiment") – in what way, and how it is necessary to "organize" (act in certain conditions) a pedagogical experiment.

The basis for the introduction of the concept of "methods of organizing a pedagogical experiment" is defined by the allocation of two levels of organization by R. S. Bielkin:

1) *strategic level of experimental work organization*; the level of organizational methodology reflects the fundamental aspects of the entire cycle of research procedures, determines the links and transitions of scientific tasks from stage to stage based on the goals and content of the study in general [2];

2) *tactical level of experimental work organization*; this level includes the organization of specific (in some cases – individual) experimental actions, organizational and technical measures within a specific act of research, provides effective deployment of the most important "subsystems" of research, including sampling of experimental work, methods of collecting, processing and analyzing information, etc. [2].

The presented provisions allow us to introduce the concept of "methods of organizing a pedagogical experiment" and "methods of pedagogical experiment" taking into account their dialectical unity as a whole and its partitions – categories that reflect the relationship between a set of objects or their structural components, elements and connections that unite them, and lead to the emergence of new properties and patterns that are not inherent in objects, parts, elements while being isolated [6].

Thus, the *method of organizing a pedagogical experiment* (the first strategic level of the organization) is a *set of interconnected methods and techniques of appropriate implementation of knowledge* of pedagogical reality in specially created conditions that effectively transform input resources (author's developments as a result of theoretical generalizations of problem under study and evaluation of its relevance) into the final product and achieve the goals of organizational

activities. "Set" in relation to the method of organizing a pedagogical experiment includes programmatically organized historical, logical, technical, organizational, informational, procedural and other tools aimed at achieving the goals and objectives of pedagogical research.

Methods of pedagogical experiment (the second tactical level of organization) is considered as a complex of theoretical and empirical methods, the combination of which allows with the greatest probability to investigate pedagogical process in its structural components and integral parts, as well as to study comprehensively the investigated problem, including all its aspects and parameters. [5]

A clear delineation of the concepts "method of organization of pedagogical experiment" and "method of pedagogical experiment" allows to dilute the didactic tasks of the discipline:

1) To outline the general content of the discipline "Methods of organization and mathematical methods of processing the results of pedagogical experiment", which includes consideration of the following key issues: choice of direction and sequence of research, experiment planning, technology of scientific activity, methods of scientific gnosis, basics of theoretical and experimental research principles of organization and conduct of scientific investigation, set of the experiment criteria, analysis of the results of experimental work.

2) to formulate the most general algorithm of research procedures carried out during the experimental work.

In this context, it is important to emphasize that at the strategic level ("methods of organizing a pedagogical experiment"), the researcher undergoes the following stages:

1. Formulation and introduction of the research topic; development of a scientific hypothesis.

2. Defining the aim, tasks, objectives, object, subject of scientific research.

3. Execution of theoretical and applied research.

4. Registering and filing the report on the performed research work.

The practical implementation of the "methods of organizing a pedagogical experiment" (strategic level) through the formulated organizational tasks involves the justification of the relevance of the issue under study, which is performed during practical classes by the graduate student him/herself; determination of stages of experiment; outlining the structure of dissertation; development of the program of experimental work; elaboration (analysis) of scientific sources on the research topic; formulation of theoretical assumptions; development of pedagogical experiment criteria and levels of manifestation of the studied phenomenon; substantiation of author's ideas and developments for improvement of pedagogical reality, etc.

Research procedures of the practical (applied) part of the experiment ("methods of pedagogical experiment") are specified as follows:

1. Clarification of the programme of experiment with selection of specified techniques (methods, forms, means) in order to perform chosen experimental procedures.

2. Definition of ways and methods of influencing the object of research (author's developments: models, technologies, didactic methods, didactic system, etc.).

3. Providing conditions for experimental work.

4. Development of ways and methods of recording the course and results of the experiment.

5. Preparation of experimental tools (devices, installations, models, etc.).

6. Providing the experiment with the necessary maintenance.

7. Analysis and generalization of the results of the pedagogical experiment.

8. Registration of results of pedagogical experiment.

Thus, the tactical level is an applied part of a holistic pedagogical experiment. Prospects for the use of this material include the graduate students' orientation, experience gaining, as well as knowledge enhancement in the course of practical classes on the implementation of author's developments, verification of the formulated theoretical assumptions during the ascertaining and formative stages of the pedagogical experiment; analysis of the results of a pedagogical experiment based on the use of selected methods of scientific research (theoretical, empirical, methods of mathematical statistics) and registration of results in the selected form.

The results of the implementation of the course "Methods of organization and mathematical methods of processing the results of pedagogical experiment", obtained on the basis of O. Smirnov's method of relative frequencies, indicated qualitative changes in the research component of training future PhDs in graduate school in assessment (A) by competent arbiters (supervisors) and self-assessment (SA) by graduate students of the third (educational-scientific) level.

Thereafter, based on the averaged data, we state the following changes: in the motivational sphere there is a transition from unstable ideas about the need to study a special course (A-0.84; SA-0.76) to a deep understanding of the key motivating factors of its inclusion in the educational programme of graduate students (A-0, 89; SA-0.84); in cognitive – from superficial knowledge obtained in the process of preliminary professional training (A-0.74; SA-0.73) to awareness of the importance of gaining knowledge with a projection on the implementation of scientific and pedagogical experiment (A-0.85; SA-0.79); in the operation sphere – from intuitive formulation and

implementation of experimental tasks (A-0.73; SA-0.72) to a flexible variable system of independent actions, the ability to apply them in any situation, taking into account the experience gained (A-0.83; SA-0.77); in personal sphere – from tactical actions in the creation and implementation of experimental work (A-0.59; SA-0.58) to rapid adaptation in the information space, a high degree of mobility, perception and processing of information, persistence in solving professional issues, formed readiness to perform a personally defined scientific task (A-0.88; SA-0.82).

Conclusions and research perspectives. With the corresponding structure of the educational programme, studying the discipline "Methods of organization and mathematical methods of processing the results of pedagogical experiment" involves solving a number of problems of fundamental training of highly qualified specialists. Moreover, mathematical methods of modeling and optimization of research processes are determined as the basic and most important ones. Under these conditions, the postgraduate student is becoming not only a scientist, but also as a conscious citizen, ready to take responsibility for solving urgent problems of society.

The analysis indicates the need to predict the effectiveness of the research component of the future PhDs training as a promising way to improve the quality of scientific and pedagogical experiment.

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