Implementation Of Networking in the Organization of a Laboratory Practical Work on Numerical Methods in the Basics of Mathematical Analysis Using a Software Package Based on The Scilab Package

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*Abstract–*This article presents an information model for the organization of a laboratory workshop of university students using the software complex developed by the author on numerical methods in the basis of mathematical analysis implemented on the basis of the Scilab package. A description of the individual local programs developed by the author on the implementation of numerical methods in the bases of mathematical analysis is presented on the example of the study of limits of numerical sequences, solving algebraic and transcendent equations, finding values of certain integrals and solving ordinary differential equations of the first order. For each program the format of input of parameters of initial data and output of intermediate and final results of calculations is specified. The application of remote information support of the laboratory workshop in the framework of the dynamic Internet site is shown.

Abstracts

To date, the question of the correct use of information and communication technologies in the educational process is relevant. Introducing such innovations into the learning process provides a great opportunity to increase students 'interest and motivation in learning activities, as well as the effectiveness of solving educational and research tasks. The use of information and communication technologies in mathematics in the organization of the educational process in universities can be clearly represented within the framework of the implementation of the laboratory workshop on the basics of mathematical analysis using complex algorithms mic structures presented in the form of various numerical methods, which is a clear example of the integration of mathematics and informatics in the process of studying disciplines of the natural science cycle [1].

The purpose of the laboratory workshop on numerical methods in the basis of mathematical analysis is to apply the software complex developed by the author based on the Scilab package as a means of integrating mathematical and information knowledge in the execution of numerical algorithms, the essence of which is to build and visualize iterative processes converging to the desired solution [2].

The main purpose of using the software complex developed by the author on numerical methods in the foundations of mathematical analysis on the basis of the Scilab package in mathematics training is to study complex phenomena and processes within the framework of the implementation of interprandial connections through the lens of

construction of various mathematical and information models in combination with clarity, Usability and direct comparative analysis as different numerical methods of solving the problem, And the values of the intermediate and final results, provided that the values of the original data vary [3].

The names of the laboratory works with the names of the programs and corresponding sections of the basis for mathematical analysis in the framework of the workshop are as follows [2], [4], [5]:

1) Calculation of values of minimum numbers of approximation to the limit of numerical sequences with application of methods of gold proportion, Fibonacci, half division (dichotomy) and their comparative analysis (program "Study of numerical sequences with application of numerical methods," section of mathematical analysis basis "Limits and continuity").

2) Approximate solutions of algebraic and transcendent equations using the method of half division (dichotomy), the combined method of chords and tangents (Newton), the method of golden proportion and their comparative analysis (program "Study of algebraic equations using numerical methods," section of the bases of mathematical analysis "Differential calculus").

3) Approximate calculations of values of certain integrals by formulas of middle rectangles, straight trapezoids, parabolic trapezoids (Simpson) and their comparative analysis (program "Study of certain integrals using numerical methods," section of the basis of mathematical analysis "Integral calculus").

4) Approximate solutions of first-order ordinary differential equations using Euler, Runge-Kutt methods of second, fourth order accuracy and their comparative analysis (program "Study of first-order ordinary differential equations using numerical methods," section of the basis of mathematical analysis "Differential equations").

In the development of the software package of information support for the laboratory workshop on numerical methods in the basis of mathematical analysis implemented on the basis of the Scilab package, the following stated requirements were met:

1) Step-by-step solution of complex set mathematical problem with application of several numerical methods.

2) Variability of the source data parameter values.

3) Displays the values of the intermediate and final results of the calculations in a visual form using a popular file format.

4) Implementation of comparative analysis of applied numerical methods to solve the set task.

5) Formulation of the dependencies of the values of the array of result parameters on the varying values of the array of source data.

In order to record the obtained results of calculations and implementation of comparative analysis, the author has developed an electronic journal form, within the framework of which it is possible for students and teachers to reflect all necessary information on the dynamics of implementation of the laboratory workshop. The electronic log is implemented in the framework of a dynamic Internet site using a visual and convenient graphical interface based on the PHP web programming language in combination with the MySQL relational database management system.

Functional equipment of the specified web interface allows to carry out activities under the status of student or teacher.

When using "Student" status, the following features are available for a particular student after the implementation of his or her authorization within the web interface:

1) Download the application corresponding to each of the laboratory works presented within the software complex to the local computer or laptop running the Windows operating system.

2) Automatic generation of values of parameters of initial data for performance of laboratory work from the point of view of both the considered mathematical object (limit of numerical sequence, algebraic or transcendent equation through the prism of consideration of the first derivative function, a certain integral or ordinary differential equation) and from the point of view of different variants of parameter values for each of the applied numerical methods of solving the set mathematical problem.

3) Upload to the site of reports generated by the corresponding laboratory work by the application, which reflect detailed information on values of intermediate and final results of calculations obtained for different varied values of initial data.

4) Forced indication within the framework of the corresponding laboratory work of the form of values of results of comparative analysis of parameters of final results of calculations carried out by students from the point of view of application of different numerical methods.

5) Loading of the student 's final report on the implemented laboratory work with presentation of the necessary output with reflection of the obtained regularities in accordance with the generally accepted format of presentation of documents files.

6) Monitoring of implemented own remote activity with visible representation of performance in the implementation of a transparent score-rating system.

7) Communication with the instructor within the framework of individual conversation for each laboratory work in feedback mode.

When using the "Teacher" status, the following functionality is available to a particular lab workshop manager after the implementation of his authorization in the web interface:

1) Download the application corresponding to each of the laboratory works presented within the software complex to the local computer or laptop running the Windows operating system.

2) Displaying a list of all students assigned to the teacher in the laboratory workshop from the point of view of the selected group, with the presentation of performance statistics for each of them as a laboratory workshop as a whole, And each of the laboratories, in particular, in terms of representing the values of the parameters of the source data, Values of the final results of calculations recorded by the student, as well as attached files in the form of reports generated by the corresponding laboratory work by the application, Reflecting detailed information on values of intermediate and final results of calculations, Obtained for different varying values of initial data, and the final report on the implemented laboratory work compiled by the student in accordance with the conventional format of presentation of document files.

3) Monitoring of remote activities implemented by each student with visual representation of performance in the implementation of a transparent score-rating system.

4) Communication with an individual student within the framework of an individual conversation for each laboratory work in feedback mode.

Thus, in the course of the author 's dissertation study, software has been developed for the implementation by university students of a laboratory workshop on numerical methods in the basis of mathematical analysis in the form of a software complex based on the Scilab package, including the study of the limits of numerical sequences, the solution of algebraic and transcendent equations, the finding of values of certain integrals and the solution of ordinary differential equations of the first order. The author also developed a web interface within the framework of his own dynamic Internet site for remote support of the laboratory workshop in terms of generating values of parameters of initial data, recording and reflecting the results of comparative analysis of values of results obtained using programs, generation and loading of reporting materials for each performed laboratory work, monitoring and virtual communication with the teacher regarding the performed educational activities.

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