Implementation of Humanitarian Components of Applied Mathematics Teaching for University Students with a Specialization in Science

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Abstract

The paper deals with the methodological aspects of teaching of applied mathematics for university students with a specialization in natural sciences in the context of higher mathematical education humanization. It describes the organization of classes for teaching of applied mathematics aimed at human development.

Keywords: A Task Approach, Humanization of Higher Mathematical Education, Student, Teaching of Applied Mathematics

1. Introduction

Results of research in the field of applied mathematics made a significant contribution to scientific and technological progress, which has become an integral part of modern civilization. We shall note such its components as nuclear energy, thermonuclear fusion, space exploration, satellite television, weather forecasting, prevention of atmospheric disasters, the study of terrestrial parts of the world and the world's oceans, mineral exploration, and others. However, it is widely known that in some cases implementation of applied research results may cause global environmental problems, irreversible negative processes in the environment. Such a situation would inevitably lead to a contradiction of modern achievements of world science and its social and moral aspects. Obviously, expert humanitarian analysis is needed for the applied research, for the experts in human sciences to express their point of view on the process. Higher applied mathematical education should also bear ideas of humanization and the accompanying humanitarization. It is no coincidence that the modern development of society is characterized by

the improvement of the education system, which is based on the principles of humanization and humanitarization to develop common cultural components and form of personal maturity of students. A significant contribution to solving the problem of personality development by means of math study made.

Modern applied mathematical education contributes to humanitarization of higher mathematical education. The concept of mathematical education humanitarization is being developed since the nineties of the last century. Back in 1988 the All-Union Congress of National Education, held in Moscow, adopted a resolution which instructed the USSR State Education together with the All-Union Council of National Education, ministries and committees of the Union Republics to consider ways of humanization and humanitarization of the entire education sector. The content of the documents and materials of subsequent conferences and forums defines the strategy for the development of modern education - ensuring the quality of education on the basis of preserving its fundamental nature and compliance with current and future needs of the individual, society and state.

Various Russian and international scientific conferences consider the problem of humanization of mathematical education. One of such international forums "Future projects: a multidisciplinary approach", was held in Zvenigorod in 2006, it discussed a range of issues related to the strategic outlook for the world and Russia, foresight, simulation, system analysis of possible alternatives. At that forum pointed out that the introduction of technology, combining both humanitarian and mathematical tools of analysis and forecasting of complex processes in the practice of research and practical decision-making requires a different level of understanding of humanitarian and mathematical fields of study than that which is currently available. And appropriate changes in the education system are required to increase this level.

2. Materials and Methods

The relevance of research. The traditional system of applied mathematical education is experiencing a contradiction between the need for humanitarization of higher mathematical education, the use of modern applied mathematics as a factor of humanization of higher mathematical education, and the imperfection of the existing teaching systems in the context of humanization of applied mathematics teaching. The existing teaching systems help to form students' skills to independently and knowingly use or develop effective mathematical models, as well as to form students' humanitarian culture and the foundations of humanitarian analysis of applied research.

This contradiction is needed to be resolved by developing methodological aspects of applied mathematics teaching in the context of humanization of higher mathematical education, which justifies the topic of the research.

The subject of the research is the applied mathematical training of students of higher educational institutions.

To solve the tasks assigned to the research, the following methods were used: analysis of domestic and foreign studies on pedagogy, psychology, philosophy, applied mathematics, generalization of experience of teaching applied mathematics for university students, the analysis of curricula, textbooks, dissertations, conference proceedings, conversation, observation, holding lectures and workshops with the students, pedagogical experiment and analysis of experimental activity.

Theoretical and methodological basis of research is formed by the fundamental works in the field of education humanization in the field of professional training and problems of individual development by means of teaching mathematics on the issue of the implementation of inter-subject relationship in applied mathematics teaching 1-19.

3. Results and Discussion

Applied mathematical education is a significant component of the fundamental training of university students. Training of students to solve applied problems, development of applied mathematical culture is one of the important goals in the process of applied mathematics teaching. Applied mathematics courses include such educational courses as ordinary differential equations, partial differential equations, numerical methods, optimization methods, operations research, theory of probability and mathematical statistics and other educational subjects. In addition, it should be noted various special courses of applied mathematics devoted to mathematical modeling, inverse and ill-posed problems for differential equations, mathematical cybernetics, fractal sets and others[1-3]. The content of the applied mathematical subjects is based on the latest achievements of scientific areas, such as: mathematical physics, spectral theory of differential equations, mathematical modeling, computational methods, operations research, optimal control, inverse problems for differential equations, etc.

The applied mathematics teaching uses specific terminology, implements interdisciplinary communication between mathematical courses, uses mathematical models and methods of their study. During training students are offered training objectives and tasks, the solution of which is fundamental, because the principle is subject to allocation stages of rational discourse.

One of the means of implementation of the process of humanization of applied mathematical education is a task approach[5,9]. and others if a task approach is based on humanitarian-oriented system of problems, in this case we can talk about task technology of humanitarian development of the individual. pay attention to the requirements that are related to the teaching of students personal responsibility for the environment, the consequences of their actions in relation to it, for their health and a healthy lifestyle, which constitute an

important part of the principle of congruity with nature, which was founded by the authors of nature-aligned revolution in pedagogy[4].

The approach leads to subjective and humanities beginning of knowledge about the world. Humanitarian-oriented classes on applied mathematics are aimed at situations that require students to make logical judgments of humanitarian character based on the research of mathematical models, to overcome moral contradictions, to make an informed choice of the right position in society. In these classes students get acquainted with a problem of humanization of applied mathematical education and the problem of moral social responsibility for the consequences of the practical implementation of applied research that needs expert humanitarian analysis.

The task serves as a means of organization and management of educational activity of students in the process of studying. According to the pedagogical Encyclopedia[13]: "The cognitive task is a learning task, suggesting the search for new knowledge and techniques (skills), and stimulation of active use of relations, relationships, evidence. The cognitive task cannot be solved by ready models, it expects new solutions, which require a guess, reckoning, etc... Highlights such main features of mathematical tasks in teaching in pedagogical institution of higher education: training (aimed at creating a system of mathematical knowledge and skills); developmental (aimed at the development of mathematical thinking); educative (aimed at the formation of a scientific outlook, cognitive interest, creativity, independence, personal qualities); controlling (related to quality control of mastering the material under study); methodical. This puts the task of examining task approach possibilities at the technological level.

It is well known that one of the directions to modernize current education, which considers the development of the individual student as fundamental, is technification of educational process. T. M. Safronova's article 14 quotes the idea of that the development of traditional pedagogy and methodology cannot ensure the functioning of a common educational space, and that the beginning of the technological age is forecasted now, which begins with the parameterization and technification of basic objects and categories of traditional pedagogy involved in a new direction of design of educational systems and learning processes. In[18] considers that hierarchically organized sequence of tasks constitutes a program of human

activity. According to[12] cognitive tasks are an effective means of transferring of social experience elements to a new generation; they reflect both the substantive and the procedural side of learning activities. In[15] finds it promising to consider task-technology as "a kind of law-conforming" activities involving the design and implementation of the educational process as a unity and creative improvised law-conforming activities involving the achievement of planned results through purposefully oriented system tasks, contributing to the development of certain personal qualities of students.

The design unit assumes the initial diagnosis, the diagnostic definition of objectives, content selection and design targeted oriented system of problems, the selection of teaching resources.

Designing humanitarian-oriented classes of applied mathematics involves several steps:

- Mathematical and training analysis of the content of applied mathematics teaching. The main objective of the analysis is to identify the humanitarian potential of applied mathematics teaching, to identify learning objectives, topics. The latter should reflect the organic synthesis of common cultural, scientific and industrial purposes. Humanitarian-oriented classes of applied mathematics should be shaped by methodological knowledge, which are not always explicitly represented in it.
- The selection of tasks included in the content of applied mathematics teaching. When planning workshops to teach applied mathematics we shall analyze all the educational applied mathematical tasks that are expected to be offered to students. Depending on their complexity, it is advisable to offer the students to solve them at seminars or laboratory studies using computer technology. In the future, to design workshops connected with both the previous classes and the new ones. Professional orientation of training, depending on the future specialty of students plays an important role in the selection of application tasks. One should strive to ensure that the setting of tasks and their solutions fully manifest applied mathematics while selecting tasks for each class. At the same time, there is a contradiction between the limited time allocated for the course on the one hand and the need to consider the variety of application tasks by virtue of their informative, extensive use of applied research and humanitarian

analysis of mathematical models and real physical objects, which implies a considerable amount of time, on the other hand. In this case, after a thorough study of educational tasks, consideration of further similar applications in more general formulation (both lectures and seminars) may be limited to formulation of the mathematical problem, an indication of the general scheme of study with reference to the results of the task previously discussed in the classroom. And in the future one pays attention to the use of this application task in a humanitarian analysis of real physical objects. Investigation of such application tasks for already known scheme can be given as an independent or individual work of students.

Training application tasks considered in applied mathematics teaching must have the cognitive, developing, practical functions. It is reasonable to consider various approaches and methods of solving training tasks, which allows to organize the creative process for students to find their solution, to teach various approaches and methods of research application tasks. Many application tasks are ill-posed problems. In the course of their studies, students prove the corresponding theorems of existence, uniqueness and conditional stability of solving application problems, analyze the correctness of the set, make logical judgments of applied and humanitarian nature. That, in turn, develops the students' rational thinking, policy and humanitarian culture.

- Formulation of learning objectives and planning of classes in applied mathematics teaching. Setting of educational diagnosable learning objectives of applied mathematics teaching is aimed at students to understand the material presented in the learning process, be aware of the role of mathematical modeling in applied research, have an idea about the methods of solving application tasks, be aware of humanitarian potential of applied mathematics teaching, be able to use the method of mathematical modeling in humanitarian analysis of real physical objects, etc.

In accordance with the educational aims a teacher plans applied mathematics classes. The corresponding system of lectures, seminars and laboratory studies requires each of them to be a certain stage for others, to serve as a basis for building the next stage, i.e. to be an organic part of the whole system. It is therefore important to define cross-cutting ideas and determine the role of each class in the implementation of these ideas when planning a presentation of each course for applied mathematics teaching. When planning a system of classes one should strive to ensure that they use various methods of training and various forms of students' activity in solving practical problems. It is well known that such a requirement to a system of classes on any subject is explained by the fact that monotony can tire students; they can lose their interest in the process of teaching. A variety of forms, methods and techniques of applied mathematics teaching contributes to the development and formation of the person of students in general, rather than any of its individual components. It should be based on the principle of optimal combination of different forms, methods and means of education, which is based on these didactic rules: the choice of forms of education organization, which is dictated by the objectives of training and the specifics of humanitarian-oriented classes; the need to correlate the form of training with real educational opportunities of a specific student group and its individual students.

4. Conclusion

Humanitarian-oriented classes on applied mathematics focus on creating situations that require the student to decide on important issues for mankind, to make justified choice of the right position in the society, to overcome the moral contradictions.

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