REQUISITOS METODOLÓGICOS PARA A ORGANIZAÇÃO DO TRABALHO INDEPENDENTE SOBRE TÉCNICAS DE PROGRAMAÇÃO NEURO-LINGÜÍSTICAS PARA DISCIPLINAS MATEMÁTICAS NA UNIVERSIDADE

METHODOLOGICAL REQUIREMENTS FOR THE ARRANGEMENT OF INDEPENDENT WORK ON NEURO-LINGUISTIC PROGRAMMING TECHNIQUES FOR MATHEMATICAL DISCIPLINES AT THE UNIVERSITY

МЕТОДИЧЕСКИЕ ТРЕБОВАНИЯ К ОРГАНИЗАЦИИ САМОСТОЯТЕЛЬНЫХ РАБОТ ПО ТЕХНОЛОГИИ НЕЙРОЛИНГВИСТИЧЕСКОГО ПРОГРАММИРОВАНИЯ ПО МАТЕМАТИЧЕСКИМ ДИСЦИПЛИНАМ В ВУЗЕ

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RESUMO

As possibilidades de técnicas de programação neurolinguística (PNL) são extensas. As técnicas de programação neurolinguística têm a oportunidade de ajudar uma pessoa a modificar seu pensamento e comportamento para aprender a alcançar os objetivos necessários. Separando os dados dos elementos mais efetivos e objetivos, a tecnologia PNL baseia-se nesses modelos, que podem ser transmitidos para outras pessoas e podem ser usados no arranjo de trabalho independente sobre disciplinas matemáticas na universidade. Então, se uma pessoa tem uma estratégia muito eficaz para a retenção de informações, então um modelo desenvolvido em sua base permitirá que a outra pessoa aprenda a fazê-la eficientemente também. Hoje, a PNL está no auge da popularidade. Praticamente todos os especialistas no campo da psicologia humana estão familiarizados com essa nova direção e estão aplicando ativamente sua metodologia.

Palavras-chave: *programação neurolinguística, trabalho independente, aluno, disciplinas matemáticas.*

ABSTRACT

Possibilities of Neuro-linguistic Programming (NLP) techniques are extensive. The techniques of neuro-linguistic programming have the opportunity to help a person to modify his thinking and behavior so as to learn how to achieve the necessary goals. Separating the data from the most effective and objective elements, NLP technology is based on these models, which can be transmitted to other people and can be used in the arrangement of independent work on mathematical disciplines at the university. So, if a person has a very effective strategy for retaining information, then a developed model on its base will allow the other person to learn how to do it efficiently, too. Today, NLP is at the peak of popularity. Practically every expert in the field of human psychology is familiar with this new direction and is actively applying its methodology.

Keywords: *neuro-linguistic programming, independent work, student, mathematical disciplines.*

АННОТАЦИЯ

Возможности методов нейролингвистического программирования (НЛП) обширны. Методы нейро-лингвистического программирования позволяют человеку изменить свое мышление и поведение. Они необходимы для того, чтобы узнать каким образом возможно достичь необходимых целей. Отделяя данные от наиболее эффективных и объективных элементов, технология НЛП основана на таких моделях, которые могут передаваться другим людям, а также использоваться при организации самостоятельной работы над математическими дисциплинами в университете. Итак, если у человека есть очень эффективная стратегия сохранения информации, то разработанная модель на ее основе позволит другому человеку научиться эффективно делать это. Сегодня НЛП находится на пике популярности. Практически каждый специалист в области психологии человека знаком с данным направлением и активно применяет свою методологию.

Ключевые слова: *нейро-лингвистическое программирование, самостоятельная работа, студент, математические дисциплины.*

INTRODUCTION

The procedure of the functional asymmetry of the cerebral hemispheres or "lateralization of the brain", which is used as one of the sources for the basic NLP assumption that the oculomotor signals connected with visual / auditory / kinesthetic representational systems, and certain areas of the brain, and this technique can be used in the organization of independent work on mathematical disciplines at the university (Dilts, 2000). For example, according to one of the theories of functional asymmetry, the left side is considered to be more logical and analytical, and the right - more creative and artistic, and it is believed that the areas of the brain specialize in performing certain functions, such as those associated with mathematics and speech (O'Connor & Seymour, 2003).

As an independent extracurricular work on mathematical disciplines on neuro-linguistic programming techniques should be used mandatory home tests, focused on practicing the ability to solve mathematical problems, in accordance with known algorithms and formulas (Pidkasistyĭ, 1992). These works provide a level of basic training in the subject, promote to the development of the ability to plan their activities, exercise self-control, work with additional sources of information if necessary (handbooks, guidelines). The advantage of home tests in NLP technology is that they are focused on the individual student's pace of learning activities, as it is considered a leading representative system. Independent work on NLP technology involves group research projects on special subjects, the implementation of which requires not only mathematical skills in research data processing, but also creative, original way of presenting the data, and the creation of this scheme, pivot

tables, charts, graphs). This work contributes to the development of the ability to carry out the transfer of knowledge into a new case study, aimed at the formation of communicative abilities of teamwork, formulates a sense of responsibility for their fulfilled work (Zenkin *et al.*, 2009).

The next form of independent NLP technology activities aimed at the study of special educational, reference, research literature, which involves writing essays, reports on various topics. Abstract work is characterized by the maximum degree of self-reliance and assists in the formation of research and design skills (Fedorov, 2011), develop public speaking skills. In addition, in the process of self-study, organized with the help of NLP technology, the student learns to determine the level of difficulty encountered by him and to formulate them. A quality solution of educational problems in the process of self-study depends on the individual abilities of students, their level of training, as well as the dominant channel of perception (Shevtsova, 2010).

In this regard, the formation of the skills of independent learning activity passes through several stages in its development and begins with short-term tasks performed during a training session. The productivity of such work depends on instructional techniques that promote activation of mental activity. It may be a task to restore the deformed text (task for digitals), drawing abstracts, in accordance with the set-up plan, creating a logical chain (task for kinetics), circuit design (work for the visualizer), filling in tables, work with the educational training program (task for auditors) (Kovalev, 2001). The great interest of students is aroused by the search and study specifically of an error in the tasking. This approach allows a student to change the relationship between teachers and students, creating the basis for an educational dialogue

(Seitova *et al.*, 2015).

Thus, in order to make the educational process not only more effective but also more interesting, fascinating both for the student and for the teacher, it is important to know to which category students are related, i.e., we use elements of neuro-linguistic programming theory (Alder, 2003). For example, it is possible to explain the material, using all channels of perception: hearing, sight, touch. In this case, it is more likely that the student will acquire the necessary information for a long time.

MATERIALS AND METHODS

Independent work of students using NLP techniques - are different kinds of individual work of students, which are carried out under the direction of, but without the direct involvement of the teacher in a specially reserved class and out of class time using the so-called "access keys" (Helm, 2000).

This paper provides the method of arranging independent work of students in the course of mathematical analysis and a workshop on the challenges of mathematics with the help of NLP technology.

The implementation of this methodology is to organize training integral calculus in the course of mathematical analysis based on the individualization of students. A test work on mastering "Indefinite integral" theme has been used for this purpose. The ability to diagnose the level of learning in time and adjust the learning process with the help of neuro-linguistic programming technology allows you to make a more flexible management system (Andreas & Andreas, 2005). Classroom system allows the teacher to monitor the student's actions, comment on them, to show basic methods of control through information technology and neuro-linguistic programming, to create conditions for self-control and mutual control (O'Hanlon, 2009).

An effective form of training in the framework of the proposed method is practical classes and independent work of students performed at home, on their own computers or in the computer lab of the university study (Ayrapetyants, 1987; Kara-Murza, 2000).

Thus, the students' independent work consists of the usual homework and individual

creative tasks. At the workshops, the students are invited to work with the teacher to check the results of homework with the help of a computer, and all individual creative tasks directly related to the use of computer mathematical system MathCAD (Dilts, 2005).

The increasing speed of changing technology brings to the fore the need to implement the principles of advanced training (O'Hanlon & Martin, 2001; Frederick & Phillips, 1995). The challenge is not so much in the transfer of knowledge but in the preparation of a graduate to the possibility of self-mastery of the efficient current professions. Independent work of a student becomes very important (Startseva, 2007).

RESULTS AND DISCUSSION:

In studying the disciplines of the mathematical cycle (linear algebra and analytic geometry, mathematical analysis, probability theory and mathematical statistics, discrete mathematics, etc.) two forms based on NLP technology can be used (Malyshev, 2013): classroom and extracurricular, which can be implemented through the following effective means of training:

- 1 Calculation and graphic works (for visualizers) - multiple sets of documents generated by the subject topics, usually four standard calculations per semester. In one set there are 10 similar options, which consist of several tasks, and one document - a sample of detailed, standard solutions of similar variants. The described method is stipulated by the formation of students' important competencies, as a culture of a written statement of the results of a work; general information culture.

- 2 Testing and evaluation tools are teaching materials for self-study of the results of this section, topics of the course. As a rule, these are computer programs containing common tasks for training. Typically, the programs generate a lot of similar tasks, taking into account the left channel of the dominant perception of the information and students' answers when working with programs are automatically commented. Very popular among students are "zero" options for all types of texts to get prepared for the next lecture-testing, as preliminary work in the mode of training significantly increases the effectiveness of control measures, which include the tasks of various levels of complexity and

depth of internal links with various sections of the course and other disciplines.

3 Electronic Workshop on Mathematics - a set of files, developed in some modern packages of applied mathematical software such as Mathcad program, representing examples of conventional and unconventional solutions of mathematical problems practically without programming and tasks for independent solving (Quinn & Rosenthalb, 2012). Peculiarities of modern instrumentation systems provide the user an extensive range of options for working with data: numerical and analytical calculations, import and export audio and video, graphical visualization of results, animation documents. Electronic workshop on the mathematics used as a reference and starting point for independent research work; they play an essential role for continuing education with the increased share of independence, allow us to differentiate training, providing students with high intellectual capacities starting material for individual self-development (Fernández-López *et al.*, 2013).

Key instruments for Mathcad - are operators and functions. For example, in our calculations, we have used the integration operator and a cosine function (Mullrood, 2004). To select the desired built-in function, it is convenient to use the Options menu.

You can define a user-defined function $f(t)$, which will depend on the variable t . You must use intended for this Mathcad assignment operator (a colon with the sign equal).

$$f(x) := \int_0^x \cos(x) dx \quad (1)$$

$$f\left(\frac{\pi}{2}\right) = 1 \quad (2)$$

We have defined a function $f(t)$, as our integral of $\cos(x)$ with variable upper limit t . Once we have defined the function $f(t)$, we can calculate its value in points (for this it is enough to enter the argument and press the key "equal" to display the document in response), to enter constants, such as π , or use the menu Symbols and Constants menu.

As an argument, there can be used not only scalar but also a vector variable. It may be identified as follows:

$$t:=0,1..5$$

$$[0]$$

$$\begin{bmatrix} 0.841 \\ 0.909 \end{bmatrix}$$

$$f(t) = \begin{bmatrix} 0.141 \\ -0.757 \\ -0.959 \end{bmatrix}$$

Then the result of evaluating the function will serve the corresponding vector.

One of the important features of Mathcad Express is the ability to construct charts in a document. Visualizes cope with this kind of job very well.

Mathcad program is also quite a powerful tool for solving problems of linear algebra (Bandler, 1995; Seitova & Abdykarimov, 2014). Kinesthetics and audials, also show good results during independent works, organized with the help of Mathcad software, due to the fact that the dominant perception of the information channel is activated.

Example 1. Calculate the definite integral

$$\int_0^8 \sqrt[3]{x} dx \quad (3)$$

Solution. First find an indefinite integral:

$$\int \sqrt[3]{x} dx = \int x^{\frac{1}{3}} dx = \frac{x^{\frac{4}{3}}}{\frac{4}{3}} + C = \frac{3}{4} x^{\frac{4}{3}} + C \quad (4)$$

Applying the Newton-Leibniz to the antiderivative formula

$$\frac{3}{4} x^{\frac{4}{3}} \quad (5)$$

($C = 0$), we obtain

$$\int_0^8 \sqrt[3]{x} dx = \left[\frac{3}{4} x^{\frac{4}{3}} \right]_0^8 = \frac{3}{4} * 8^{\frac{4}{3}} - 0 = 12 \quad (6)$$

Example 2. Calculate the definite integral

$$\int_1^2 e^{2x} dx \quad (7)$$

Solution. Using the formula

$$\int e^{kx} dx = \frac{1}{k} e^{kx} + C$$

we get

$$\begin{aligned} \int_1^2 e^{2x} dx &= \frac{1}{2} e^{2x} \Big|_1^2 = \frac{1}{2} (e^4 - e^2) = \\ &= \frac{1}{2} e^2 (e^2 - 1) \end{aligned} \quad (9)$$

Example 3: Calculate the definite integral

$$\int_1^2 \left(\frac{4}{x} - 5x^4 + 2\sqrt{x} \right) dx \quad (10)$$

Using originally found tabular integrals, we obtain

$$\begin{aligned} \int_1^2 \left(\frac{4}{x} - 5x^4 + 2\sqrt{x} \right) dx &= 4 \int_1^2 \frac{dx}{x} - 5 \int_1^2 x^4 dx + \\ 2 \int_1^2 \sqrt{x} dx &= 4 \ln|x| \Big|_1^2 - 5 \frac{x^5}{5} \Big|_1^2 + 2 \frac{x^{\frac{3}{2}}}{\frac{3}{2}} \Big|_1^2 = \\ 4(\ln 2 - \ln 1) - (2^5 - 1^5) &+ \frac{4}{3} (2\sqrt{2} - 1\sqrt{1}) = \\ 4\ln 2 + \frac{8}{3}\sqrt{2} - 32\frac{1}{3} \end{aligned} \quad (11)$$

Example 4. Calculate the definite integral

$$I = \int_e^{e^2} \ln x dx \quad (12)$$

Solution. Integrating by parts, considering $u = \ln x$, $dv = dx$; then $du = (1/x)dx$, $v = x$. We find

$$\begin{aligned} I &= x \ln x \Big|_e^{e^2} - \int_e^{e^2} dx = e^2 \ln e^2 - e \ln e - \\ x \Big|_e^{e^2} &= 2e^2 - e - e^2 + e = e^2 \end{aligned} \quad (13)$$

Let us turn to the calculation of definite integral by a change of a variable. Let

$$\int f(x) dx = F(x) + C, \quad (14)$$

where, $F(x)$ – an antiderivative for $f(x)$. If a sub integral expression, we try to make a substitution of a variable (8)

$$x = \varphi(t), \quad (15)$$

then in accordance with formula (16) it can be written

$$\int f(x) dx = \int f[\varphi(t)] \varphi'(t) dt = F[\varphi(t)] + C \quad (16)$$

In this expression

$$F[\varphi(t)] - \quad (17)$$

antiderivative function for

$$f[\varphi(t)] \varphi'(t) \quad (18)$$

In fact, its derivative, according to the rule of differentiating a composite function, it's equal to:

$$\begin{aligned} \{F[\varphi(t)]\}' &= F'_{\varphi(t)} [\varphi(t)] * \varphi'(t) \\ &= f[\varphi(t)] \varphi'(t) \end{aligned} \quad (19)$$

Let α and β – value of the variable t , for which the function meaning

$$x = \varphi(t) \quad (20)$$

accepts corresponding values a and b , i.e.

$$\varphi(\alpha) = a, \quad \varphi(\beta) = b. \quad (21)$$

Then

$$\int_a^b f[\varphi(t)]\varphi'(t)dt = F[\varphi(t)]|_a^b = F[\varphi(b)] - F[\varphi(a)] \quad (22)$$

But, according to the Newton-Leibniz formula, the difference $F(b) - F(a)$ is

$$\int_a^b f(x)dx, \quad (23)$$

as $F(x)$ – an antiderivative for $f(x)$.

So,

$$\int_a^b f(x)dx = \int_\alpha^\beta f[\varphi(t)]\varphi'(t)dt \quad (24)$$

This is the formula for the transition to the new variable under the sign of the definite integral. With the help of it, the definite integral

$$\int_a^b f(x)dx, \quad (25)$$

after a substitution of a variable

$$x = \varphi(t) \quad (26)$$

is converted into a definite integral with regard to the new variable t . At the same time the old limits of integration a and b are replaced by new ones. In order to find an equation to new limits α and β , it is necessary for

$$x = \varphi(t) \quad (27)$$

to put the values $x = a$ and $x = b$, i.e., to solve equations

$$\varphi(\alpha) = a \quad (28)$$

and

$$\varphi(\beta) = b \quad (29)$$

relating to α and β . After finding a new calculation of the integration limits calculation of the definite integral is reduced to the use of Newton-Leibniz formula for the integral of the new variable t . The antiderivative function, which is obtained in the result of finding the integral, to return to the old variable is not necessary (Seitova *et al.*, 2016; Seitova *et al.*, 2016a).

Whereas calculating the definite integral by the method of the variable replacement, it is often convenient to express not the old variable as a function of the new, but on the contrary, the new – as the function of the old.

Example 5: Calculate the definite integral

$$I = \int_4^5 x\sqrt{x^2 - 16} dx \quad (30)$$

Solution. Let's make a substitution of the variable, assuming

$$t = x^2 - 16 \quad (31)$$

Then $dt = 2x dx$, where $x dx = (1/2) dt$, and the integrand expression is transformed as follows:

$$x\sqrt{x^2 - 16} dx = \sqrt{x^2 - 16} * x dx = \left(\frac{1}{2}\right) \sqrt{t} dt \quad (32)$$

Let us find new limits of integration. Substituting the values of $x = 4$ and $x = 5$ into the equation

$$t = x^2 - 16 \quad (33)$$

gives

$$\alpha = 4^2 - 16 = 0, \quad (34)$$

and

$$\beta = 5^2 - 16 = 9 \quad (35)$$

Using the given formula (50), we obtain

$$I = \int_0^9 \frac{1}{2} \sqrt{t} dt = \frac{1}{2} \int_0^9 t^{1/2} dt = \frac{1}{2} \frac{t^{3/2}}{3/2} \Big|_0^9 = \frac{1}{3} \cdot 9\sqrt{9} = 9 \quad (36)$$

After the substitute of the variable, we did not return to the old variable but used the Newton-Leibniz formula to the obtained antiderivative results (Kozhasheva & Filko, 2013).

The same type of independent works can be offered to the right side hemisphere, only at the design of the task to make the background black and the print white - for effective assimilation of visual information (Seitova & Turganbaeva, 2015; Seitova *et al.*, 2015a; Abdykarimov, 2014).

Further, everyone receives individual tasks, taking into account the representative system of perception and processing of information on relevant topics for the realization of these tasks on the MathCAD. This self-study is aimed at graphic material terms and conditions of selection points independence in drawing up the integral sums, which makes the condition for students clearer and easier to understand (Seitova & Abdykarimov, 2014).

Below there are offered individual creative tasks on the topic "Calculating definite integral":

For audials (teachers should read aloud the task or give a task with the help of audio recordings).

Visuals can be offered the development of presentations on the themes: "The definite integral and its properties", "Applications of the definite integral" and "Applications of multiple and curvilinear integrals", and design tasks for independent computation of the definite integral are recommended as follows: (a colorful design).

Kinesthetics have proposed the creation of electronic tables on the following topics (Seitova&Abdykarimov, 2015): "The definite integral and its properties", "Applications of the definite integral", "Applications of multiple and curvilinear integrals" "Methods of integration".

Digitals are offered tasks of high complexity and innovative problem-solving techniques, as the perception of information takes place via logical understanding, with the help of numbers, characters, and logical

arguments.

CONCLUSION:

Thus, effective training courses on mathematical analysis of neuro-linguistic programming techniques are largely due to the independent decision of problems with practical content with the use of neuro-linguistic programming techniques. The need to use practical materials for teaching students mathematical analysis is dictated by the fact that the emergence, formation, and development of mathematical concepts have their origin in sensation and perception, as well as the fact that the cognitive activity of a student is facilitated by a close relationship of logical thinking processes and sense perceptions.

The effectiveness of neuro-linguistic programming techniques is that the creative nature of tasks and all the activities are in themselves a powerful stimulation to learn. Neuro-linguistic programming techniques allow students to arouse interest in creative, active independent work or team activity.

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