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**THE HIERARCHY OF COMPONENT FOR TASKS SOLUTION
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In the present article the case in point is an application of new informational technologies in the process of teaching Linear Algebra in Kherson State University. The component-oriented approach to the teaching Linear Algebra is examined as well as hierarchy of components which is used in the system and advantages of such approach in comparison with traditional approach.

Keywords: distance learning, linear algebra, educational software.

Introduction

The world process of transition from industrial to informational society as well as social and economical changes occurring in Ukraine requires considerable changes in many spheres of the state's activity. First of all it is related to the reformation of education. In the National Program “Education. Ukraine of the XXI century” the following items are foreseen: ensuring education development on the basis of new progressive conceptions, application of new pedagogical technologies and scientific-methodical achievements in the process of upbringing and education, formation of new system for the informational support of education, joining of Ukraine to the transcontinental system of computer information.

The development of the system of education of Ukraine should lead to:

- occurrence of new possibilities for the purpose of renewal of content and methods of disciplines teaching and knowledge distribution;
- enhancement of possibilities to get education for the great number of young people, with the exception of those, who can not study at the institutions of higher education according to the traditional forms in the result of lack of financial or physical possibilities, professional overemployment, remoteness from the cities, prestigiousness of the educational institutions, etc.;
- realization of system of continuous education “through the whole life”, including secondary, pregradual, higher and postgradual education;
- individualization of education on condition of its mass character.

For the purpose of achievement of the indicated results it is necessary to develop the distance education, introduction of which in Ukraine is provided by the National Program of Informatization. Lately in the foreign systems of education have occurred the considerable structural changes which are caused by the development of Internet and its increasing influence on the all kinds of activity of the society. According to the information of foreign experts in the future each employed person should have the higher education – from the point of view of the XXI century, the minimum educational level which is necessary for mankind survival. That's why it is not occasional that within last decade the number of students who study according to the nontraditional technologies have been considerably enlarged in comparison with the number of students of the full-time course of study.

The question of most current importance is an application of modern informational technologies in those spheres of mental work which are the most difficult for perception, when the complexity of teaching is caused by the great number of routine work. The great number of calculations, which accompanies the search of the way for tasks solutions, doesn't give the opportunity for the student to understand the main point of research processes and as a result it doesn't form the necessary knowledge and skills. In the National State Program “Education” (Ukraine of the XXI century) is indicated that the education should ensure a many-sided development of individual as an integral personality, development of his skills and talents, and on

this basis it ensures the enrichment of the intellectual potential of the nation, its spirituality and culture, the formation of the citizen of Ukraine, who is able to make a conscious and social choose [1].

With the advent of new technologies appeared corresponding changes in the different spheres of production, science, culture and education. The system of education by means of staff training ensures the subsequent development and modernization of scientific-technical and cultural potential of the society. It is directed to the outlook and that's why it should react to the changes in the society in a proper time, because it is one of the determining conditions of its efficient functioning. It follows that nowadays a necessity of development and introduction of new technologies of knowledge, skills and abilities formation, formation of new content, methods, and means of education, didactic and methodical support in general is very actual. In full it is related to the higher pedagogical school and in particular to the organization of teaching and educational process there. The traditional methodical systems don't correspond to the modern needs. The modern informational and communicational technologies are used in the fragmentary manner in the working practice of the higher pedagogical schools. At the same time the execution of the educational and pedagogical objectives suggested by the National Doctrine of the development of education in Ukraine in the XXI century demands a fundamentally new support of the educational and pedagogical (upbringing) process. One of the working approaches to its effective realization is a component-oriented education, the foundations of which were developed by O.V.Spivakovskiy.

The Conception of the Component-Oriented Education

The idea of component-oriented approach consists in such organization of the educational process by which the previous, earlier learned knowledge and means of activity should be used as a new instrument for tasks solution of more higher and complicated level. The traditional technologies of education also provide the usage of earlier learned knowledge, means and techniques. For example, student can not solve the system of linear equations without applying elementary arithmetic. In course of such teaching the common is a situation when during any tasks solution it is necessary to make all actions – from elementary transformations and calculations to the last step – result.

In course of component-oriented approach a certain type of thinking based on the search, selection and the most appropriate usage of the components for solutions of the previous tasks in the process of solution of tasks of the higher level of complication is formed by students (pupils). The ability of forming of the solution scheme for the indicated more complicated tasks in the form of a completed new component which can be used for the solution of the next tasks is also formed.

The component-oriented approach demands to distinguish on the each stage of education the essential and non-essential, it assists to the formation of abstractions by means of creation of own or usage of known, previously made components for the purpose of solution of new, more complicated task. At the same time it outlines a new ideology of development of the pedagogical program means – new instrument by the help of which it is possible not only to provide effective and resulting education but also to upgrade the content of the subjects on the basis of creation and usage of new components. At that the significant intensification of the process of cognition is provided, individual trajectory of education by means of possibility to render any set of components for everyone involved in the process of education by the tutor (teacher).

The technology of the component-oriented approach demands formation of conception of the component as an abstraction, which is an instrument for creation of new abstraction and understanding the fact that means and methods of the students' activity can be improved by means of mastering of the earlier learned and created components. The pedagogue should realize that the principle of the component-oriented education brings qualitative changes in the educational and cognitive activity which determines a new approach for tasks solutions, connected with ability to find the most effective components and to unite them for the purpose of solution of the given task.

Nowadays the technological prerequisites of usage of such approach are provided by the modern informational technologies of education. The usage of the component-oriented approach in education passes through the integration of traditional and new computer-oriented technologies of

education. This demands not only recomprehension of content, but also recomprehension of methodical system of education, including development of special computer surroundings by the help of which it is possible to support and realize the component-oriented principle of education.

The tasks solution of each class demands usage of a certain instrument. For example for the linear equation it can be the elementary transformations, operations of adding, subtraction, division and multiplication. But the schemes of tasks solution for the each class can be the components (instruments) for tasks solution of the other class of higher level of hierarchy and abstraction. In the given example the schemes of tasks solution of such classes can be the components: finding of the determinant of the linear equation, solution of system of linear equation, finding converted matrix, etc. The knowledge, skills and abilities received in course of study of a certain theme are converted to the component which is used for solving tasks of the more complicated level. Thus it is possible to build the consecution of education in a different way, to ensure the possibility to choice what components should be informed to the student and what tasks should be solved by him independently according to the purpose of education, student's abilities and other components of the process of education.

The indicated problem can be solved through the prism of separation of essential and non-essential in the process of tasks solution in the examined class.

The possibility to choice the necessary components at that personally for each who support the procedure of tasks solutions of the given class determines the principle of the component-oriented approach, which is based on the following basis:

- necessity to distinguish the essential and non-essential in the course of task solution;
- choice of components solving which ensure necessary depth and speed of result;
- methodically sound system of determination of level of the detailed elaboration for tasks solution;
- possibility to use schemes or algorithms for solution of the earlier solved tasks as a component in the process of solution of the next tasks.
- usage of abstractions, which correspond to the hierarchy of components of educational tasks solution.

These conceptions are laid in the foundations of the program system.

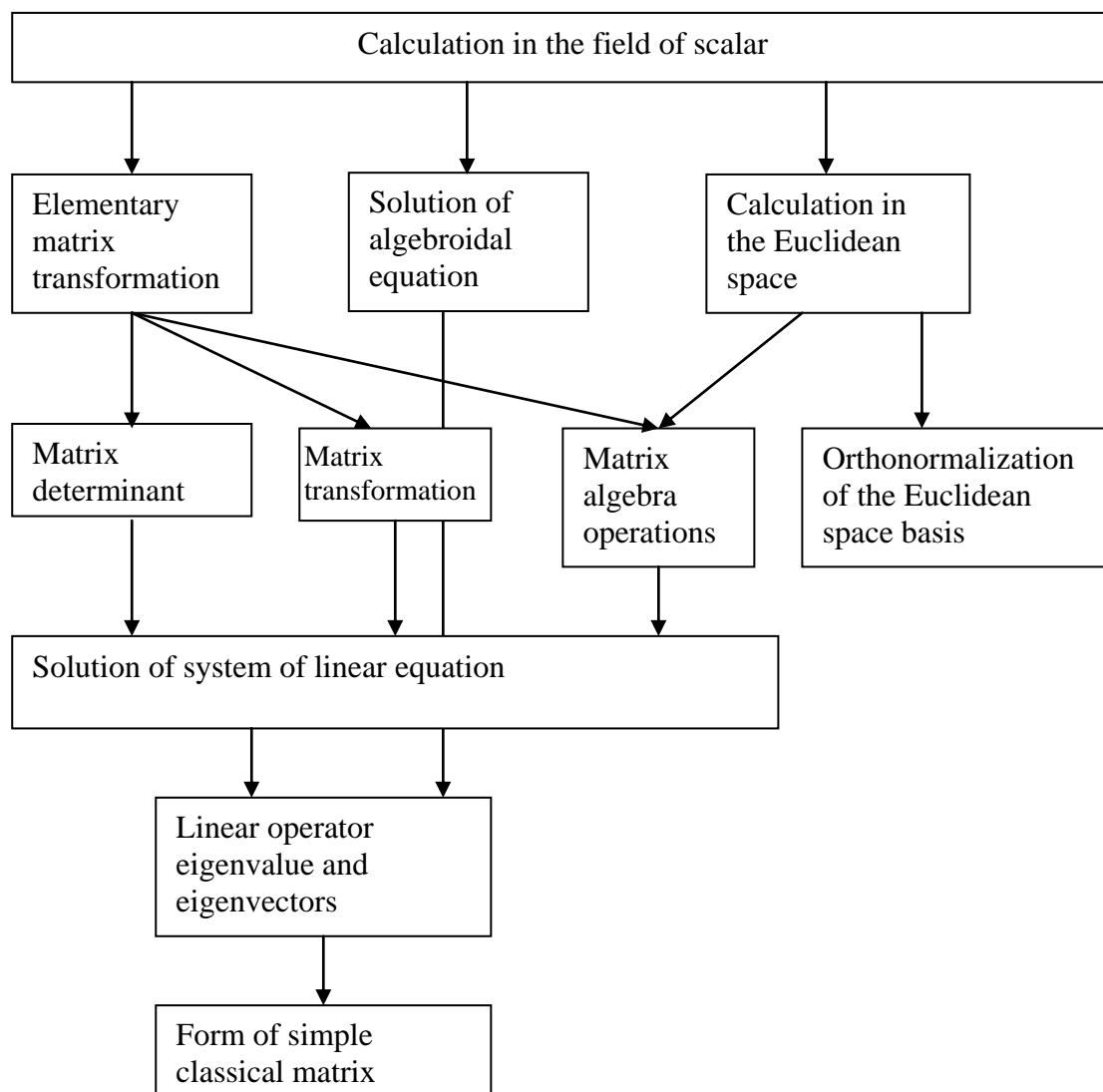
The most considerable changes in course of subject studying in comparison with traditional appeared in the methodology of practical lessons and tests giving. The fulfillment of tasks with the help of program and methodical complex "WebAlmir" forms qualitative practical skills, abilities and knowledge of the students in the methods of Linear Algebra. The formation of a proper level of knowledge is realized by the choice of the appropriate instrument base, which consists of technological educational components. In fact the student manages the process of solution, initializing the execution of each step of calculations. The computer immediately and correctly fulfils calculations and rewritings, thereby releasing the user from the excess waste of time.

To our opinion this methodology is probably the best settlement of disputes between volumes of teaching materials and limitation of human abilities.

As we can see a new approach gives considerable advantages also during the organization of student's independent work. First of all the process of control of practical lessons is considerably simplified. Secondly in the process of individual and test lessons of students the tutor uses the computer technologies in the process of verification of the executed tasks in full and verification of correctness of each step of task. This released the tutor from the routine of search of mistakes and enables him with opportunity of individual work with students.

Thus the above mentioned facts permits to make conclusion that the usage of computer technologies raises students' interest to the conducted lessons and assists to the more conscientious attitude to the education. Besides, the application of modern methods of data processing assists to the general development of the informational culture of students and their professional formation.

We show hierarchy of components in course of Linear Algebra, picture 1.



Picture 1. The Hierarchy of Components in the course of Linear Algebra

Let us give the example of solution of system of linear equation with the help of matrix method. As we know, $A \cdot X = B$, where A is a matrix with coefficients by unknowns, B is a vector of absolute terms. Then vector $X = A^{-1} \cdot B$. So to solve this task we need to find the matrix converted to the matrix A . In the system “WebAlmir” we can choose two ways of solution: by means of elementary transformations of the augmented matrix we can find converted to A or we can use a component “Converted matrix determination”. The given component automatically finds the matrix converted to the existing one in case when the matrix determinant is equal to 0. Then the user should multiply the received converted matrix to the vector of absolute terms using the component “To multiply two matrixes”. As a result we receive the vector bearing the meaning of unknowns that were in search. So, the process of solution corresponds to consistency of the following actions: finding the converted matrix, multiplication of two matrixes. In other words in this case the student concentrates on the algorithm of solution ignoring the direct calculation.

The practical lessons are carried out in modern computer class. There is a free access to the methodical recommendations of the teacher that conducts the practical lessons from the working places of students. This document is located in the special educational site of the university. It is not included to the program-methodical complex of Linear Algebra as the basic one. As a rule the tutor that carries out the lesson (not the lector only) has his own view to this lesson organization. Methodical instructions contain the references to the theoretical material from the text-book and the

list of tasks that are to be solved during the practical lesson. We should emphasize separately that the tutor has an objective to determine the concrete instruments for each educational task of Linear Algebra which should be used by the student during his work in the field of tasks solution – the basic module of software environment. Thereby the tutor has a certain freedom.

The students are obliged to have the text-book and to use the electric version of the book of problems integrated (as a component) to the software environment of “WebAlmir”. As a rule the educational task contains 6-8 educational problems. Let us note that it in 2-3 times exceeds the traditional organization of the lessons. The practice of carrying out the lessons with such technology proved that the volume of practical lessons comparing with the traditional technology is not changing and is $1\sqrt{2}$ of the volume of general course that is approximately equal to 36-40 academic hours.

At the first lesson the students load the program and register themselves. To let the students begin to acquaint with the program the tutor has to add just registered users to the list of students.

After the user’s information was added to the list of students he is able to enter the program and begin his work using the password and correspondent rights. Two thirds of the educational time at the first practical lesson is assigned to the acquaintance with the possibilities of the program “WebAlmir” usage, one third is assigned directly to the acquaintance with the tasks solution environment.

At the next lessons in accordance with the objective the tutor is able to show some possibilities in the form of the components that are ready for usage.

For instance, while learning the topic “Detection of the Matrix Determinant” the student passes step by step all the course of solution identical to the traditional one, releasing from calculations only. In the further process of solution of more complicated tasks in which the determinate detection is one of the steps of solution the tutor is able to show the possibility of the finished matrix determinant reception for all or some students.

Organization of tests

The most significant are the changes that were made in the organization of current control of knowledge. The thing is that such form of control as the student’s work at the board under the tutor’s supervision and with the others students’ participation (that does not correspond to reality) is excluded from the practice absolutely. According to our methodology the students pass 8 current control tests within the semester.

Each test devoted to one of the basic tasks of Linear Algebra. It is understood that the test is executed in the “Tasks solution environment”. The solution of all tasks is checked by means of the environment for arithmetical accuracy and completeness. Upon completion of tests, the tutor appraises it in accordance with the number of solved tasks and quality of solution. It is significant that there aren’t any arithmetical mistakes in the process of solution, that’s why the tutor appraises knowledge of the method of task solution.

Finally, those students who have got good and excellent marks have a right to use the corresponding basic task as a technological component in course of the other tasks solution in their further work in the “Environment”. Let us give a concrete example:

- Basic task 1: “To solve the system of linear equations”
- Basic task 6: “To detect the linear operator eigenvectors”

If the student received good or excellent mark for his test paper No. 1 of the “System of Linear Equations” he has a right to miss the solution of the systems of linear equations with the help of which the eigenvectors are detected with the help of Gauss method in the test paper No.6 that is over a few steps of linear matrix transformation and to do only one command – “To solve the system of linear equations”.

This principle is one of the concrete forms of component approach usage to the process of education. Let us give the approximate plan of practical lessons and test papers conducting (table 1).

Oriented plan of practical training and test

No.	Topic	Hours	Notes
1	Systems of linear equations	2 pr.	Basic components: elementary system lines transformations
2	Vector spaces	4 pr. 2 c.p.	Basic components: elementary matrix transformation
3	Basis and dimensionality of vector spaces	4 pr. 2 c.p.	Basic components: systems of linear equations
4	Matrixes	4 pr.	Basic components: systems of linear equations
5	Matrix's rang	4 pr. 2 c.p.	Basic components: systems of linear equations
6	Linear operators	4 pr. 2 c.p.	Basic components: systems of linear equations, matrix determinant
7	Systems of linear equations (continuation)	4 pr. 2 c.p.	Basic components: systems of linear equations, matrix determinant, matrix transformation
8	Linear operator eigenvectors	4 pr. 2 c.p.	Basic components: systems of linear equations, matrix determinant, calculation of coefficients and roots of particular polynomial
9	Form of simple classical matrix	2 pr. 2 c.p.	Basic components: systems of linear equations, eigenvalues and linear operator eigenvectors calculation
10	Euclidean spaces	4 pr. 2 c.p.	Basic components: elementary transformations, scalar product, absolute value of a vector, launch angle

Organization of Final Control

The final control of Linear Algebra is as a rule the examination that is preceded by the spoken test. The tutors conduct it at the computer class. Organization of the spoken test and examination is actually a traditional one. The main feature is the thing that the students answer only theoretical questions but during the process of preparation and answering they have an opportunity to use software environment “WebAlmir” as the lector did. The general mark of the student is put by the lector who takes into consideration the marks of the student for test papers apart from the appraisal of his theoretical answers of examination paper questions.

The usage of environment “WebAlmir” is very profitable for student’s independent work organization. Having the access to the server the students have an opportunity to solve the necessary number of tasks for fixation or revision, to work with theoretical material, to exchange their views by means of discussion when they have spare time. It is very useful and convenient for those students who are unable to solve the same number of tasks as the most students do because of their physical features and weak preliminary basis. The tutor checks the tasks solutions when it is convenient to him and opens one or another possibility (component) for the next lessons. The stages of student’s work during the process of tasks solution are the same as at the practical lessons.

In such a way the developed model of the course “Linear Algebra” realizes state educational standard of “Linear Algebra” teaching by the means of:

- intensification and expansion of theoretical basis of the course in the first place by means of decreasing of time for routine operations execution;
- usage of systems of distant access to the structured educational material for the students and teachers as in synchronic as in asynchronic conditions;

- the necessity of analysis of the existing conception of Higher Mathematics teaching from the point of singling out the educational units that can be used as a components of solution of tasks of the higher level;
- usage of computer orientated programs of educational and professional destination during the course of Higher Mathematics teaching;
- providing the practical direction to the results of studying;
- creation of conditions for the most full discovery of genetic skills and abilities of the students, forming the necessary level of motivation of educational activity.

The developed integrated computer system allows periodical renewal and replenishment of the new content. Its usage ensures effective operation of all the compounds of component-orientated approach to Linear Algebra studying on the single platform. The component-orientated principle is considered as an information technology of personally-orientated model of education realization. From the methodological point of view it is based on the following principles: integrity perception of the object of studying, unity of content and procedural in the process of education, adequacy of purposes in the system of higher education, integration and inter-subject connection.

The developed universal information form-factor with the scheme of knowledge level monitoring and the necessary skills and abilities acquisition in the different levels can be modified to use for the other educational disciplines teaching. The structured model of education provides the construction of situation on the basis of maximum account of individual interests of each student that ensures its activity according to his own trajectory of education. Meanwhile the pedagogical skills are the potential possibilities, preconditions and knowledge and skills are the content basis on the ground of which the abilities realize and develop. The modern technologies of education ensure the organic unification of the subjective experience of students and the basis of mathematical science: construction of educational lessons, text-books and tutorials directed not only to the knowledge level expansion, structuring, integration and generalization of the subject content but to practical transformation of the existing subjective experience of the student. Linear Algebra studying on the basis of component-orientated information technology is more effective comparing with traditional methodological systems in the context of personally-orientated approach realization as it increasingly furthers the realization of individualization principles and differentiation of educational process expands its content, increases the intensification and effectiveness of education in general.

The usage of information and technical means increases the basic factors of education effectiveness (the level of formation of basic mathematical concepts and abilities to identify, analyze and use it, mastering of methods and ways of tasks solution, depth of knowledge learning) of the students.

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