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A Competent Approach to Teaching Probability Theory and Mathematical Statistics

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Abstract: This article examines the competence issues, problems and proposals for teaching probability theory and mathematical statistics in higher education institutions.

Keywords: competence, statistics, principle of fundamentality, principle of professional orientation of training.

The current stage is characterized by high rates of scientific and technological progress, the emergence of fundamentally new progressive technologies, which determines the relevance of the problem of the quality of the educational process that meets the requirements of the modern world economy and international standards.

Modern trends in the development of society set system-oriented educational and educational goals for higher education, the comprehensive implementation of which is aimed at training competent, creative specialists capable of making informed and informed decisions in various situations, including random ones.

The existence in the world and society around us of an infinite number of both dynamic and statistical or random patterns allows us to assert that modern specialists, who are the intellectual resource of society, must have not only key competencies in the field of their professional activities, but also subject competencies in the field random.[3]

The formation of such competencies is an important condition for training a successful and competent specialist, and probability theory and mathematical statistics become the basic subjects of the learning process.

At the same time, the avalanche-like introduction of information technology in the last two decades in the areas of professional activity of specialists of any profile (including mathematics teachers) requires the use of computers in the educational process, as the basis for improving their professional training at a university and for subsequent practice.[4]

The development of probabilistic thinking in students during the learning process is complicated due to the difficulty of virtual perception of the mechanisms of random processes and patterns, as well as the lack of initial training in probability theory and mathematical statistics.

The educational process in higher education, including probability theory and mathematical statistics, is subject to certain laws and principles of teaching.

In modern didactics, a number of patterns and laws of teaching have been identified. The following principles are formulated in the works of leading experts:

- the conditioning of the learning process by the needs of society for highly qualified specialists of a wide profile, comprehensively developed and creatively active;
- the relationship between teaching and learning in the holistic learning process;
- dependence of the content of training on its objectives, reflecting the needs of society;
- interdisciplinary connections between different cycles of academic disciplines and between individual disciplines within a given cycle;
- the relationship between the student's educational and scientific activities.

The most important pattern of the educational process in higher education is the pattern that concerns interdisciplinary connections. Particular importance is given to the connection between fundamental disciplines and core special disciplines. Requirements based on the most important laws are elevated to the role of learning principles. The laws of learning are organically connected with the principles of learning, which are implemented both in the educational process as a whole and in its individual components.

A specific principle for higher school is the principle of professional orientation of education, since higher school has always been and will be professional in its essence and purpose.

The professional orientation of the educational process is understood as such its organization, which contributes to the formation of a professionally significant motivational sphere of the future teacher. The basis of teacher professional training is the formation of a person's professional orientation. The implementation of the principle of professional orientation in teaching mathematics is aimed at forming the mathematical aspect of the future specialist's readiness for professional activity. [1] The content of this concept includes the following: development of thinking and formation of professionally significant techniques of mental activity; provision of mathematical apparatus for the study of special disciplines and professional training; methodological preparation for continuous self-education in the field of mathematics and its applications.

Professional orientation in scientific and pedagogical literature is considered as a form of specific interdisciplinary connection and is characterized as a specialized relationship between general educational knowledge and professional knowledge (G.S. Gutonov, L.V. Melnikova, A.Ya. Kudryavtsev, N.N. Lemeshko, T. V. Voronina, T.N. Aleshina, etc.).

The principle of professional orientation presupposes the integration of general scientific and special disciplines at the university; general scientific knowledge with special knowledge and skills, as well as the formation of significant qualities of a future specialist. The essence of any teaching principle is revealed in the content of the contradiction it is aimed at resolving. The principle of professional orientation resolves the contradiction between the requirements of society for the formation of a comprehensively developed integral personality and the need to prepare it for active participation in a certain area of professional activity in accordance with personal interests, individual abilities, and social needs.

The principle of professional orientation regulates the relationship between the general and the specific in education, determines the dialectic of the interaction between the holistic development of the individual and his special, professional development. It is this circumstance that predetermines the special didactic significance of the principle of professional orientation in vocational education.

The professional-pedagogical orientation of teaching mathematics is understood as the need for targeted and continuous formation in students of the foundations of professional skills, based on active and deep knowledge of the school mathematics course, its scientific foundations and

methodological support, acquired against a favorable emotional background of a positive attitude towards the teaching profession, towards mathematics as to the academic subject [1].

Currently, in higher education didactics, six principles have been identified on which the concept of professional pedagogical orientation of education is based: fundamentality, continuity, leading idea, binary, informatization, integrated approach (A.G. Mordkovich, G.L. Lukankin, N.I. Batkanova). [2]

Let us consider the possibilities of implementing the principle of fundamentality in the process of teaching probability theory, the study of which is an organically integral part of the process of teaching mathematics.The principle of fundamentality is that the teacher must have fundamental mathematical training, providing him with mathematical knowledge that goes far beyond the scope of the school mathematics course, and demonstrate erudition in the implementation of interdisciplinary connections.

Professional pedagogical training presupposes such a volume of mathematical knowledge, abilities and skills that will serve the future teacher as a scientific foundation for fruitful work at school: deep mastery of mathematical facts and patterns, skilled handling of them, the ability to use various methods and means of teaching mathematics. In particular: a complete and deep understanding of the basic facts and ideas that are used in school, the ability to solve problems of any level of complexity and in various ways.

In relation to the study of mathematical disciplines, the principle of fundamentality expresses the need for serious, solid mathematical training, taking into account the needs of the acquired teaching profession; fundamental mathematical training of the teacher is necessary, providing him with effective mathematical knowledge within limits that go far beyond the scope of the school mathematics course, and universality in his mastery of various mathematical academic subjects at school, but this fundamentality is not a goal, but a means of teacher training.

Students, as a rule, have very little school knowledge in the field of stochastics. In this regard, of particular interest are problems that demonstrate the connection of probability theory with other sciences: physics, chemistry, biology, psychology, economics, etc., which clearly shows its interdisciplinary connections with other courses.

It is obvious that in order for students to better assimilate the material throughout the entire course of study, special attention should be paid to the connection between learning and life, while relying on specific examples. This will allow students not only to change their (by the way, quite common) attitude towards probability theory as a science replete with abstract concepts, but also to successfully apply their knowledge in practical activities.

Due to the fact that the probability theory course is an important element of the methodological training of the future teacher, the variability in the introduction of basic concepts becomes of great importance. A comprehensive presentation of the material is necessary, showing different ways of introducing the same concept and solving problems. For example: various definitions of probable (classical, statistical and geometric); calculating the desired probability using various formulas and comparing the obtained values.

This approach to learning contributes to the formation and development of the student's ability to think abstractly and freely navigate various approaches to studying the material. When studying stochastics, it is useful to use algorithms to solve standard problems, as well as to develop skills in independently composing algorithms, etc. In problems, it is necessary to draw students' attention to the relationship between scientific and practical components, identifying patterns that will allow them to build a mathematical model and find a solution algorithm.

The future specialist must have a clear understanding of probability and the features of various methodological approaches in presenting the probabilistic line, since he will have to lay down and form probabilistic statistical knowledge in his students; must be able to compose and solve

applied problems, for which he must have professionally significant modeling skills, as well as the compilation and application of algorithms. The student needs a certain level of logical-combinatorial thinking, by which we mean logical thinking, supported by the skills: find all logically possible solutions; group individual elements according to a certain characteristic; see differences in the resulting samples.

As an example, consider the following problem: The batch contains 10% non-standard parts. Four parts were selected at random. Write the binomial law of distribution of a discrete random variable X - the number of non-standard parts among the four selected ones and construct a polygon of the resulting distribution.

To solve this problem, the student must know about the distribution law of a discrete random variable, what values does this random variable take? It takes values from 0 to 4:

X 0 1 2 3 4

But knowing this is not enough for a complete understanding of this random variable. We must determine with what probability these values are accepted. To do this, we calculate these probabilities:

$$P(\mathrm{X}=0)=C_4^0\cdot 0{,}1^4\cdot(1-0{,}1)^0=0{,}1^4=0{,}0001$$

$$P(\mathrm{X}=1)=C_4^1\cdot 0{,}1^3\cdot(1-0{,}1)^1=4\cdot 0{,}1^3\cdot 0{,}9=0{,}0036$$

$$P(\mathrm{X}=2)=C_4^2\cdot 0{,}1^2\cdot(1-0{,}1)^2=6\cdot 0{,}1^2\cdot 0{,}9^2=0{,}0486$$

$$P(\mathrm{X}=3)=C_4^3\cdot 0{,}1^1\cdot(1-0{,}1)^3=4\cdot 0{,}1\cdot 0{,}9^3=0{,}2916$$

$$P(\mathrm{X}=4)=C_4^4\cdot 0{,}1^0\cdot(1-0{,}1)^4=0{,}9^4=0{,}6561$$

Control: 0.0001+0.0036+0.0486+0.2916+0.6561=1

Let us write the required binomial distribution law for X:

X	0	1	2	3	4
P	0.0001	0.0036	0.0486	0.2916	0.6561

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