METHODS OF TEACHING HIGHER MATHEMATICS AT THE TECHNICAL UNIVERSITY

J. J. Ergashev
Tashkent state technical university
UZBEKISTAN

ABSTRACT

The level approach to teaching methods contributes to the creation of situations of success in educational and cognitive activities and, in general, directs the learning process not only to the assimilation of information, but also to the formation of students' independence, to disclose their personal potential, to increase their internal motivation. The learning outcome is assessed not by the amount of information communicated, but by the quality of its assimilation and the development of the student's abilities for further independent education.

Keywords: Student, higher mathematics, methodology, teaching.

INTRODUCTION

At the present stage of development of educational technologies, one of the most important factors in improving the quality of training of specialists in higher educational institutions is the rationalization of the educational process through optimal curricula, new generation programs, new forms and methods of teaching.

Teaching higher mathematics in accordance with the described principles presupposes significant changes in the presentation of mathematical material and in the organization of its assimilation in comparison with the traditional model. The movement on the subject unfolds in the logic of the systemic study of mathematical objects. The description of the training content is built using a multi-level system of concepts.

Mathematical disciplines have a huge applied potential, which makes it possible to identify essential connections between phenomena and processes in professional activity. Mathematics allows future engineers to develop techniques for constructing and analyzing mathematical models of engineering problems. She also develops intuition and reflection in the processes of forecasting and decision-making under conditions of uncertainty.

Improving the mathematical training of future engineers is a multifaceted problem, the solution of which requires a deep assimilation of the foundations of mathematical science, the ability to see and use within subject and inter-subject connections, the applied orientation of the course of higher mathematics, the formation of students' ability to apply mathematics to solve practical problems, to model phenomena and processes occurring in production and in nature.

LITERATURE REVIEW

The search for effective forms of the educational process, taking into account the specifics of the student's personality, undertaken by the Department of Higher Mathematics of the Tashkent State Technical University (TashSTU) for many years, led to the development of a tiered methodology for organizing the educational process in higher mathematics. The origins of this

methodology can be found in [1-3]. The textbook [1] is, apparently, the first experience in writing textbooks with several (I must say, very difficult) levels of depth of material presentation; in the book [2], the same material is presented in parallel on two levels (light and high). The manual [3] is historically the first in the methodological support of the level educational process in mathematics, developed and implemented by the Department of Higher Mathematics of Tashkent State Technical University.

The task of the level methodology of the educational process is to awaken students 'interest in acquiring knowledge, help the student in overcoming difficulties, accelerate the adaptation process for first-year students in a university, and ensure the organization of students' independent work.

The study of higher mathematics, in turn, has the goal of educating a modern engineer who harmoniously combines professional skills, wide era and competence, mathematical culture, intellectual development and a high level of general culture of the individual as a whole.

The level approach to teaching mathematical disciplines is aimed at obtaining flexible, systemic, generalized knowledge, skills, abilities, research techniques and solving mathematically formalized problems by the future specialist, as well as at developing his creative attitude to business and a desire for self-education, which further determines the ability a specialist to implement the modern requirements of society at the highest level, gives him the opportunity to be professionally mobile, adapt to new areas of activity and, thus, be in demand on the labor market.

METHODOLOGY

Motivation. The higher mathematics course at the university is based on the mathematics curriculum of the general secondary school. The teacher of a higher school must preserve the best that was laid down in the students during school years, develop the level of mathematical culture that was acquired by students at school, and provide an opportunity for personal growth in the field of mathematical activity for both those students who have a high level of school preparation, and and more poorly prepared students. Undoubtedly, an individual, differentiated approach to learning is needed here, taking into account the level of training, the abilities of students, their psychological differences. In addition, the study of higher mathematics as an academic subject has a number of features, assumes the assimilation of material at various levels of abstraction and is laborious even for students with good school preparation. But there are quite a lot of students among the students with a low level of cognitive motivation and poor mathematical training, a wide spread in the level of training of freshmen is obvious. Therefore, the need to organize the learning process in accordance with a personality-oriented technology that activates the student's educational and cognitive activities, contributing to the formation of his mathematical culture becomes urgent.

Analyzing the reasons for the low academic performance of students, one can single out such factors (as significant), such as:
- the presence of gaps in knowledge, skills and, as a result, a low level of independence and inability to solve the task in general;
- low level of feedback (mainly the result is controlled, not the learning process);
- the pace of training, as a rule, is not adequate to the level of training of a particular student (orientation towards the average student).

The traditional methodology of higher education, designed for an abstract "average" student, does not seem to be flexible enough to effectively conduct the educational process, taking into account the student's personality, his abilities, the initial level of education (in a particular subject), etc.

A clear delineation of the material by levels of difficulty and the allocation of a mandatory field of knowledge in a subject is a powerful incentive and additional motivation for learning not only for well-performing students, but also for those who find it difficult (especially in the 1st year) to master sufficiently abstract material of higher mathematics.

The leveled methodology makes it possible to successfully correct the initial knowledge (school education) of freshmen directly during the course of studies in the course of higher mathematics, which contributes to the adaptation of the student at the university. An important advantage of this technique is its focus on work and a pronounced motivation to receive a good education, as evidenced by the experience of conducting subject Olympiads.

Each student realizes and uses his strengths, understands and compensates for his weaknesses. Thanks to the layered approach, students develop the ability to plan, analyze and evaluate their learning activities.

Principal description. The purpose of the level technology of the organization of the educational process is to create conditions for the inclusion of each student in the activity corresponding to the zone of his immediate development, to provide conditions for independent (and / or under the supervision of the teacher) mastering the program material in the amount and with the depth that individual characteristics of the student, which, in turn, has the goal of forming the student's mathematical culture as part of his culture as a whole. Thus, learning is a purposeful and motivated process and the teacher's task is to include each student in activities that ensure the formation and development of cognitive needs. The teacher moves from the position of the bearer of knowledge to the position of the organizer of the student's successful educational activity, fully applying the pedagogy of cooperation, which allows to achieve sustainable interest and a positive attitude towards the subject.

The program is the first component of the level organization of the educational process and contains modules for completeness and depth of presentation of the material. At the same time, three depth modules are represented in each completeness module: basic, profile and deep. This curriculum is based on the principle of fundamental (multilevel) mathematical training of students with the strengthening of its applied orientation. The program was developed in accordance with the level technology of teaching used in the Tashkent State Technical University for the methodological support of teaching mathematical disciplines. In a level-based typical program in higher mathematics, material is classified both by its importance and by the level of difficulty.

Sets and operations on them. Faces of numeric sets *. Basic numerical sets. Extended number line *. Elements of mathematical logic (necessary and sufficient conditions, direct and inverse theorems) **. Symbols of mathematical logic and their use. The concept of mathematical structure * *.

Display, its scope, values * and graph **. Function as display of numeric sets *. Function of one variable, ways of setting it. Examples of functions of several variables *. Number

sequences. Basic elementary functions, their properties and graphics. Complex and inverse functions. Class of elementary functions.

The neighborhood of a point, the neighborhood of an infinitely distant point *. Limit of a function at a point and at infinity. Endless limits. Limit in the language "e-S" *. One-sided limits. Limit properties. Limit of a Sequence Lemma on a bounded monotone sequence *. Infinitely large and infinitely small functions, their properties. Remarkable limits. The number "e". Disclosure of uncertainties. Sequence condensation points **. Upper and lower limits of the function at point **. Topological definition of the limit **.

Continuity of a function at a point and on an interval. One-sided continuity *. Properties of continuous functions. Function breakpoints and their classification. Continuity of elementary functions. Theorems on continuous functions on a closed interval and their application in solving equations and inequalities *. Continuous displays **. Uniform continuity **. The closed graph theorem **. Semi-continuous above and below functions **.

Complex numbers and actions on them. Complex plane. Algebraic, trigonometric and exponential notation of complex numbers. Moivre and Euler's formulas. Extracting the root of a complex number *. The concept of number systems with several imaginary units **.

Let us note some of the fundamental aspects of the level technology of organizing the educational process in mathematics at the university. All the studied program material is divided according to topics into blocks, which are classified into three levels: A, B, C.

The first level material A (basic) is a mandatory field of knowledge in the subject - the minimum program - the level of knowledge necessary for the successful continuation of training.

The second level B is marked with an asterisk (*) and contains tasks that expand the student's understanding of the topics studied, establishes connections between concepts and methods of various sections, gives their rigorous mathematical justification, as well as examples of the use of mathematical methods in solving applied problems. Material A + B (profile) levels A and B covers the entire standard program of the course in higher mathematics - the maximum program - and is sufficient to ensure the student's independent (or under the supervision of the teacher) work with educational literature. Its complete mastery corresponds to the highest mark on the exam. Level C (optional) is marked with two asterisks and contains material of increased difficulty, expanding and deepening the classical mathematical education of an engineer - these are modern sections of mathematics and its applications, and mathematical modeling, and the study of real practical problems, taking into account the chosen specialty, and non-standard problems of an Olympiad nature , requiring a search for methods of solution, etc. Material A + B + C of three levels - an in-depth program opens the way for research in the field of applications of mathematics. Note that the lower level material does not require recourse to the higher level.

The sequence of presentation of the material and its distribution by semester is developed in the corresponding work program of the discipline, taking into account the specialization of specific specialties, based on the tasks of timely mathematical support of general scientific and special disciplines and preserving the logical harmony and completeness of the mathematical courses themselves. It is assumed that a deep mastery of the basic concepts and methods of

higher mathematics will allow students to master those additional sections that they will need in the future.

The directions of the level methodological support of the educational process are mainly traditional in content: lectures, practical and laboratory classes, control and independent work, work under the supervision of a teacher, exams (including in the form of tests), etc., but they are organized according to the level methodology.

Let us dwell in more detail on the main forms of the educational process with the use of leveled teaching technology.

DISCUSSION

Lectures. Special consideration should be given to the question of the methodology of lecturing lectures. At the lectures, basic mathematical concepts are introduced and explained, the role and specificity of mathematical modeling in engineering and mathematical education in the formation of a specialist's personality are emphasized, mathematical statements - theorems are proved and basic mathematical methods are presented. Mathematical concepts, statements and methods, where possible, it is desirable to illustrate on geometric (mathematics in pictures) and / or physical objects, if possible, taking into account the future specialty of the trainees, which allows us to present mathematics as a universal language for studying special disciplines - the language of "communication of civilized engineers ". It is recommended to lecture at levels with a well-thought-out system of indicating (marking) levels.

The main attention, of course, should be paid to the fundamental methods, ideas and algorithms of mathematics. The first level of complexity contains the motivation of the introduced concepts, the formulation of the main statements, comments on definitions, properties and theorems, examples, simple proofs with a "transparent" idea. The second level includes strict formulations, definitions, evidence and material, which makes it possible to have a deeper understanding of the topics under consideration, expanding the student's understanding of the subject.

It is no secret that when working through lectures, many students have difficulties if the presentation is not conducted taking into account the levels of importance and complexity of the material.

Most (average) students, as a rule, listen to the lecture until the first incomprehensible (usually more difficult - level B) place and, not "grasping" the essence here, stop following in the future. At the consultation, having skipped these passages at the first reading on the recommendation of the teacher, they then safely disassemble the entire lecture. Hence the conclusion: more difficult passages should be announced (with the help of thoughtful notation) immediately when giving a lecture. For example, the wording of a statement, its intuitive or geometrical justification - interpretation (mathematics in pictures), examples of application can be given at the A level, and a strict mathematical justification, the materiality of sentences, counter examples, etc. are carried out at a more formal level B.

Practical lessons. In practical lessons, students clarify and consolidate the lecture material, receiving an explanation of the main theoretical provisions of the course, master the basic methods, techniques and methods for solving mathematical problems, including those adapted to the future specialty. A level technology of methodological support of practical lessons is recommended, according to which each student on each topic receives one of the equivalent tasks at all levels at

once: A + B + C, however, begins to perform the next level only after completing all the tasks of the previous one. When completing the A + B + C level task, a strong student, like a weak one, is obliged to complete the standard A level tasks, while, as a rule, he does it much faster and often in a more original way. As a result of completing the task, each student is at his own level: A, A + B or A + B + C. It is also useful to conduct a diagnostic level test in elementary mathematics at the first lessons in higher mathematics, which allows to determine the quality of knowledge, skills and abilities of the entrants. Based on the results of this test, students who did not pass it can be offered a level-level assignment in elementary mathematics. It is advisable to conduct this test in those sections of the school course, which are then more in demand in the course of higher mathematics, and it is enough to prepare tasks in two levels: A and B. Here, the student's initial awareness of his own (individual) abilities occurs.

Usually level teaching is associated with the distribution of cards of various difficulty levels: for the strong and for the weak. From our point of view, such a division into "strong" and the rest seems to be wrong. In our country, as already noted, each student receives an assignment at all three levels at once, and in order to become “strong”, he must quickly cope with the “weak” part.

Independent work of students. One of the primary tasks is to improve the forms and methods of students' independent work, which plays a leading role in the development of their cognitive abilities, readiness for self-education, contributes to the development of creative skills, initiative, and the ability to organize their time.

The program of the course "Higher Mathematics" is quite extensive and is built mainly on the basis of the material studied in the previous periods of study. Therefore, the gaps of "this period" in the knowledge, skills and abilities of students lead to the fact that the successful continuation of education becomes difficult. Failures in education can lead to psychological depression of students, moreover, to the fact that some of them will have to interrupt their studies at the chosen higher educational institution. One of the main reasons for this is the lack of skills of independent work among trainees against the background of constant novelty in the educational process, the use of special methods and forms of organization of training, where independent work is brought to the fore. As a result, a serious problem arises of adapting students to learning, enhancing cognitive activity and organizing independent work, which together are aimed at restoring lost knowledge and skills. Since there are no specially allocated hours for repetition in the course, insufficiently initially prepared students in the first classes in higher mathematics receive a "simulator" - a set of exercises for working out certain, specific skills and abilities of the "previous period" of training. This complex is accompanied by a special reference literature developed at the department. The tasks of the simulator are aimed at providing a basic initial level - level A in the level organization of the educational process implemented at the Department of Higher Mathematics of Tashkent State Technical University, which allows laying the foundation for successful continuation of training. In essence, the system of such an approach is aimed at “stirring up” the student, instilling in him a taste for independent work, bringing him to the understanding that a significant part of the problems in the transition to solving problems is associated with insufficiently careful study of the theory and, finally, to provide students with assistance in resolving emerging problems.

The learning process is well and correctly organized if the main actor in it is the learner himself. The teacher in this process is assigned a role, although very important, but still of the second plan - to help, in any case - not to harm. Thus, in the foreground in the learning process is the

independent work of the student himself as the most important condition for the quality (effectiveness) of training.

Let's note the main directions of the organization of independent work of students at the Department of Higher Mathematics of Tashkent State Technical University.

1. Selection of material and development of assignments for independent work, designed for both short-term and long-term execution periods.

2. A differentiated approach in defining tasks for independent work by gradually complicating the material, observing feasibility in tasks, taking into account the volume of the discipline being studied and the level of complexity. A gradual transition from the simplest forms of educational research work of students to the higher form outside the academic research work in senior years. Here it is also recommended to provide a level methodological support, and it is advisable to issue assignments for independent work for at least a week (every Sunday). At the same time, a tiered approach to the organization of the educational process is used.

3. Determination of reporting forms, scope of work, deadlines for submission and control of implementation and results achieved (including with the help of computer tools): a survey at a training lesson, report, intermediate and final testing, control work, laboratory work, colloquium, test, project protection. In the organization of control and self-control of students' knowledge, an important role is assigned to independent verification work designed to correct knowledge in the course of studying the material. Let's note some ways of carrying out such work:
- independent work is carried out in the classroom, but with preliminary preparation of students, including setting tasks, repeating the necessary theory;
- independent work is done at home, and in the classroom, its results are checked;
- independent work is carried out in the classroom, without preliminary preparation (and often without warning) of students.

4. Close connection of independent assignments with special disciplines, professional orientation.

5. Providing students with access to specialized literature, information and technical resources, allowing them to more professionally solve and analyze problems.

The independent work of students is mainly organized through current assignments for practical exercises, the issuance of computational graphic assignments (standard calculations) on the selected topics of the course, theoretical topics submitted for independent study, as well as within the framework of students' research work. The management of independent work is carried out mainly through consultations and self-training of students under the supervision of a teacher, which should also be ensured by appropriate curricula.

At consultations, the teacher first conducts introductory conversations, the main purpose of which is to repeat the necessary material necessary for the successful completion of the work, and then generalizing conversations, during which incomprehensible places are clarified, mistakes made by the student are corrected. Here, pedagogical support seems to be in demand: consulting assistance of a teacher, as well as discussion of tasks by the students themselves, group and individual consultations taking into account the personal characteristics and capabilities of students.

CONCLUSIONS

The level approach to teaching methods contributes to the creation of situations of success in educational and cognitive activities and, in general, directs the learning process not only to assimilate information, but also to form students' independence, to disclose their personal potential, to increase their internal motivation. The learning outcome is assessed not by the amount of information communicated, but by the quality of its assimilation and the development of the student's abilities for further independent education.

The level organization of the learning process in accordance with the personality-oriented technology, which activates the student's educational and cognitive activities, contributing to the formation of his mathematical culture, seems extremely relevant. It is focused on fulfilling the most important task of higher education - training specialists who are able to think creatively and work independently, identify problems and find ways to solve them.

The implementation of the level methodological support of the educational process requires a significant revision of the existing "standards" of the teaching load, especially the departments working with the first year. One of the primary steps in this direction could be the introduction of self-study hours in the grid for the first year under the supervision of a teacher.

REFERENCES

1. Il'in V.A. Matematicheskiy analiz. / V.A. Sadovnichiy, Bl.X. Sendov. VI.: Nauka, 1979.

2. Manturov O.V., Matveyev N.M. Kurs vysshey matematiki. –M.: Vysshaya shkola, 1986.

3. Marchenko V.M., Yanovich V.I. Metodicheskoye posobiye po razdelu.