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Synergetic Approach Implementation in the Remote System of Dynamic Settlement Projects

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Abstract: The proposed study examined the use of a synergistic approach in the remote system of dynamic settlement projects developed by the researcher. A synergetic approach is an unconditioned combination of finite set of objects with the possibility of different system creation with their unique properties, characteristics and laws. The use of a synergistic approach during the integration of full settlement projects and remote learning allows you to create a fundamentally new information system of education. A remote system of dynamic calculation projects is based on the use of "a program in a program" principle, the essence of which is to implement information system dynamic settlement projects in a main core, presented in the form of a full-fledged independent software modules with the specification of different interconnected computational algorithms that are processed directly by the main envelope of an information system. The model of a computational project is generated automatically on the basis of random numbers generated by a generator concerning the values of initial data within the information system and in accordance with a synergistic approach. A student performs manually the necessary related settlement procedures for a sequential order within a generated settlement project layout of all the required intermediate and final results with the possibility of a multiple adjustment and the check of incorrectly specified design parameter values by an information system.

Key words: Synergetic approach, distance learning systems, natural-science disciplines, remote system of dynamic settlement projects, parameter

INTRODUCTION

Problem urgency: During the implementation of university student learning process concerning natural science disciplines cycle in general and mathematics in particular, it is advisable to use a synergistic approach, the essence of which lies in the fact that a certain finite set of objects, combining an arbitrary manner can create a variety of systems with unique properties, characteristics and laws. Synergetics as science considers natural phenomena and processes from the point of view of complex self-organizing systems and shows that all the processes and phenomena in nature are connected to constant matter, energy and information exchange with the environment which makes them non-equilibrium inevitably. The analysis of such system behavior "far from equilibrium" found that the systems acquire fundamentally new properties and begin to obey special laws. A synergetic approach is an innovative one and it is the following one: a certain finite set of objects, combining an arbitrary manner, can create a variety of systems with its unique properties, characteristics and laws.

In the course of natural-science disciplines study it is reasonable to apply settlement projects in order to perform intermediate and final control of university student knowledge and skills. Within each settlement project, students perform related computational algorithms based on the integration of arithmetic and logical operations in order to obtain and visualize intermediate and final settlement results on the basis of the obtained value options concerning the original data.

In order to implement the settlement projects by university students it is appropriate to apply information and communication technologies which allow you to combine distance learning system and local computer simulator into a single information unit in order to realize full settlement projects by students including the implementation of interrelated complex settlement procedures with the specification of all necessary calculation intermediate and final result values within a remote level regardless a temporal and a spatial location of a student.

Distance learning systems applied as a part of an educational process at universities (Robert *et al*., 2008; Bohun, 2013; Bogun, 2014) can not ensure the implementation of settlement projects by students in a remote mode. And this reduces the level of independent activity of students and education quality significantly.

MATERIALS AND METHODS

Remote system of dynamic settlement projects: The use of a synergistic approach during the integration of full settlement projects and distance learning allows you to create a fundamentally new information system of education.

A remote system of dynamic settlement projects presented in the framework of a dynamic researcher's web site http://www.bogun.yaroslavl.ru/index.php?raz=sdob implemented with the use PHP and MySQL technologies is based on the use of "a program in a program" principle and consists of two main information components. The first component of a system is its kernel and it is responsible for the display of the necessary information within an individual virtual information space through the use of a graphical user interface and necessary navigation components.

The second component of the information system is represented as the combination of independent program modules which are the components of the dynamic settlement projects with the indication of various interrelated calculation algorithms which are processed then directly by the main envelope of an information system (Bohun, 2013, 2014, 2015, 2016).

The advantage of this information system is the possibility of a full remote independent student work organizing in terms of full settlement project implementation. According to the ideology of the synergetic approach each design project is presented in the form of program module source code processing results concerning a required settlement project for the automatic generation of initial data values, in accordance with which the development of a settlement project layout is performed. As a part of a settlement project layout a student is provided with text fields to specify the values of the intermediate and final calculation results with the possibility of multiple adjustments concerning incorrectly specified values of design parameters.

RESULTS AND DISCUSSION

The interaction of users with an information system: The interaction between an end user (e.g., a university student) and the information system is carried out according to the following algorithm:

On the basis of a necessary program module source code processing of a dynamic settlement project by an information system kernel a layout of a settlement project is developed and depicted visually. Within the layout presented in the form of a web page, the values of initial data are displayed in the form of text components, painted in green color as well as text boxes to indicate value calculation intermediate and final results accompanied by the necessary comments using hypertext components.

The result of the program module source code processing concerning an estimated project the information system core performs necessary calculations automatically and the resulting values of the intermediate and final results are stored in the respective tables of a relational database.

A student performs the necessary calculation procedures independently and manually according to a developed task of an estimated project and enters the values of obtained intermediate and final results sequentially in the corresponding text fields (Fig. 1)

Realization of calculations:

Method of a gold proportion

Calculation of values of intermediate results:

Step 0:

Number of the numerical sequence: $n^{GP}_{A0} = 6$

Number of the numerical sequence: $n^{GP}_{B0} = 5000$

Number of the numerical sequence: $n^{GP}_{C0} =$ 1914

Number of the numerical sequence: $n^{GP}_{D0} =$ 3092

Member of the numerical sequence of $x_n = x(n)$: $x(n^{GP}_{C0}) =$ 0.7148

Member of the numerical sequence of $x_n = x(n)$: $x(n^{GP}_{D0}) =$ 0.7145

Function $y = f(n)$: $f(n^{GP}_{C0}) =$ 0.0005

Function $y = f(n)$: $f(n^{GP}_{D0}) =$ 0.0002

Step 1:

Fig. 1: Specification of result values by a student

followed by the core check mechanism activation of an information system concerning the values of intermediate and final results specified by a student (Fig. 2).

The result of the check by information system core of an estimated project performed by a student is the update of a design project generated layout in which the design parameter values correctly specified by a student are displayed as text components, painted in blue color. Erroneously specified values of intermediate and final calculation results by a student are displayed in text fields for the possibility of multiple specifications and the check of these parameters values by a student as long as the values of these parameters are not true (Fig. 3 and 4).

It should be noted that a teacher within a remote system of dynamic settlement projects has broad opportunities to organize the monitoring of a student educational self-activity in terms of project implementation as a whole and in terms of a process detailed display concerning the performance of an individual design project by a student.

Application of information system in real educational process: Currently, the information system is used successfully by the researcher and his colleagues during the training of students within the disciplines of "Mathematics" and "Higher Mathematics" in various

Realization of calculations:

Method of a gold proportion

Calculation of values of intermediate results:
Step 0:
Number of the numerical sequence: $n^{GP}_{A0} = 6$
Number of the numerical sequence: $n^{GP}_{B0} = 5000$
Number of the numerical sequence: $n^{GP}_{C0} =$ 1870
Number of the numerical sequence: $n^{GP}_{D0} =$ 1870
Member of the numerical sequence of $x_n = x(n)$: $x(n^{GP}_{C0}) =$ 0.75
Member of the numerical sequence of $x_n = x(n)$: $x(n^{GP}_{D0}) =$ 0.73
Function $y = f(n)$: $f(n^{GP}_{C0}) =$
Function $y = f(n)$: $f(n^{GP}_{D0}) =$
Step 1:

Fig. 2: Check of result values by the system

Realization of calculations:

Method of a gold proportion

Calculation of values of intermediate results:
Step 0:
Number of the numerical sequence: $n^{GP}_{A0} =$ 6
Number of the numerical sequence: $n^{GP}_{B0} =$ 5000
Number of the numerical sequence: $n^{GP}_{C0} =$ 1870
Number of the numerical sequence: $n^{GP}_{D0} =$ 3100
Member of the numerical sequence of $x_n = x(n)$: $x(n^{GP}_{C0}) =$ 0.75
Member of the numerical sequence of $x_n = x(n)$: $x(n^{GP}_{D0}) =$ 0.73
Function $y = f(n)$: $f(n^{GP}_{C0}) =$
Function $y = f(n)$: $f(n^{GP}_{D0}) =$
Step 1:

Fig. 3: The change of incorrect result values by a student

Realization of calculations:

Method of a gold proportion

Calculation of values of intermediate results:

Step 0:

Number of the numerical sequence: $n^{GP}_{A0} = 6$

Number of the numerical sequence: $n^{GP}_{B0} = 5000$

Number of the numerical sequence: $n^{GP}_{C0} = 1914$

Number of the numerical sequence: $n^{GP}_{D0} = 3092$

Member of the numerical sequence of $x_n = x(n)$: $x(n^{GP}_{C0}) = 0.7148$

Member of the numerical sequence of $x_n = x(n)$: $x(n^{GP}_{D0}) = 0.7145$

Function $y = f(n)$: $f(n^{GP}_{C0}) = 0.0005$

Function $y = f(n)$: $f(n^{GP}_{D0}) = 0.0002$

Step 1:

Fig. 4: The check of changed result values by a system

areas of undergraduate. At that the students perform the following dynamic design projects: "Arithmetic operations for matrices", "Solution of linear algebraic equation systems", "Finding of triangle parameters on a plane by analytic geometry methods", "Finding the limits of numerical sequences", "The solution of algebraic and transcendental equations", "Approximate calculation of definite integral values", "Approximate solutions of ordinary differential equations of the first order".

Summary: Thus, using a synergistic approach during the implementation of a distance by university students as the part of dynamic project distant system developed by the researcher allows the students to perform full design projects during the study of natural science subjects according to the principle "a program in a program" with the use of complex calculation algorithms which contributes to a significant increase of education process quality.

CONCLUSION

According to the data stated above, it can be concluded that the application of a remote system of dynamic settlement projects developed by the researcher in the educational process of universities, built on the implementation of a synergistic approach allows students to carry out full settlement projects according to various academic disciplines of natural-science cycle within a remote level regardless of a spatial and a temporal location with the possibilities of repeated specification of design parameters and a full implementation of a settlement project. The implementation of full settlement projects by students at a remote level in which you need to perform complex calculation algorithms with the indication of all necessary intermediate and final calculation result values, contributes to a significant increase of education quality in terms of getting a clear coherent system of knowledge and skills.

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