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ADAPTATION OF THE MAPLE SYSTEM FOR EFFECTIVE STUDENT'S INDEPENDENT WORK IN HIGH MATHEMATICS

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Abstract. *The significance of the material presented in the article is due to the necessity of developing and implementing the latest information technologies at the study of higher mathematics using the systems of computer mathematics. The solution of the standard tasks of higher mathematics on the topic of differential equations involves the execution of bulky, similar arithmetic calculations and records. If there is an error in the calculation, its localization takes a lot of time, which leads to the student's quick fatigue. The concept of adaptation of SCM Maple to higher mathematics is suggested by creating a training Maple simulator on the topic "Linear homogeneous differential equations" in order to more effectively master students 'material, as well as to enhance students' learning and cognitive activity. The main results of the authors are presented in the field of development of the educational complex in higher mathematics, the main element of which are procedural simulators as well as procedure generators.*
Keywords: *Maple-training simulators, higher mathematics, the independent work of the student.*

Introduction

In the modern period of the mankind development, the goal of higher education is the formation of high-level creative thinking specialists, which in turn requires the creation of a new model of higher education, the development of creative abilities, the cooperation of teachers and students in the educational process.

The most important goal of the modern school is to give the student at all levels of university education not only general and professional training, but also

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the necessary basis for self-education, develop the ability to use the acquired knowledge actively to solve scientific and practical problems. The realization of this goal implies that in the modern high school the educational process should acquire the character of independent work of students, organized and managed by the teacher using the latest methods and means of study.

One of the conditions for improving mathematical education in a technical university is the active use of modern information technology, as well as systems of computer mathematics (SCM).

After analyzing the works by S.A. Rakov (2011), S.O. Semerikov (2008), O.V. Spivakovsky (2006), O.M. Spirin (2006), Yu.V. Trius (2005, 2010), M.I. Zhaldak (2003, 2004), one can identify trends in the use of information technology (IT) in education, as well as in these works, attention is drawn to the problems of developing skills of independent work of students using IT.

While studying higher mathematics by students the use SCM gives a possibility to provide visualization, graphical interpretation, mathematical modeling of processes, complex calculations, as well as the opportunity to use SCM as one of the means for organizing independent work of students.

To organize a systematic, individual and systematic process of studying in a high school, optimization of the educational process, which should combine traditional methods and new forms of learning using information technology, is required. These technologies are implemented at all stages: the study of the theoretical course at lectures - a combination of lectures, manuals and information computer technology (ICT); practical classes and independent work of the student - solving individual tasks using algorithms for solving problems with comments and examples and their computer visualization; execution of calculation and graphic works - application of automated complexes to solve research and creative tasks.

Implementation of educational innovative technologies in higher education is always relevant. Problems of the use of ICT as well as computer algebra systems are highlighted in the works by O.B.I.M. Zhaldak (2004), V.I. Klochko (1997), N.V. Morse (Morse, 2003). In the considered works it is noted the search of necessary methods for increasing the efficiency of the educational process and the coefficient of useful activity of the system "student - teacher". The need to combine traditional teaching methods, which are mostly explanatory, with new forms of learning, including the use of modern multimedia technologies, is dictated by the limited time of material mastery, in particular higher mathematics, poor student educational level and ineffective organization of the educational process.

Optimization of the educational process with the use of modern information technologies can be achieved by combining verbal and visual presentation of the

material, independent work at all stages of obtaining knowledge and skills and organization of the system, individual and systematic training.

The purpose of this article is to introduce readers with the experience of teaching higher mathematics to students of Vinnytsia National Technical University, who study in the field of computer science.

In the course of the work, the analysis of scientific and methodological literature on the research problem was conducted, as well as in practice, the computer support of the course for higher mathematics in the unit of linear homogeneous differential equations was implemented and the computerized approach to the methodology of higher mathematics student training at the Technical University.

Experience of the higher mathematics university course organization and realization Body of the Article

By means of SCM it is possible to provide individual learning "in mass order" especially in the process of choosing an educational action (explanation, hint, encouragement), taking into account the ability of each particular student to study. Using a computer provides an opportunity to take into account the peculiarities of the student's cognitive processes - perception, thinking, memory, and also to provide assistance to the student based on his individual abilities.

According to many experts, the availability of modern mathematical packages, in particular, SCM creates conditions for radical review of the content, goals, forms, means and methods of teaching higher mathematics of future engineers. The number of papers on the use of mathematical packages during the study of higher mathematics increases with each passing year.

When using systems of computer mathematics in the study of higher mathematics it is necessary to carry out considerable work on the adaptation of such systems. After all, they were created, first of all, to provide professional activities of a specialist. Work (Mikhalevich, 2008) shows the perspective direction of adaptation of SCM Maple for the study of higher mathematics of students of technical and economic specialties is the creation and use of training simulators for the automated reproduction of the step-by-step approach to solving typical problems of higher mathematics (TPM).

The Department of Higher Mathematics of Vinnitsa National Technical University during the organization of the educational process in studying the subject "Higher Mathematics" uses a wide set of teaching tools, which requires the use of a variety of methods and tools for managing the cognitive activity of each student at different levels of learning knowledge and skills development.

1. Lecture course is one of the main forms of knowledge transfer and is a combination of the presentation of theoretical material by the lecturer and the use of information technology in the audience.

2. Practical classes are focused on teaching methods for solving typical problems of higher mathematics, in the structure of practical classes the independent work of students dominates.

Practical classes are a combination of: individual tasks, - algorithms for solving problems from all sections of practical classes with comments and examples illustrating their use, which allow to study methods for solving problems with the student's direct participation in logical considerations, the construction of variants of drawings, the choice of paths solution;

3. Typical student calculations are one of the forms of solving students' problems of higher complexity.

4. Student's independent work (SIW). Independent work is the main means of mastering the student material at time, free of compulsory training. Therefore, in order to increase the SIW, the student must himself realize the need to acquire new knowledge and skills. In order to implement and help the student during independent study of the material, it is expedient to use the training Maple simulators (TMS) (Mikhalevich, 2008) which provide an opportunity to get the course of the solution of mathematical problems in detail. In addition, the use of TMS stimulates the cognitive activity of students, contributing to the intellectual development of the individual. The availability of TMS swill enable students to test their abilities and skills or, in case of difficulties, the program will tell you the next step.

According to O. V. Spivakovsky generating programs are intended for presentation of sets of tasks of a certain type from a given topic. Their use provides the opportunity conduct test or independent work in the classroom, providing each student with a specific task that corresponds to his individual abilities (Spivakovsky, 2006). Therefore, for the selection of tasks for practical work on the topic of linear homogeneous differential equations, an author's generator of the tasks of higher mathematics on the subject of linear homogeneous differential equations(LHDE) was developed, which allows the teacher in a short time to provide each student with an individual task (Fig. 1), the teacher should just specify the required number of examples, as well as the complexity of the examples (currently, there are only two levels of complexity) (Fig. 2). In addition to the task generator itself, the author's TMS, on the teacher’s choice, has the ability to write the answer to each task (Fig. 3). The work of the generator is aimed in such a way that during the calculations there are no complicated irrational coefficients in finding solutions.

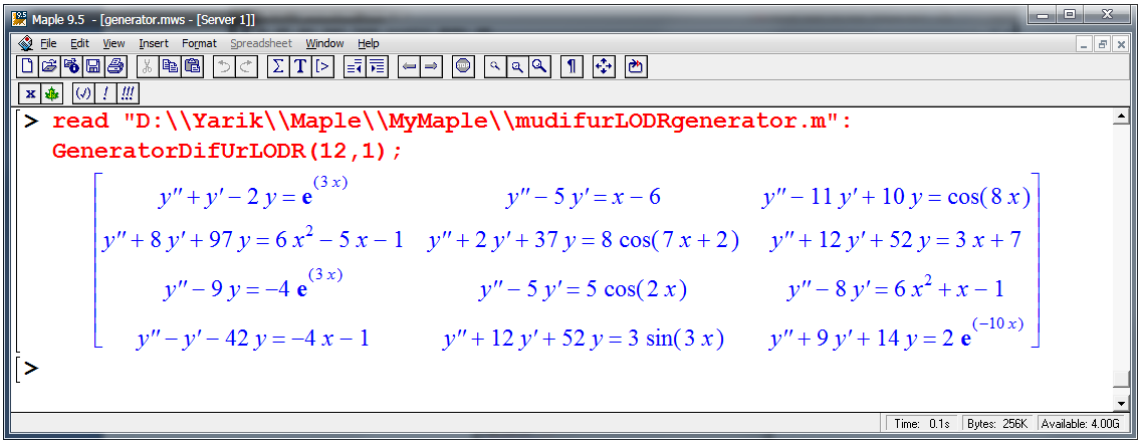

Figure 1 ***Generation of individual tasks, level of difficulty 1***

Using the system of computer mathematics during practical classes greatly improves the educational process, helps control and self-control the correctness of the solution of the tasks, and visualization of the results gives the opportunity to clearly demonstrate the results obtained, to conduct their comprehensive analysis. The abovementioned opportunities can also be demonstrated when at lectures using multimedia learning aids. It is necessary to note the importance of using the Maple package when conducting research work with students.

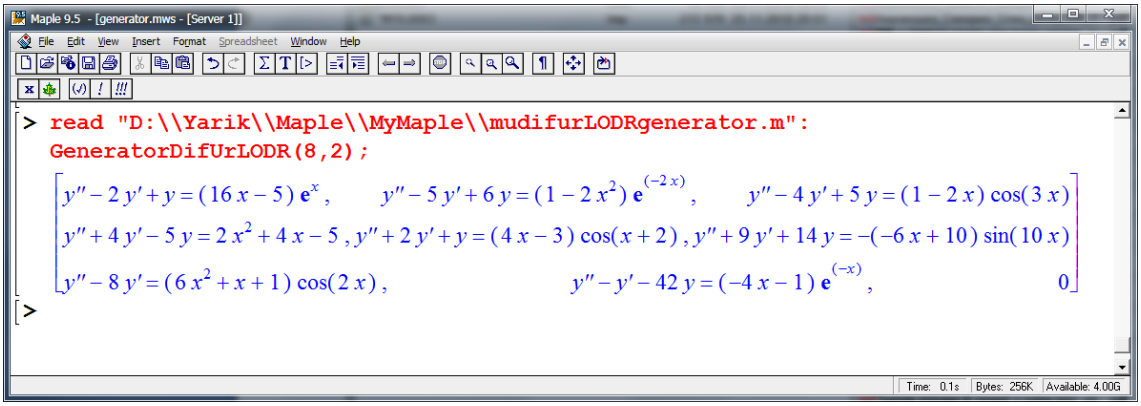

Figure 2 ***Generation of individual tasks, level of difficulty 2***

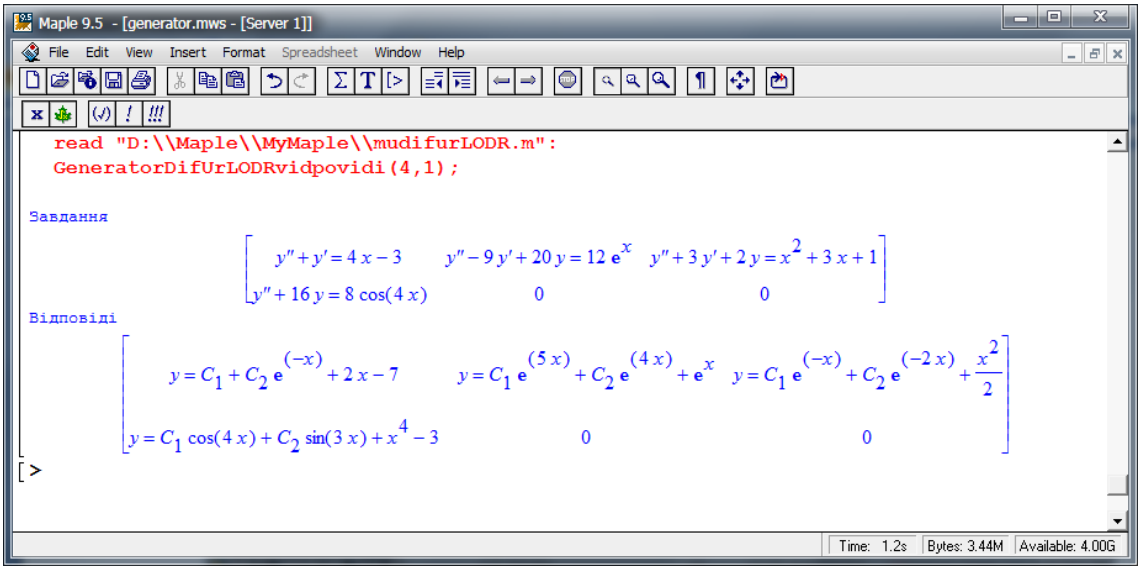

Figure 3 ***Result of generation of individual tasks with answers***

To improve the efficiency of independent work of students during the study of the topic LHDE was developed educational Maple simulator. Let's consider the description of the developed author's TMS n the subject of LHDE and the results of work on the solution of problems of higher mathematics. Procedure simulator "mydifurlodr (` y"` - 2 * `y'` + y = (16 * x - 5) * exp (x));" step by step decodes LHDE (Fig. 4.). It is enough for the student to connect and carry out the author's procedure "mydifurlodr (*****);", where instead of the asterisks it is necessary to insert its equation. The purpose of creating this simulator is to ensure a high level of higher mathematics education, as well as to reduce the routine load on the teacher. With the simulator, the student's independent work becomes more effective. The role of the teacher is to provide advisory assistance. Also, the student has the opportunity to independently solve the problems, and the simulator to use as a check of their steps and, in case of an error, without the teacher's assistance, to localize the mand also change the condition of the problem, the initial data and observe how the solution is changing.

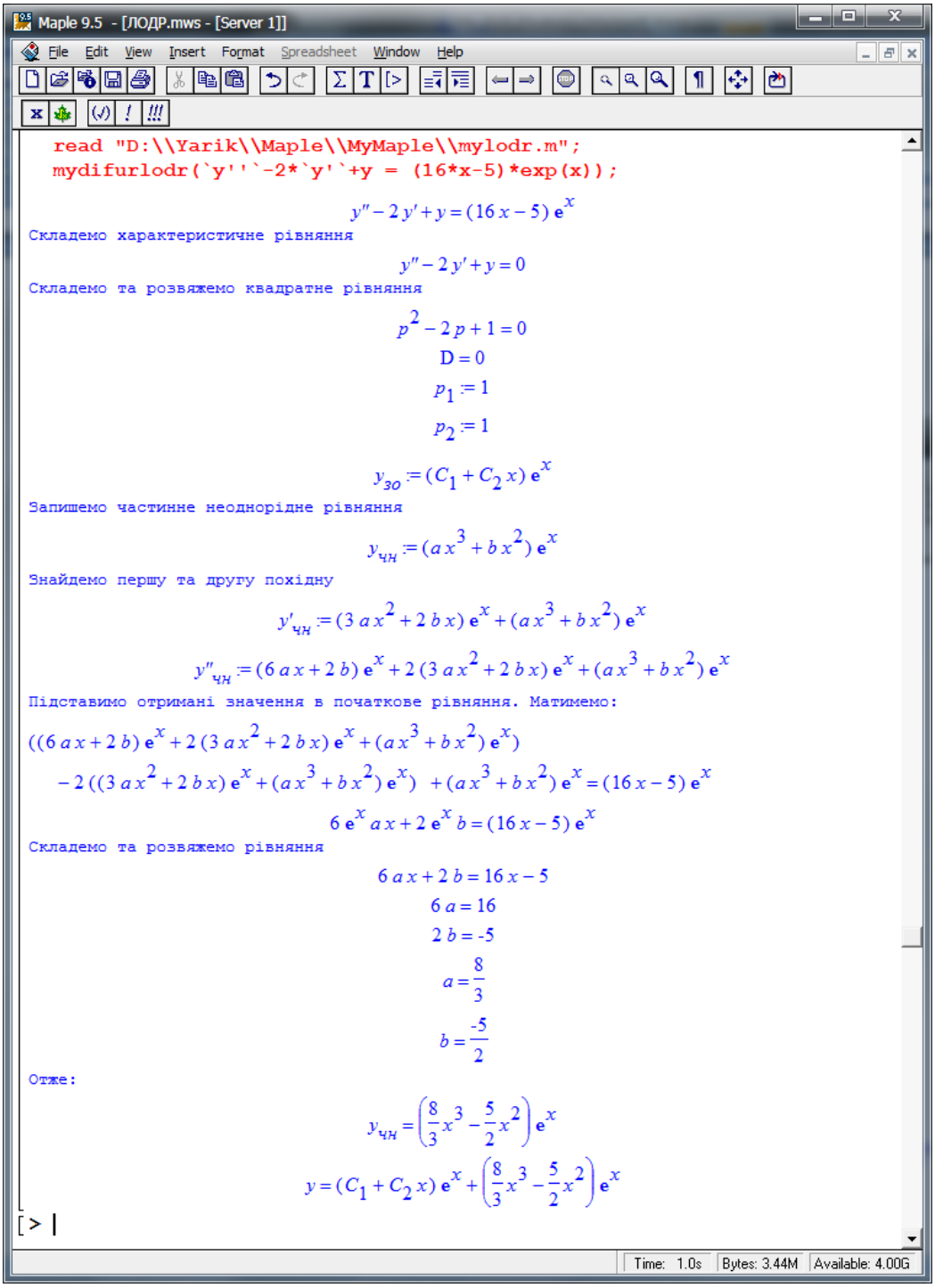

Figure 4 ***Work of TMS on the theme of LHDE***

According to the traditional technology of learning, during the ISW, in case of questions from the student, he must wait for the teacher to get advice on his question. In the case of the use of TMS for the organization of the class and extracurricular activities ISW, the teacher has the opportunity to part routine for the teacher functions related, in particular, to finding the place of error in the

process of solving problems of higher mathematics, to pass to the student who can perform these functions by TMS, which, in turn, enables the student to independently receive answers to a number of questions. In case of a student's questions, he does not address himself to the teacher, but he tries to solve his own question by means of TMS. In case the problem is solved by means of NMT the student continues to work independently, in case when the student is unable to get an answer to his question with NMT he expects the teacher to consult. Of course, the use of TMS is not able to replace the teacher, which remains the main guideline of the educational process.

With TMS, practical classes actually turn into independent work of students under the control of a teacher. The role of the teacher is to select tasks and consult. It is important that the teacher is largely exempted from most of the routine checks, partially passing this work on the students themselves. Students, in their turn, receive a greater degree of independence.

The use of author's NMT in the process of organizing the independent work has several advantages:

- educational products are performed at a high level, and are adapted to the teaching methodology at a technical university;
- the possibility of choosing a student individual work mode;
- unlimited variability (diversity) of tasks taking into account potential possibilities and abilities of students;
- increase professional motivation of students.

Thus, the use of author training simulators in the organization of independent work of students provides an opportunity not only to intensify the work of students, but also provides the basis for their further continuous self-education, therefore, the pedagogical information and educational environment, which is created by integrating the totality of software and hardware and traditional forms of education, and determines the independent work of the student as more independent and creative.

Conclusions

Thus, it can be concluded SCM Maple is particularly suitable for organizing student independent work to strengthen material learned at classes and preparing for classroom exercises. The use of ICT aids is one way for optimizing the educational process by creating the conditions for a personal approach at teaching the students. When developing tasks for the student independent work using computer training programs, the teacher focuses on the individual work of students with well-prepared structural material. Researches show that the use of SCM in the current conditions significantly changes the role and functions of

teachers and students, greatly affects all components of the educational process: the environment, features and methods are changing themselves.

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