

POSSIBILITIES OF MODERN INFORMATION TECHNOLOGIES IN STATISTICAL DATA PROCESSING

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Abstract

Modernization of Russian education, the introduction of new educational standards put before the education new tasks in the field of research activities of pedagogical graduates. Priority task is the preparation a teacher who can conduct pedagogical research and perform a qualitative analysis of the results.

Modern information technologies provide new opportunities for the organization and conduct of pedagogical experiments from the creation of didactic materials, the processing of results by means of information technology to automated systems for analysis and forecasting the results of pedagogical research.

The main problems connected with the statistical processing of data are shown in the article, the connection between the main directions of informatization of modern teaching technologies and the means of information technologies are shown, the main functions of using information technology tools, as well as the methodology for training for statistical data processing using information technology. The effectiveness of introducing this methodology into the training of future teachers is proved.

Keywords: pedagogical research, pedagogical experiment, information technology, automated systems

1. INTRODUCTION

In connection with the modernization of Russian education, with its diversification, pedagogical tasks of teachers have become much more complicated. Ideal teacher of the XXI century is the teacher-researcher - the initiator of pedagogical innovations, able to perform the functions of a pioneer of new principles, methods of teaching and upbringing, to combine algorithmic activity with creative search, to take into account the characteristics of different classes on conditions of differentiated teaching, to compare the effectiveness of various methods, techniques and means of teaching when solving the same didactic tasks; to assess the psychological orientation and the level of the impact of certain techniques on the mental processes of students; to solve dozens of problem pedagogical situations every day; to conduct research in different concepts, comparing the opposite viewpoints.

One of the most important functions of a teacher-researcher is his readiness for diagnostic activities.

Attestation of pedagogical staff and the identification of their compliance with qualification categories, the research activity of future teachers, students of teacher training institutes raise the task of preparing for the organization and conduct of pedagogical research and analysis of the results using statistical methods.

2. INFORMATION TECHNOLOGIES IN SCIENTIFIC RESEARCH AND PROFESSIONAL ACTIVITY

At the present stage of the development of computer technology and information technology tools, the possibility of their application in carrying out pedagogical research becomes apparent. The tool component includes the software methodologies used at each stage of the research. The database management system and the database itself are used at the preparatory stage to identify, collect and systematize the initial input data during preparation for the research and at the implementation stage of pedagogical research they are used to automate the processes of collecting, storing, accumulating and processing information.

Following S. I. Arkhangelskiy, the pedagogical experiment will be understood as the "method of research which is used to elucidate the effectiveness of the application of certain methods and means of teaching and upbringing." (Arkhangelsk, S. I., 1980)

Education is one of the main subjects of pedagogical research. There are different approaches to the notion of education: 1) the process; 2) the activity aimed at mastering a system of scientific knowledge, cognitive skills, development of abilities; 3) a synonym for the formation of personality.

"In our time, not only science is improving technology, but technology is modifying the content and methods of science, comprehensively changing human activities" (Filatov O. K., 1999). In modern conditions, the ever increasing use of information and communication technologies in the activities of the teacher is naturally inevitable and necessary. Therefore, one of the important components of the training of a modern specialist is the widespread use of computer systems designed to automate professional activities. However, this process is of a dual nature: on the one hand, it creates backgrounds for a deeper understanding of the properties of the objects and processes being studied in mathematical models, parallel research and optimization, but on the other hand, the understanding of the application of these automation systems in professional activity requires a sufficiently high qualifications that teachers have not yet mastered.

The main directions of informatization of modern teaching technologies can be divided into substantive and procedural. The informative approach includes the influence of informatization on the content of training. In the procedural approach, four areas are identified: the construction of an information model of education and its use in pedagogical research; the use of the method of graphs, networks for the construction of curricula and the logical structure of the learning material; use of methods and means of informatics for processing the data of studying the state of educational results - the use of computers for the implementation of methods of mathematical statistics; use of methods of formalization and modeling (description) of individual components of teaching technologies, the possibility of diagnosing and measuring the parameters of certain components.

Pedagogical experiment uses a procedural approach for the implementation in which information technology tools such as graphical and text editors, databases and database management systems, spreadsheets, multimedia / hypermedia, telecommunication networks can be used.

Computers and electronic telecommunications provide access to accumulated knowledge, both in textual and graphic forms, imaginative information. It has long been known that figurative information is better understood than textual information. A man of the late twentieth and early twenty-first centuries will have to demonstrate his understanding of ideas, facts, concepts, theories, and not just memorize them. Therefore, the school needs a teacher who can participate actively and involve his students in the search, research and creative activities, develop knowledge based on the use of sources of information obtained not only at school, but also from all over the world. The use of telecommunication networks allows the teacher to engage in regional, interregional and international pedagogical research.

The connection between the main directions of informatization of modern teaching technologies and the means of new information technologies is presented in Table 1.

Table 1. Connection between the main directions of informatization of modern teaching technologies and ICT tools

N	Main directions	Contents	Results	Software
1	2	3	4	5
1	Construction an information model of training	Construction on the basis of a general theory of management	Creation of an information model and its use in pedagogical research	DB, ET, Multimedia and expert training systems
2	Using the method of graphs, networks to construct curricula, the logical structure of the learning material	Optimization of the conceptual structure of the learning material	Apparatus for identifying and optimizing the logical structure of the learning material	Expert training systems, DB
3	Application of methods and means of informatics for the processing of data of study of the state, learning outcomes	The use of computers for the implementation of methods of mathematical statistics	Creation of methodology and software for processing data of monitoring the status of learning outcomes	ET, DB, DBMS, environment of programming languages, expert training systems
4	Application of methods of formalization and modeling (description) of individual components of the teaching technology	Formalization and technologization of the description of goals, learning outcomes and other components of teaching technologies	The ability to diagnose and measure the parameters of certain components	Multimedia, expert training systems

Pedagogical experiment is the most important form of pedagogical research organization. It provides a more accurate, more profound study of pedagogical phenomena than simple observation or practical, experimental work. The peculiarity of the pedagogical experiment is the creation of special experimental situations, the repetition of the experiment in various conditions, and the testing of the data obtained in practice.

The development of modern pedagogy of higher education needs the training of students of the teacher training institutes for research skills, including the realization of a pedagogical experiment. The higher school has a task to prepare experts with the formed methodological, research, computer and innovative culture. Modern society is interested in getting such workers who are able to independently and actively act and think creatively. The ability to conduct a pedagogical experiment is one of the criteria for the willingness of a graduate of a teacher training institute to independent, creative activity in the future work, and therefore should occupy an important place in general education and vocational training.

The most promising way is to improve the effectiveness of pedagogical research through the use of information and computer technology. Therefore, one of the important components of training a modern specialist is the ability to apply the means of information and computer technology in research and professional activities. Pedagogical experiment uses graphic and text editors, databases and database management systems, spreadsheets, multimedia / hypermedia, computer telecommunications. They allow teachers to conduct a pedagogical experiment at a sufficiently high level, avoid errors in calculations, automate and facilitate work with information obtained during the research.

Means	Functions of using ICT tools	
	Informatics	Pedagogical experiment
Education programs	Improving the learning process	During the experiment
Environments of programming languages	Forming an algorithmic style of thinking, learning programming	Development of educational, controlling, training and demonstration programs for pedagogical experiment
Graphic editor	Introduction to the systems of graphic presentation of information	Creating drawings for visual handouts, diagrams based on the results of the experiment
Text editors	Introduction to the systems of textual presentation of information	Preparation of various handouts used during the experiment, documents and reports on the results of the experiment
Spreadsheets	Introduction to the systems of the processing of numerical information	Modeling, graphical representation of numerical data (Tables, diagrams, graphs). Carrying out calculations on the results of the pedagogical experiment
DBMS, DB	Forming the skills of systematization and data search	Collection and systematization of data during processing
Multimedia systems	Introduction to the systems of structural representation of various types of information	Organization of research activities. Development of multimedia applications for various experiments
Expert training systems	Introduction to the artificial intelligence systems	During the experiment for making decisions
Systems for developing training programs	Developing the skills of designing training programs	Developing training programs of the necessary area, to test any hypotheses regarding the learning process

3. EXAMPLES OF DEVELOPED SOFTWARE PRODUCTS FOR STATISTICAL DATA PROCESSING

3.1 Automated System for Analyzing The Results of Psychological and Pedagogical Research

The goal of any pedagogical experiment is the empirical confirmation or refutation of the hypothesis of research and / or the validity of theoretical results, that is, the justification that the proposed pedagogical influence (for example, new content, forms, methods, means of instruction, etc.) is more effective (or, possibly, on the contrary - less efficient). For this, at a minimum, it is necessary to show that, when applied to the same object (for example, to a group of students) it gives other results than the application of traditional pedagogical influences

For this purpose, an experimental group is formed, which is compared with a control group. The difference in the effects of pedagogical influences will be justified if the two groups that initially coincide in their characteristics differ after the implementation of pedagogical influences. Therefore, it is required to make two comparisons and show that in the first comparison (before the beginning of the pedagogical experiment) the characteristics of the experimental and control groups coincide and in the second (after the end of the experiment) they differ.

Since the object of the pedagogical experiment is usually people (students, teachers, employees and heads of education management bodies, etc.), and each person is individual, then it is possible to speak about the coincidence or difference in the characteristics of the experimental and control groups only in a purely formal and statistical sense. In order to determine whether coincidences or differences are random, statistical methods are used which are based on the data obtained as a result of the experiment and these methods make an informed decision about coincidences or differences. The check of statistical hypotheses is carried out with the help of a statistical criterion, which is a function of the results of observation. A statistical criterion is a rule (formula) by which a measure of the discrepancy between the results of a sample observation and the hypothesis is determined. Currently, there are a lot of criteria for the analysis of psychological and pedagogical research, and therefore, in carrying out such research, future teachers (especially of humanities) are poorly oriented in all the diversity of these criteria and just ignore them. Therefore, we developed the software product "Automated system for analyzing the results of psychological and pedagogical research" (Gorokhova R. I., Nikitin P. V., 2012), the main window of which is presented in Figure 1.

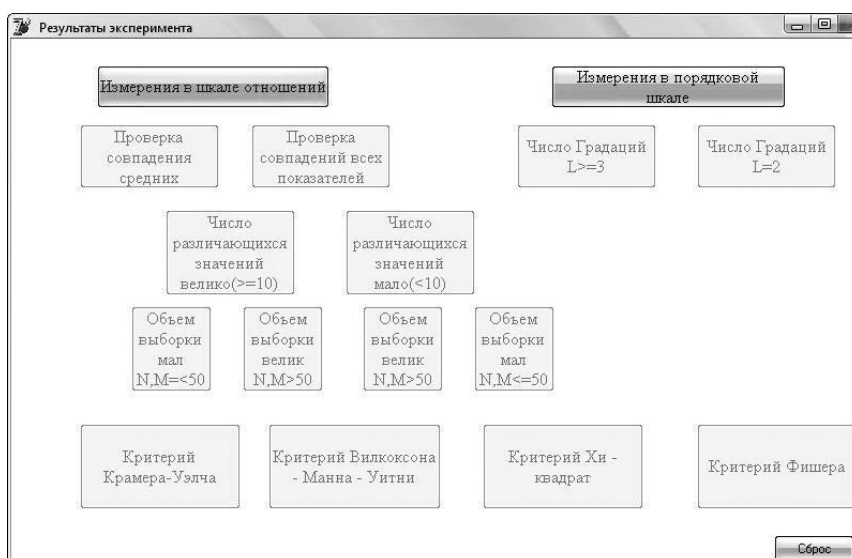


Figure 1. Main window of the program.

This software product realizes an algorithm for using statistical criteria for analyzing the results of pedagogical experiments. The automated system for analyzing the results of psychological and pedagogical research allows us to make a choice of the appropriate measurement scale, the number of gradations, the verification of coincidences of indicators, and the sample size and, in accordance with them, to select a certain statistical criterion for data processing.

The general algorithm for using statistical criteria is simple: before the beginning and after the end of the experiment, based on the information of the results of observations (characteristics of the members of the experimental and control groups) the empirical value of the criterion is calculated (the algorithm for selecting the statistical criterion and the formulas for calculations are given below). This number is compared with the known (tabular) number - the critical value of the criterion (the critical values for all the criteria we recommend are given below). If the empirical value of the criterion is less than or equal to the critical one, then it can be stated that the characteristics of the experimental and control groups coincide with the significance level of 0.05 according to a statistical criterion.

Using the proposed program allows the researcher to obtain information about the results of comparing the indicators in the control and experimental group excluding the calculation stage.

4. RESULTS

The check of our research was conducted on the confirmation of the following hypothesis: if we use modern pedagogical technologies in the preparation of students of pedagogical universities for pedagogical experiment, then:

- The general level of vocational training of future teachers increases;
- Motivation to conduct pedagogical experiments in educational research, research work at the university and in future professional activity due to the development of creative activity of students is increased (Nikitin,

2014).

At the initial stage, we reviewed and analyzed 16 graduation theses at the faculty of preschool pedagogy and psychology, 22 graduation theses in the Department of History and Philology, 8 in the Faculty of Physical Education, 34 at the Faculty of Physics and Mathematics; total - 80 theses. Among them were works performed in conjunction with the Department of Pedagogy and Psychology. As a result of a general analysis of all the theses, the following data were obtained: the experiment in all stages was carried out only in 11.9% of all the theses; the questioning at the initial stage was carried out in 9.4% of works, on the final - in 2.5%, and comparison of the results of questioning before and after the experiment was done in 6.9% of the examined theses; historical and retrospective study was 31.4%; psychological diagnosis was revealed in 5.7% of works. The development of topics and plan for various subjects is represented in 39.4% of works. The use of information and communication technology tools and the creation of software products is revealed in 42.36% of diploma papers (Nikitin P.V., Fominykh I.A., Mel'nikova A.I., 2015).

Introduction of the presented automated systems was carried out within the framework of disciplines, studied according to curricula of corresponding areas. It is logical to study the basics of analyzing and processing the results of pedagogical research in studying the subject "Statistical Methods in Pedagogical Studies," which is included in the curricula of all the areas of pedagogical education at our university. The program of this academic subject examines the mathematical foundations of pedagogical research and tests of statistical hypotheses. The subject "The use of information and communication technologies in the learning process" makes it possible to analyze various information technologies not only from the perspective of use in the educational process, but also from the point of view of applying pedagogical research at various stages from its organization, carrying out and ending with the analysis of results and testing hypotheses.

At the final stage, we also reviewed and analyzed the same theses of the same faculties. As a result of a general analysis of all the graduation theses the following data were obtained: the experiment in all stages was carried out in 30.9% of all the theses; the questioning at the initial stage was carried out in 70% of works, on the final - in 62%, and comparison of the results of questioning before and after the experiment was done in 48% of the works; historical and retrospective study was 37.2%; psychological diagnosis was identified in 50.3% of works. The development of topics and plans for various subjects is represented in 77.4% of works. The use of information and communication technology tools and the creation of software products are revealed in 92% of diploma papers (Nikitin, 2017).

Thus, the analysis of graduation theses carried out at the final stage of the experiment allows us to discover the increase of overall level of vocational training of future teachers and the motivation for conducting pedagogical experiments in educational research, research work in the university and in future professional activity.

In conclusion, we should note that the introduction of information technology in the educational process allows us to form a "new look" of students at pedagogical research. The software products considered in the article contribute to a qualitative change in the approach to work with information obtained in the course of research at all its stages: from ascertaining to control, quantitative processing of measurement results by various statistical methods, without complex calculations and mathematical transformations. The use of various information technologies and software products in training switches the preparation of future teachers to a qualitatively new level.

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