NON-CLASSICAL PROBABILISTIC-STATISTICAL RESEARCH METHOD AND ITS APPLICATION FOR RATING STUDENTS BY THEIR KNOWLEDGE LEVEL

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Probabilistic-statistical methods are widely used in scientific research. There are two probabilistic-statistical methods: classical (mass) and non-classical (individual) [1]. Classical probabilistic-statistical research method is based on probability theory and и mathematical statistic. This method is used to analyze mass phenomena of random character, it includes several stages, the following ones are basic:

– building of probabilistic reality model, based on statistical data analyzes (determination of random variable distribution law);

– required calculations using mathematical tools in the context of probabilistic model;

– probabilistic-statistical research results interpretation as applied to real situation.

The difference between non-classical and classical probabilistic-statistical research methods is, that non-classical can be applied not only to mass events, but also to detached events of stochastic character. This method can effectively be used to analyze individual behavior during various activities, e.g. in the process of learning. Characteristics of non-classical probabilistic-statistical method of psycho-pedagogical researches will be considered taking students behavior in the process of learning as an example.

Learning as a kind of activity, which aim is to gain knowledge, skills and habits, depends on level of consciousness of each student. Structure of consciousness includes the following cognitive processes: sensation, perception, memory, thinking, imagination. The analysis of these processes [2] shows, that they involves elements of randomness, conditioned by random nature of mental and somatic state of individuum, and also, physiological, psychological and information noises which accompany brain activity. The latter forced us to discard determinist dynamic system in favor of random dynamic system in describing mentation. It means, that determinism of consciousness is realized through randomness. Therefore we can conclude, that one's knowledge, being in fact a product of consciousness, is also of random nature, and, hence, we could use probabilistic-statistical method to describe each student behavior in the process of learning.

According to this method each student is identified by distribution function (probability density), which defines probability of finding him in a single information space area. In the process of learning distribution function, that identifies a student, evolving, moves in information space. Each

student is characterized by individual properties, so independent localization (areal and kinematic) of individuals is possible.

According to probability conservation law a system of differential equations was written down. These are continuity equations, that link probability density alteration per a time unit in a phase space (space of coordinates, velocities and accelerations of various orders) with divergence of probability density flow in the studied phase space. In [3, 4] analysis of analytical solutions of set of continuity equations (distribution functions), which characterize each student behavior in the process of learning, is conducted. Distribution functions represent superposition of waves, spreading out in informative space.

Probabilistic-statistical scaling [5,6] is used within experimental researches of student behavior in the process of learning. According to it, scale of measurement is represented as an ordinal system $< A; L_\Psi, F, G; f, M >$, where A is some quite ordered set of objects (individuals), which have characteristics of interest (empiric system with relations); L_Ψ is function space (space of distribution functions) with relations; F is operation of homomorphous mapping of A into subsystem L_Ψ; G is group of possible alterations; f is operation of mapping distribution functions from subsystem L_Ψ onto numeric systems with relations of n is dimensional space M. Probabilistic-statistical scaling is used to determinate and analyze experimental distribution function and includes three stages:

– to find experimentally distribution functions according to the results of examination [5];

– to map distribution functions into numeric space. This requires calculation of moments of individual distribution functions. In practice, usually we need only to calculate moments of first order (expectation value), second order (dispersion) and third order, that characterize distribution function asymmetry;

– to rate students by their level of knowledge, comparing individual distribution function moments of various orders.

Non-classical probabilistic-statistical research method allows not only to rank students by the level of knowledge, but also to make suggestions for optimizing the process of education [7].

References

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