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## THE DIDACTIC ANALYSIS OF STUDIES ON THE INVERSE PROBLEMS FOR THE DIFFERENTIAL EQUATIONS

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In article results of the didactic analysis of the organization and carrying out seminar classes in the inverse problems for the differential equations for students of higher educational institutions of the physical and mathematical directions of preparation are discussed. Such analysis includes a general characteristic of mathematical content of seminar occupations, the analysis of structure of seminar occupation, the analysis of realization of the developing and educational purposes, allocation of didactic units and informative means which have to be acquired by students when training each section of content of training in the inverse problems and other important psychology and pedagogical aspects. The attention to establishment of compliance to those of seminar occupations to lecture material and identification of functions in teaching and educational process which are carried out at the solution of the inverse problems, and also is paid to need to show various mathematical receptions and methods of their decision.

Such didactic analysis helps not only to reveal such inverse problems at which solution students can collectively join in creative process of search of their decision, but also effectively organize control of assimilation of knowledge and abilities of students on the inverse problems for the differential equations.

**Key words:** training in the inverse problems for the differential equations, the didactic analysis of studies, the student

Efficiency and effectiveness of pedagogical activities in higher educational institutions in many respects depends on the formulated didactic purposes and tasks, the realized didactic principles of training, selection and formation of content of training, methods of training, forms of the organization of studies, on scheduled ways of their implementation (look, for example, [1; 19; 21; 22; 25]). Therefore, tasks of enhancement of characteristics of educational process, upgrade of training, education and development of the identity of students on the basis of the modern achievements of world science are set for the modern Russian higher school.

Content of training in the inverse problems for differential equations (IPDE) is guided more by students of the higher education institutions studying at the physical and mathematical directions of preparation and shall consider their professional directivity of preparation. Training in IPDE shan't degenerate in the simplified and concise presentation of the appropriate courses. When training in IPDE it is important to pay attention to detection of application-oriented aspects of such mathematical tasks and physical interpretation of the received decision; on formation of skills of students

independently to formulate logical outputs of application-oriented and humanitarian character from the received decision of the inverse problem (look, for example, [2–18; 20; 23; 24]).

Planning, development of a technique of training and implementation of the process of training of students in IPDE has to be carried out by experts in this scientific area. For the correct statement of training in IPDE it is necessary to reach a certain level of mutual understanding when planning content of training of students in physical and mathematical disciplines, the considering content of training in IPDE both in department, and between departments of physical and mathematical profiles of the corresponding directions of training of students in higher education institution. Content of training in IPDE includes knowledge not only general education physical and mathematical disciplines, but also special sections, such as the theory of the generalized and analytical functions, the tensor analysis, methods of the solution of the nonlinear integrated equations and other special sections which not always enter the content of training in physical and mathematical disciplines.

Training in IPDE has to be carried out on older years when students have already mastered basic mathematical disciplines, such as algebra and geometry, the mathematical and functional analysis, the ordinary differential equations and the differential equations in private derivatives, the integrated equations, optimization methods, numerical methods and other subject matters. Situation when the volume of knowledge of IPDE, extent of possession and the nature of the skills acquired by students is defined by them together with leading experts in area of future specialization of students is reasonable. Time allowed for training in IPDE has to be fixed in the appropriate working programs in which besides the content of training the purposes, the principles, tasks and basic provisions of training in IPDE have to be stated.

One of the main forms of the organization of studies for IPDE is seminar occupation. Feature of seminar classes in IPDE consists in a possibility of the active involvement of each student in discussion of setting of the inverse problem, approaches and methods of its decision of the logical analysis of results of its decision in applied researches. On seminar occupations students, mastering the theory and methodology to IPDE, solve various mathematical problems. For example, construct an integrable equation to which satisfies the decision of the direct task; prove theorems of a correctness of the inverse problem; explain the idea of search of approximate solution to IPDE; write out the difference analog IPDE; construct a computing algorithm by means of which approximate solution to IPDE can be found, carry out the analysis of its properties (convergence, stability and other properties), solve also other mathematical problems.

As the educational job, maybe, it is entrusted to students to explain the idea of the proof of a correctness or the conditional correctness to IPDE or, for example, according to the found solution to IPDE to formulate logical outputs of application-oriented or humanitarian character.

On seminar occupations by the teacher the results of independent and personal operation of students on assimilation of the theory and practice of the decision can be summed up of IPDE. It is necessary to mark that independent operation of students is the important and necessary educational activities promoting effective training in IPDE. The organization of independent operation of students it is necessary to fix and deepen

fundamental knowledge in the field of the theory and methodology to IPDE, to gain experience of an independent research of such tasks and a statement of logical outputs of application-oriented and humanitarian character.

Within independent operation, for example, it can be offered to students to execute mathematical calculations which don't require new knowledge of the inverse problems which was lowered on lecture occupation; to decide to IPDE, logically connected to the explained sections of the inverse problems; to read the specific scientific article across IPDE which on setting and a method of a research is close to considered earlier on lecture occupation, to understand a method of its decision, to analyze a physical sense of the most application-oriented task, to express the opinion on advantage and advantages of the approach to its decision explained in article; to perform term or final qualification paper on IPDE.

Hours and subjects for independent operation of students shall be stated in the working program for IPDE by the teacher. Their quantity shall be coordinated with the head of the department for the purpose of prevention of educational overloads of students. The diagram of its carrying out shall be developed and agreed by the teacher with students.

We will mark that the marked didactic analysis allows to reveal a role of seminar classes in IPDE in formation at students of skills of application of mathematical methods of the decision of application-oriented tasks; judgment by students of scientific and cognitive potential of the theory to IPDE; formation at students of analytical skills and abilities to formulate similar settings to IPDE and to generalize them; acquisition by students of skills it is reasoned and clearly to explain solutions to IPDE.

The similar didactic analysis includes a general characteristic of mathematical content of seminar occupations (the analysis of a subject of seminar occupation, her communication with the stated material on the previous lecture occupation); judgment of mathematical content of seminar occupation (the analysis of the studied physical process or the phenomenon; analysis of statement to IPDE; the analysis of structure of auxiliary data from the physical and mathematical disciplines necessary for the decision for IPDE; the analysis of possible approaches to the decision to IPDE and the expected results of her decision; analysis of methods of the proof of the corresponding theorems of existence, uniqueness and conditional stability of the decision to IPDE, their constructibility; the analysis of novelty of the considered return task for students, etc.); the stages of the organization of the developing training of students determined by mathematical contents.

In the course of the didactic analysis it is necessary to pay attention to statement of the purposes of seminar occupation which are defined by the mathematical content of this occupation, a role and the place of seminar occupation in the section of content of training in IPDE.

Besides, it is necessary to carry out the analysis of structure of seminar occupation which includes:

- training of students for active, conscious assimilation of knowledge (updating of knowledge and her receptions; ways of creation of motivation of training in IPDE or problem situations; statement is more whole than seminar occupation);

- the analysis of the scientific character, completeness and sequence of a research considered to IPDE; methods of activization of activity of students at the decision to

IPDE, degree of their independence, methods of management of cognitive activity of students, implementation of feedback;

— the analysis of system of mathematical tasks from special sections of mathematical disciplines (the generalized functions, analytical functions, fundamental solutions of the differential equations, the nonlinear integrated equations, etc.) which decision promotes the successful decision to IPDE;

— the analysis of forms and control methods assimilation of knowledge in the field of the theory and methodology to IPDE students;

— the analysis of logic of seminar occupation, interrelation of his stages, logic in transition from one stage of occupation to another;

— the analysis of registration of results of solutions of mathematical tasks from special sections of mathematical disciplines or decision IPDE to a board;

— analysis of summing up seminar occupation;

— analysis distribution of time for various stages of carrying out seminar occupation.

It is also necessary to carry out the analysis of realization of the developing and educational purposes which, in particular, assumes:

— development of all-educational abilities of students (ability to work with educational and scientific literature across IPDE);

— development of intellectual abilities of students (mathematical, logical, speech);

— formation of scientific outlook of students (ability and skills to reveal application to IPDE in applied researches);

— development of independence of students in mastering of the theory and methodology to IPDE;

— accounting of specific features of students;

— development in students of motivation of the doctrine;

— development in students of logical, algorithmic and information thinking;

— detection of level of insistence of the teacher, his objectivity in an assessment of knowledge and abilities of students;

— formation of culture of communication of the teacher with students.

In the course of carrying out seminar classes in IPDE it is expedient to fix and analyze didactic units and informative means which have to be acquired by students when training each section of training in IPDE. Mathematical and physical concepts, definitions, axioms, lemmas, theorems of existence, uniqueness and stability, constructive algorithms of the decision to IPDE are among such didactic units. Their assimilation at the level of knowledge, understanding, application in standard situations is reached by means of the decision of protozoa to IPDE. Mastering students of such didactic units is the initial stage of mastering methods and receptions of the decision to IPDE according to the concrete section of content of training in IPDE.

It is necessary to observe coherence of subjects to IPDE of seminar occupations lecture not only on types and identity of the return tasks, but also to consider a professional orientation of training. It is expedient to reveal functions in teaching and educational process which are performed at the decision to IPDE among which motivational informative, developing, bringing up, operating, illustrative.

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## **ДИДАКТИЧЕСКИЙ АНАЛИЗ УЧЕБНЫХ ЗАНЯТИЙ ПО ОБРАТНЫМ ЗАДАЧАМ ДЛЯ ДИФФЕРЕНЦИАЛЬНЫХ УРАВНЕНИЙ**

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В статье обсуждаются результаты дидактического анализа организации и проведения семинарских занятий по обратным задачам для дифференциальных уравнений для студентов высших учебных заведений физико-математических направлений подготовки. Такой анализ включает: общую характеристику математического содержания семинарских занятий; изучение структуры семинарского занятия; реализацию развивающих и воспитательных целей,

выделение дидактических единиц и познавательных средств, которые должны быть усвоены студентами при изучении каждого раздела содержания обучения обратным задачам и другие важные психолого-педагогические аспекты. Обращается внимание на установление соответствия тем семинарских занятий лекционному материалу и выявление функций в учебно-воспитательном процессе, которые выполняются при решении обратных задач, а также на необходимость демонстрировать различные математические приемы и методы их решения.

Такой дидактический анализ помогает не только выявить такие обратные задачи, при решении которых студенты могут коллективно включиться в творческий процесс поиска их решения, но и эффективно организовать контроль усвоения знаний и умений студентов по обратным задачам для дифференциальных уравнений.

**Ключевые слова:** обучение обратным задачам для дифференциальных уравнений, дидактический анализ учебных занятий, студент

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