INFORMATION – ACTIVITIES POINT OF VIEW AS

THE POSSIBLE BASIS OF HIGHER MATHEMATICS

G.A. Larionova
Chelyabinsk State Agricultural University
75 Lenin prospect, Chelyabinsk, Russia 454080
davydov@csu.ac.ru

ABSTRACT

The course of higher mathematics in the higher educational establishment must aim at: 1) the formation of mathematical knowledge and skills to apply it; 2) the formation of methodology for solving applied problems.

The first and the second functions can be carried out in general on the basis of certain point of view and the leading role of the development of student's mentality. For the effective teaching of higher mathematics we must take into consideration the double nature of mentality, that may be formed as search of values and personal sense of life, and as information process, which is determined such as the perception, keeping and remarking of information. In the abstract meaning the remarking of information by all means is regulation and compression of it to determinate aim or the given problem, by definite language or code. For professional activity this is the selection of information from the "noise", lowering the entropy according with the interests, orientations and possibilities of the specialist's personality.

The factor of integration of the variety of different given training of methods and application for development of thinking of the future specialist concerning its double nature, can be information - activity point of view to professional training and development of the student's personality.

Its main idea is the organization of the educational- professional activity, in which the compression of the training information takes place by regulating it, by imitation of professional activity according to the subject, the nature of motives, knowledge and actions of their application.

The course of higher mathematics in the higher educational establishment must be aimed at these functions: 1) the formation of mathematical knowledge and skills to apply it; 2) the formation of methodology to solve of the applied problems.

The first and the second functions can be carried out in general with the third function on the basis of certain point of view and the leading role belongs to the function of the development of students' mentality, which we have been examining in the course of higher mathematics in more detailed way.

These aims were abovementioned from the general problems of education and the tendency of its were development. In particular, the specialists note that the majority of students are not clever enough to solve creative problems. The solution of these problems requires *quick orientation* [1, 2] in the given information and the problem situations, *organization* of the problem (defining what information can be take from the problem situation, what is required to describe it, what information and methods can be used for the solution), *planning* of solution of the problem (the definition of lacking information (self-education) for solution, the selection of the mathematical methods of solution and definition of its algorithm and also mathematical verification of it), *realization* of the algorithm of solution with the help of computer, *the control* of the process and results the new information (or results of solution), *interpretation of the obtaining result* in the language of problem situation (the decoding of the new information).

Thus, in the course of mathematics, the students must learn the basis methods of solution the problems, the their algorithms, mathematical verification of these algorithms and to use them creatively.

The knowledge of the methods of solution the problems may be defined as the methodology of solving the applied problems. For example, the subject of the calculus is the approach to the solution of the applied problems, consisting of two positions:

> 1. All real processes or objects "in the infinitesimal" can be take proportionally and can be classified with the help of the prime models or linear dependence.
>
> 2. The simulation of real processes or objects can be extended by means of limited transition from the "infinitesimal" to the real size.

Thanks to this approach for solving the applied problems the differential and integral calculus "were born" as well as, the operations of the differentiation and integration, the notions of derivative and integral, the methods of differentiation and integration and the mathematical verification. The students, learning the calculus as a methodology for solving the problems, receive the concept about the possible situations of application, mathematics and understanding the existence of the other points of view to the solution of the applied problems (for example, the theory of catastrophe, which studies the leap transitions in the real processes, unlike the calculus), while learning they can discover and mathematically verification their own method of solution.

The first and the second functions can be carried out in general on the basis of certain point of view and the leading role of the development of students' mentality [3], because for the creative use of different mathematical methods and their algorithms the progress of the memory [4] is needed as well as, the attention, the rate of thinking and other qualities, without which the effectivity of orientation in the information and its application for organizing and solving given problems is lowering.

How must mentality be developed? To answer this question we must take into consideration the double nature of mentality that may be examined as search of values and personal sense of life [5], and as informational process [6], which is determined as the perception, keeping and remaking of information. In the abstract meaning the remaking of information by all means is regulation and compression of it according to definite aim or the given problem, by definite language or code. For professional activity this is the selection of information from the "noise", lowering the entropy according with the interests, orientations and possibilities of the specialist's personality. It is the essence of the intellectual progress, which is limited by the back of this level of intellectual development of the students, or the discrepancy of their intellectual level of development to the demanded level for doing an educational-professional activity according to the solution of the professional problem. The new organization of mentality is formed by special process or prolonged alternation of special influences. Every stage of any process may be characterized by the new information structure of mentality, which is reflected in its qualities, because the essence of the mentality progress is the purposeful accumulation of the learning information and simultaneous regulating and structuring it according to educational aims of the professional training and the future professional activity. The results of the psychological research confirms that the process of learning in the determine conditions forms the intellectual structure, which correspond to successful cognitive and professional activity. On the other hand, the learning-professional activity presents the all the conditions for intellectual progress of future specialists. Therefore, for the forming the professional activity, the application of the knowledge of mathematics is it necessary and sufficiently to organize intellectual progress on the basis of professional direction of learning information.

Thus, the intellectual progress or the professional direction can not be take separately as they both promote to the becoming of professional activity.

Obviously, that manifestation and development of all the qualities of also thinking take place in the mode of life, in all the training, but in the special centripetal organization of the training is the most intensive and effective. The perspectives of high professional education can be seen in the individual development and discovering of the functional qualities and possibility of brain for remaking of information by means of pedagogic and realization of its possibilities.

The factor of integration of the variety of different given training methods and application for development of thinking of the future specialist, concerning its double nature, can be information – activity point of view to professional training and development of student's personality. Its main idea is the organization of the educational - professional activity, in which the compression of the training information takes place by regulating it, by imitation of the professional activity according to the subject, the nature of motives, knowledge and actions of their application.

Information-activity point of view is the unity of the information point of view, worked out in the theories of information (N. Viner, K. Shennon, S. Goldman and etc) and by psychologists (S. L. Rubenshtain, A. N. Leontiev and etc). The activity access, carried out in psychology for the formation of given characteristics presupposes to include the subject to the definite activity. The fact is that the description of activity point of view doesn't define the mechanism of students' thinking, which can be revealed and realized on the basis of information point of view.

Information point of view is the applicable means of research, which has the specific sense in the teaching of mathematics that determines the ordinary informing of the students. Such learning doesn't ensure the necessary accuracy of knowledge.

For example, the physical sense of the derivative of function often is identifying with as a derivative itself: the derivative = the speed of moving. Such distortion of the understanding of the derivative of function doesn't allow applying it in the solution of problems; the progress of the mentality in this case doesn't take place.

The progress (or its precision) of knowledge and the mentality of the students may take place by engaging the students into a special activity. This may be organized by solving the problem: Let's use the simple example avoiding the notion vector-function.

Define the modulus and the direction of the speed of the movement of the arm of the manipulator, if the trajectory of its movement is defined with the parametric function:

$$\begin{cases} x = 12\cos t, \\ y = 16\sin t. \end{cases} \quad t - \text{time}$$

Solution:
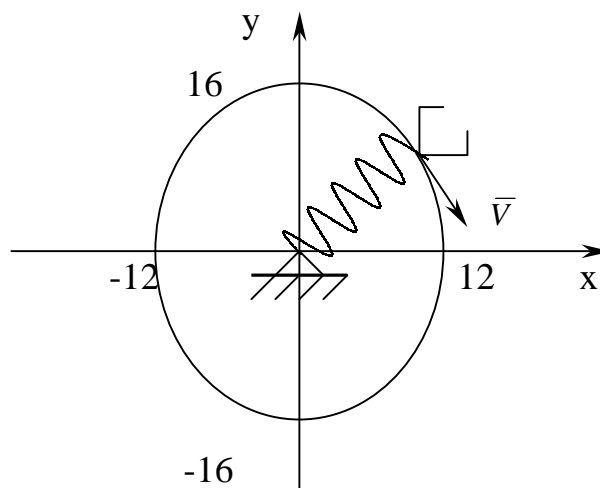
In this case the given trajectory of the movement in the variety is the ellipse:

$$\frac{x^2}{144} + \frac{y^2}{256} = 1.$$

The derivative of this implicit function y'ₓ is the speed of the change of the function (dependent variable) y, concerning the argument (independent variable) x, but it isn't the speed of movement, because the speed of movement is the function of time (this is the change of the curve in the unit of the time). The derivative of the parametric function of coordinates of the arm of manipulator as the function of time defines namely the module of speed of the arm manipulator movement:

$$|\vec{v}| = \sqrt{(x')^2 + (y')^2} = \sqrt{\left[(12\cos t)'\right]^2 + \left[(16\sin t)'\right]^2} = \sqrt{144\sin^2 t + 256\cos^2 t} =$$

$$= \sqrt{144\sin^2 t + 256(1 - \sin^2 t)} = \sqrt{144\sin^2 t + 256 - 256\sin^2 t} = \sqrt{256 - 112\sin^2 t}.$$

The direction of speed may be dinited by the slope of the tangent to the trajectory:

$$\frac{x^2}{144} + \frac{y^2}{256} = 1 : y = \pm 16\sqrt{1 - \frac{x^2}{144}},$$

$$y' = \pm 16 \cdot \frac{\frac{2x}{144}}{2\sqrt{1 - \frac{x^2}{144}}} = \pm \frac{x}{9\sqrt{1 - \frac{x^2}{144}}}$$ - this is the slope of the tangent to the trajectory

(direction of speed) as function of coordinates x.

The solution of the similar problem depends, specifies and *orders* [7] the receiving information in accordance with the aim of the learning-professional activity during the course of study. When, as is noted, the ordering of knowledge is the new structure of the mentality, it means the transition from one stage to another that is the progress of the students' mentality.

Thus, the information point of view as the possible basis of higher mathematics is aimed at preparing of the future professional activity.

That is why one should examine the information – activity point of view in the professional training, in particular as the possible basis of higher mathematics.

This point of views may be determined by some ideas of thermodynamics [8]. The primitive informing of the students is as «Brownian» or «chaotic» component of mentality (aimless accumulation of the information). The development of mentality is as vectorial or directed component (*ordering* of information or lowering of its entropy in accordance with aims of the professional training).

Bibliography:
1.   Teplov B. Selected works. Moscow, 1985.
2.   Leontiev A. Activity. Consciousness. Personality. Moscow, 1975.
3.   Vertgeimer M. The productive memory. Moscow, 1987.
4.   Atkinson R. Human memory and the learning process. Moscow, 1980.
5.   Frankl V. Der Mensch vor der Frage nach dem Sinn. Munchen, Zurich, Piper, 1979.
6.   Solso R. The cognitive psychology. Moscow, 1996.
7.   Abdeev R. The philosophy of the information civilization. Moscow, 1994.
8.   Kvasnikov I. Thermodynamiks and statistical physics. The Theory of the not in equilibrium systems. Moscow, 1987.