# KNOWLEDGE ACQUISITION SYSTEM TRAINER1 (SIMULATOR FOR TEACHING FINANCIAL ANALYSIS) AS INEVITABLE COMPONENT OF DISTANCE LEARNING

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*Abstract: In article the existing systems of collection of knowledge are analyzed, need of computer simulators of creation for collection of knowledge in economy is checked, necessary conditions for their functional capabilities and use are defined, the initial computer simular for the collection of knowledge created by us is figured. In article the existing systems of training of the financial analysis are analyzed. One of ways in improving of quality of e-learning of objects of an economic profile - development and applications during training of simulator.  In article   the technology of preparation and training of the financial analysis with use of an assessment bankruptcy of the enterprise by means of the logician - probability and the Z-score of models, the developed author of software package TRAINER1 the exercise machine. The TRAINER1 used for the multi-scenario analysis and generalization of results to predict assumptions of possible errors and to create recommendations of their correction.*

*Keywords: Knowledge acquisition, Simulator, Financial analysis, Semantic analysis, Debriefing. FINSIM1.1*

*ITHEA Keywords: Please use keywords from http://idr.ithea.org/tiki-browse_categories.php .*

## Introduction

Achieved results in the field of informatization makes development of distance learning possible. Distance learning can be considered as form of teaching by correspondence approved in practice during decades, which is by correspondence in form but is relevant to form of attended teaching by its sense. Components of distance teaching of subject are as follows: textbook created by using hypertext technology, video lectures, special programmed environment, which provides: 1. Acquisition of knowledge in training regime; 2. Model typical situations and acquire decision making skills; 3. Demonstrate and assess acquired knowledge.

Problems of knowledge acquisition, demonstration and assessment have always been, is and always will be topical issue. Process of searching is infinite in time and space. Three approaches are singled out: traditional (informal), using computer systems (formal) and combination of these two.

Traditional method is effective one that has been experienced during centuries and is very unlikely to be changed ever. In the last three decades intense research has been taking place and computer programs of different kinds and functional possibilities have been created. These programs are oriented towards knowledge acquisition, demonstration and assessment.

In the field of knowledge acquisition transferring knowledge using video lectures, multimedia electronic books and printed publication are frequently used today. In addition, online consultations with the teachers is also widely accepted.

Many scientific publications are written regarding improving teaching process using electronic systems of knowledge acquisition. One of the directions is drawing out computer simulators.

In the exploitation of complex technical systems and training of management specialists different kinds of simulators have been used for a long time. In the article {Трухин 2008} teaching simulators of different aims existing in Russian Federation are analyzed. In the recent years simulators have been widely used in medical institutions in the process of teaching medical personnel and improving their qualification [Свистунов 2011]. Working out of simulators of different type and aim - started from physical ended by electric - is taking place in today's world. Mainly three kinds of simulators are prevalent: physical, electronic and combination of two.

Experience in drawing out and use of electronic simulators in the training of specialists in the area of management includes: Railway tickets cashier, managing and exploiting heating systems in train coach and etc. [3].

Training of specialist in any field including economist consists of two main components: theoretical knowledge and practical skills. Object of our research is acquisition of knowledge oriented towards searching for a method of elaboration mechanism of practical skills. Acquiring skills for operating aircraft, ships, boats and similar apparatus is impossible without physical simulators.

Object of the learning of economic processes are informational flows depicting movement and modification of material currents. Because of this only computer simulator can be used in training of economists. Their role is particularly important in the distance learning. Methodological foundations of realization of simulator are economic-mathematic models and computer systems. Teaching practical skills using simulator is achieved by solving situational problems.

Scientific research works done for elaboration of simulators for subjects of economic profile represented in scientific papers and dissertations are very interesting [Ельцин 2013, Рышкевич 2013].

Analysis of informational materials shows that there is no common understanding between the concepts of electronic simulator and simulator. Part of the researchers understand electronic simulator as a unity of textbook made using hypertext technology and informational-programed complex. Using electronic textbook introduction to and acquisition of the issue is done, while programed complex provides fixation of acquired issues. In this process student solves the problems in an interactive regime and answers theoretical questions. In order to answer correctly to these questions student uses reminder represented by text, graph, and video. Process of the teaching and exam for certificate is made online.

Hence, for training high quality specialists of economic profiles and permanent qualification improvement of management specialist's two interlinked problems have to be solved: first – drawing out universal program package of electronic simulator, second – filling knowledge base of simulator by knowledge base of problematic section.

First problem consists of two interlinked problems: first – elaboration of electronic textbook using hypertext technology and second – elaboration of programmed environment for problem solving online in the interactive regime. In a special literature theoretical and practical issues of creating electronic textbooks using hypertext technologies are widely discussed. Simple programs – editors are available in the environment of which any teacher or professor working in the field of economics can create electronic textbook after some training. Today, many electronic textbooks are created. Any textbook is presented with text, graph, video. It serves as a basis for knowledge acquisition. After introducing materials in the textbook it is necessary to solve practical problems, analyse theoretical issues and etc. This goal can be achieved by program – simulator.

Different kinds of simulators have been used in exploitation of complex technical systems and training of specialists for a long time. In article /1/ simulators existing in the field of business and used on the levels of teaching and functioning are given: AdSim Advertising, Baton Simulations, Blue Ocean Strategy Simulation (BOSS), Capsim Foundation and etc.

In article /2/ simulators of teaching purpose existing in Russian Federation are analyzed. In the recent years simulators have been widely used in medical institutions in the process of teaching medical personnel and improving qualification /3/.  This is not surprising, because any mistake made by technical system and medical personnel brings immediate results. Moreover, mistake of technical system – made by ship or aircraft crew brings their life under risk.

Because of the fact that result of the mistake caused by low qualification of an economist will show up after $\Delta t$ period, it remains unnoticed for the decision makers. Result of the mistake can be fatal for the society.

Mistakes made by economists on a different level of management are the results of impunity syndrome. Economists' inability to predict the possible result of their decisions comes from the low level of their training. Processes of transferring, acquiring, revealing of knowledge must be changed as a matter of principle.

Our focus is made on searching for the methods, ways and means of reduction or in ideal case – liquidation of errors made by economists that are caused by low qualification.

At the moment simulators of different kinds and purpose are being drowned out in developed countries – started from the physical simulators ended by electronic ones. It won't be mistake if we say that there are mainly three kinds of simulators being constructed: physical, electronic and combination of two

For the training of economists we can create and use only electronic simulators.

Modern information tehnologies allow us to look differently to the teaching process and cunduct it in an unusual way.

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Under the simulation modeling informational-programed environment is considered in which specific type of situation is being modeled.

Aim of the elaboration and use of simulators is:

**First** – Enabling for understanding management of the situations arising on a real object, decision making and analysis of expected results of decision in the teaching process.

**Second** – Enabling modeling existing situation with real data and looking at expected results before making decision in the practical activities.

It is worth to be mentioned that like electronic diagnostics it is impossible to achieve adequate modeling of actual situation regardless the perfection of the situational model. Because of this, final word is on decision maker and he/she makes decision under self-responsibility.

Topics discussed in the specific discipline include discussion and acquisition of typical finite situations for those simulation models should be drowned out.

Second problem consists of two interlinked problems: first – elaboration of electronic textbook using hypertext technology and second – formation of system knowledge base.

Simulators can be used invariably or with the little modification in the following areas with the common legal space:

1. In the higher education institutions in different countries, including Georgia:
   - For the training of specialists;
   - For the retraining of specialists in the field of management: economists, financiers, marketing specialists and others.
2. In the process of enterprise management.

Preconditions for drawing out simulators for economic processes exist – these are theoretical and practical experience of elaboration and use of intellectual systems of decision making in different problematic areas (medicine, technical systems and etc.). Like economic processes in medical diagnostic systems here we deal with the information processes. Because of this while drawing out simulators of economic processes modeling mechanisms for knowledge demonstration and decision making can be taken into account. Clearly, like medical diagnostic systems at first classification of economic simulators using certain criteria must be done. This criteria include: problematic areas (entrepreneurial, macroeconomic processes), kinds of problematic areas, situation types and etc.

Problems of elaboration and use of simulators depicting economic processes for training of economists stand in the center of our attention. Form of the realization of economic simulator is computer programmed complex. Its aim is to ensure that in the teaching process student acquires skills for situation analysis, economic decision making and assess results of the decision for the different values of real data.

Use of simulators in the teaching process changes methods and approach to the transfer of knowledge. The role of the teacher is particularly increasing, which should be able to:

- Comprehend the working principles of the simulator;
- Understand the realization algorithm of the problematic situation that is simulated;
- Interpret the results of the simulation;
- Correct of the simulation results taking into account the factors considered by the simulator;
- Approve/reject simulation results

On the practical lessons student is required to explain simulation results. Simulation realization and analysis of the results depend on the knowledge about problematic area. Because of this, introduction to and acquisition of issues regarding the simulation are integral parts of the simulator.

Components of study using the simulators are as follows: computer turned in a global network, program simulator, electronic textbook realized by hypertext technology linked to simulation organized on a server. Integral part of the any kind of studying process including the studying process using simulators is video clip representing the process of studying. After classes the video is placed on the internet and student gets it.

Our modest experience in drawing out economic simulators enables us to form necessary requirements for simulators.

Simulator is used to:

- Model problem depicting actual economic process using certain algorithm;
- Solve linear and non-linear optimization problems;
- Form multi-optional plans;
- Comply and select options;
- Visualize of simulation results in a form of diagrams, tables, videos or their combination;
- Model N independent variable in the problem depicting model by $\forall n_i$ variable and represent the results in the form of diagram;
- Model by any of $n_i$ and $n_{i+1}$ variable from the set N simultaneously and represent the results in the form of table;
- Model using number of variables simultaneously for the different values of variables;
- Represent multi-optional results of modeling;
- Explain simulation results.

Using program package it can be possible to:

- Introduce to the essence of the problem, algorithm;
- Realize simulation in many natural language.

Work with the simulator must be allowed for every interested person without any kind of registration and passwords.

Simulator should enable us to make as situation modeling as well as simulation of solving problem using known algorithm and research the algorithm to solve this problem. Clear example of it is solving the problem in Excel with its financial functions. Observing the process of problem solving in Excel using its functions we can see how the result is being changed in response to the changes made in the

values of arguments. Arguments themselves reflect occurrence of the certain fact such as taking credit, investing, amortization and etc.

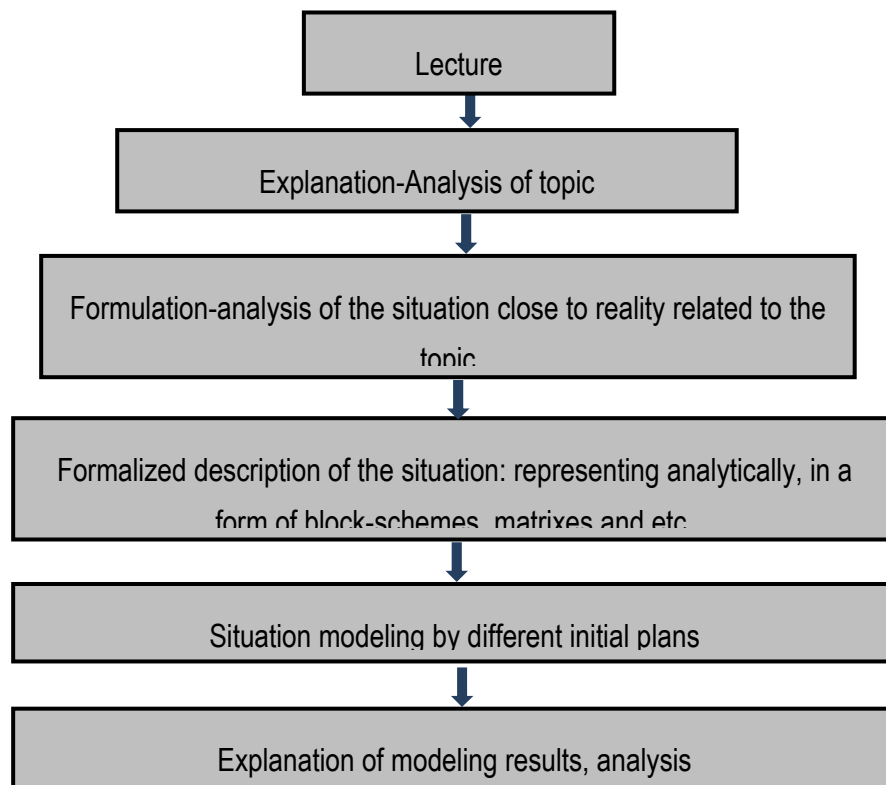We see conducting lectures and practical classes using simulators in such way: /Fig. 1, 2/

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┌─────────────────────────────────────┐
│              Lecture                 │
└─────────────────────────────────────┘
                 │
                 ▼
┌─────────────────────────────────────────────┐
│       Explanation-Analysis of topic          │
└─────────────────────────────────────────────┘
                 │
                 ▼
┌───────────────────────────────────────────────────────┐
│  Formulation-analysis of the situation close to        │
│  reality related to the topic                          │
└───────────────────────────────────────────────────────┘
                 │
                 ▼
┌───────────────────────────────────────────────────────┐
│  Formalized description of the situation: representing │
│  analytically, in a form of block-schemes, matrixes    │
│  and etc.                                              │
└───────────────────────────────────────────────────────┘
                 │
                 ▼
┌───────────────────────────────────────────────────────┐
│    Situation modeling by different initial plans       │
└───────────────────────────────────────────────────────┘
                 │
                 ▼
┌───────────────────────────────────────────────────────┐
│      Explanation of modeling results, analysis         │
└───────────────────────────────────────────────────────┘
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Figure 1. Block-scheme for giving lecture using simulators

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┌───────────────────────────────────────────────────────┐
│                 Practical classes                      │
│                                                        │
│  Situational models around the topics discussed on     │
│  the lecture are being examined                        │
└───────────────────────────────────────────────────────┘
                 │
                 ▼
┌───────────────────────────────────────────────────────┐
│  Situation modeling and explanation of results by the │
│  students considering the preconditions set by the     │
│  teacher                                               │
└───────────────────────────────────────────────────────┘
                 │
                 ▼
┌───────────────────────────────────────────────────────┐
│  Teacher generalizes the results got by the students.  │
│  Analysis of the mistakes                              │
│  and recommendations (debriefing)                      │
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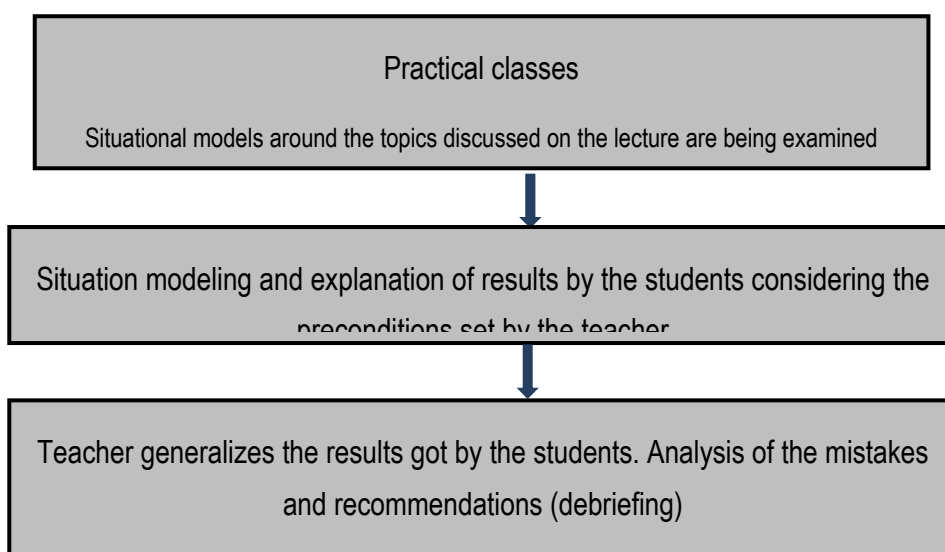
Figure. 2. Block-scheme of conducting practical classes using the simulators

Use of the simulator in the teaching process consists of the stages of planning and functioning.

On a **planning stage** from the set of the simulators teacher selects simulator(s) depicting the given topic;
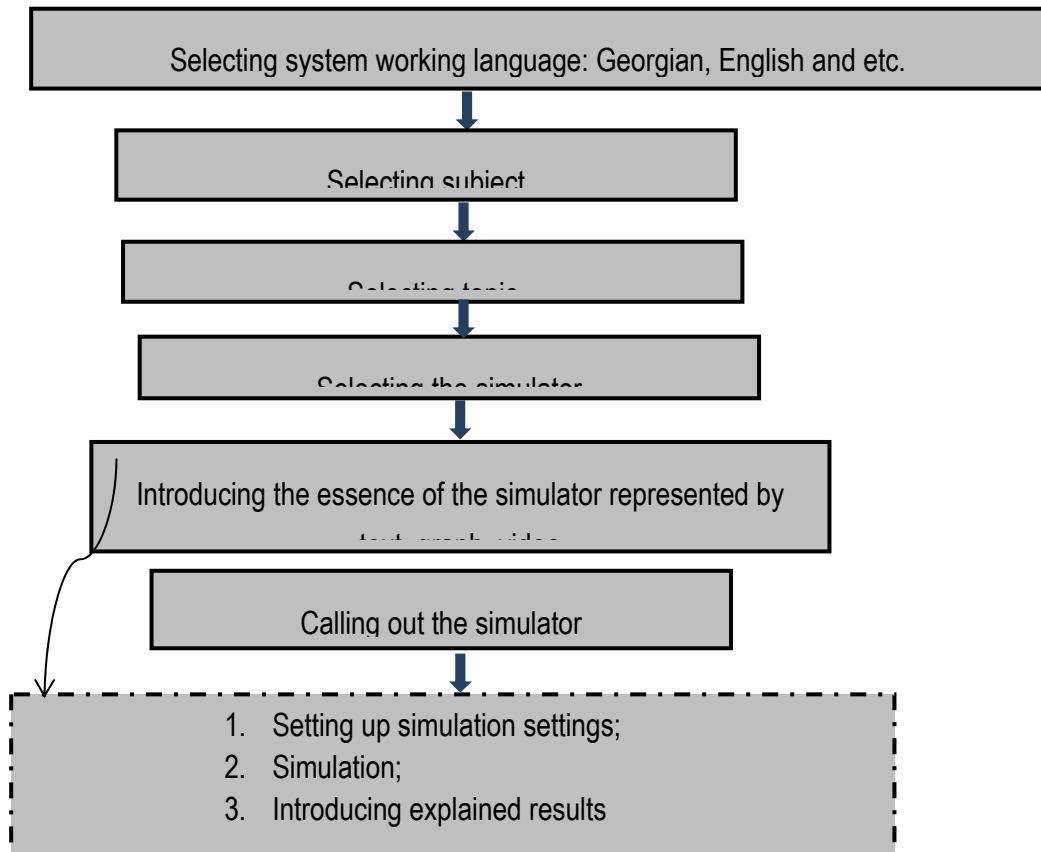
Functioning stage /Fig. 3/



Figure  3. Stage of functioning in conducting teaching with the simulator

In the program package FINSIM1.1 created by us simulators are realized that are used in: first, modeling evaluation of financial stability of enterprise by Altman, Springate, Fulmer, Brzezinski, DuPont models. With these models financial stability of enterprise is evaluated using one, two and many (all the variables included in the model) variables; second – simulating 15 functions of Excel by one or two variables.

Algorithmic-programmed environment of the simulator is universal, but its informational inside part depends on the teacher of subject, its approach to the transfer of knowledge and etc. Because of this, drawing out typical simulators in the teaching process as a standard is unacceptable. Simulators by subjects can have recommendation-auxiliary role.

Currently, analysis of the simulators used in trainings of the specialists in different fields and our years-old experience in computer systems for demonstrating and assessing knowledge and practical exploitation allows us to form necessary requirements for the computer simulators oriented towards economic profile subjects:

3.  Existence of theoretical and practical issues;
4.  Formation of knowledge base according to the theoretical and practical issues of the subjects, subject topics and sub-topics;
5.  Formation of standard tasks for training;
6.  Explanation of any task in the exercise demonstrating specific method, algorithm and solution;
7.  Formation of base of advices and recommendations for avoiding repetition of the errors made during the training;
8.  Introducing specific results of the training, advices for correction of the errors and showing recommendations;
9.  Making analysis of the errors made during the training in the certain period of time;
10. Changing trajectory of training by student based on the answers.

## Formation of the knowledge base of the simulator.

Basis of the training is formation of knowledge base by the teacher according to the subjects, subject topics and sub-topics. Knowledge base general tests have two types – closed and open.

Closed tests are ones for which on every posed question maximum seven answers comes out of which three are correct. Answering to the posed question is brought down to selection of the right answers out of maximum seven options.

Open test is a test in which the answer of the student must be written in the form of numerical value, sentence or expression.

Based on our experience it is better to have 70% open tests in the test base and remaining to be closed tests, which can preferably be distributed according to the number of right answers in the following way:

Table 1.

| Name | Number (%) |
|---|---|
| Tests with one right answer | 25% |
| Tests with two right answers | 35% |
| Tests with three right answers | 40% |

In the closed tests assessment mustn't be partial, because selecting two or three right questions out of seven is quite hard and requires thorough knowledge of the issue. Open tests are tasks. Possible answers to the tasks aren't limited. Teacher assesses solution result according to his/her attitude and makes ranging of total points based on the answers. Formation of the test base according to the sub-topics occurs in a way that closed and open tests describe typical situations.

For the closed tests firstly, correct answers with detailed proofing are provided by the teacher and secondly, in case of wrong answers advices and recommendations are provided.

For the open test (task) the teacher indicates: firstly, solution for the specific task, secondly, method for solution such task, algorithm, mathematic model, area of use, solution technique and technology, programmed means such as Excel, MATLAB used in solution and etc.; thirdly, the reasons for the wrong answers and the ways and means to avoid them.
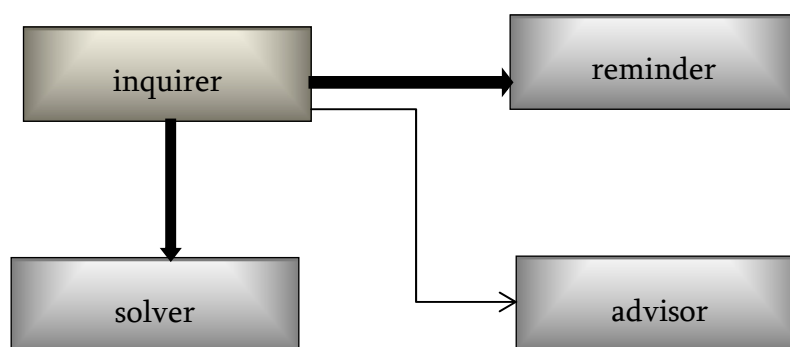


Fig. 4. Essence structure of the tests

Hence, basis of representing any test is information given in a following structure /pic. 1/

"Inquirer" consists of two sections: question (task) text and the possible answers.

"Solver" consists of question, task solution algorithm, model, solution description formulated in specific "inquirer".

In the "reminder" solution method, experience of solution of analogous task, expected results in case of wrong answer and etc. are given.

In the "advisor" negative results are discussed. Reasons causing them and the ways of avoiding negative results are shown here.

In order to study causes for negative results and factors affecting them there is tight connection between the "reminder" and the simulator of specific economic processes given in the "inquirer". Using it the process of the modeling by one, two and multiple variables, formation of multi-optional plans and etc. are made [Tea Munjishvili, 2017].

Any functional block given on the pic. 1 can be shown by the text, graph, video or their combination.

**Planning the training.**

Planning the training - selection of the topics, sub-topics, tests, time of the training – is made by the teacher within the simulators familiar to us and individual potential of the student isn't taken into account. In the ideal case student should have possibility to select topics for training from the test base and sub-topics, their number and training time. In practice a compromise option can be found, particularly:

- Teacher forms standard exercises according to the sub-topics showing all the tests regarding this sub-topic;
- Certain points are assigned to the answers for any closed and open test;
- Partiality of assessment for any test and necessity for semantic analysis are showed for any test.

Before a start of the training 1) student selects topics and sub-topics, 2) defines number of the tests for the training according to the sub-topic and 3) sets total time for the training.

Teaching the subject using the simulator is done in the following sequence /Fig. 5/:

In the given scheme of knowledge acquisition we pay attention to the discussion of the training results – debriefing stage (debriefing is an English word meaning discussion of the results of the work done). In some way this is actually done in many cases by the lecturers, but has no clearly shaped form. Errors made by the students while working with the simulator are shown on the computer display of the lecturer in the form of report. Lecturer analyses it and discusses the results with the students after the training – debriefing.

The process of debriefing is informal. In the article A. A. Svistunov [Свистунов 2013] describes the tasks and aim of debriefing in details. It pays particular attention to the role of the lecturer as a leader in the process of the debriefing. He notes that the leader is obliged to create emotionally compatible environment. It is unacceptable to concentrate attention on the mistake done by the student, on the contrary it should be represented as group mistake and allow the members of the groups to express their thoughts. In such discussion ideas, problem solving ways and methods are generated among the group members.

**Lecture**

Materials given in the electronic textbook are being analyzed, key issues are addressed especially. Video recording is made, which will be placed on the

Practical **classes**

- Lecturer explains typical problems. Shows peculiarities of the problem solving, technique and technology. Pays attention to the analysis of the results and the forms for its representation;
- Students solve the problems in the environment of TRAINER1 simulator

Discussing training results - debriefing

Figure 5. Teaching the subject using the simulator

Requirements set for the leaders in [Свистунов 2011] aren't new. They are formed fully and in details in the work regarding the method of managing intellectual processes, psycho-heuristic programming method [В.В.Чавчанидзе 1974].

Thoughts and proposals expressed by the students in the process of group discussion are taken into account by the lecturer while working on preparing materials and making corrections for the simulator.

Exercise created by the student can be represented before the start of the training graphically in a form of looped finite oriented G graph, where $\forall v_i, v_i \in V$. From the set of the tests indicated in the exercise P is the selected test by probability. $\forall v_i, v_i \in V$ is linked to the neighboring knot with one rib $e_i \in E$. $\forall v_i, v_i \in V$ of G graph has loop (cycle). Number of the cycle depends on a student. Realization of the loop emerges in the system when the test is wrongly answered. Student can call out the "advisor" N times.

We have created electronic textbooks in economic subjects that have been functioning since 2013. These are: operational management, strategic management (author: Prof. Badri Ramishvili), financial functions in Excel (author: Prof. T. Minjishvili) and zero version of simulator [Tea Munjishvili 2013,....., Badri Ramishvili 2013]. Training is done using program package "Cyber1" [Tea Munjishvili 2014]. Considering negative and positive sides in the process of "Cyber1" exploitation, program-simulator TRAINER1 is elaborated in which abovementioned requirements are realized [Tea Munjishvili 2017].

Following are ensured using our computer simulator TRAINER1:

1. Formation of standard exercise by the teacher taking into account leading teachers in subjects, topics, sub-topics;
2. Formation of individual exercise by the student before the start of the exercise;
3. Possibility of elaboration of closed and open tests;
4. Existence of maximum three right answers out of seven options in the closed tests;
5. Existence of any number of the answers in open tests;
6. In the closed tests fixing the answers only after marking needed number of right answers and giving answer fixing command;
7. Using words, numbers, sentences or their combination, also abbreviations in the open tests;
8. Understanding indicative sentence used in the answers in case of breaking synchronization and inserting words;
9. Writing words used in the indicative sentences and general answers in any case, using wrong versions of these words;

10. Identification of actually written answer to the problems depicting certain subjects, topics, sub-topics, sub-chapters to the standard value of this answer. Breaking synchronization, writing words in any case, omitting or inserting words aren't allowed here;

11. Posing the problem using text, graph, video or their combination;

12. Existence of support on subject, test using text, graph video or their combination;

13. Existence of advices and recommendations for the mistakes in closed tests;

14. Existence of advices and recommendations for the mistakes in any answer in open tests;

15. Fixing respective points $q_i \in Q$ to the $\forall n_i, n_i \in N$ answer of the problem. Point can be whole or decimal positive number;

16. Receiving different kinds of diagnostic messages during the training process. For example, omitting words, numbers and etc., while using unknown words;

17. Ordering tests in a probability sense at the beginning of the testing process and selection of tests in a probability sense in the process of training;

18. Getting different analytical information after the training, particularly: report on the training process, advices and recommendations for avoiding errors made at specific training (debriefing), statistics of mistakes made in certain period of time and their representation by the form of diagram;

19. Generalization of the errors made by the students, group discussion, formulation and realization of proposals and recommendations.

Necessary conditions for using computer systems:

1. Proper work of technical system: computers, computative network, server, program means. This condition is an axiom. It doesn't require noting;

2. Original discussion of topics, sub-topics according to the syllabus and formation of relevant tests by the lecturers;

3. Creation of comprehensive support according to the typical test, represented in the form of text, graph, video information;

4. Periodically renewing information in the support base, tests, adding new tests, modifying existing ones.

**Metods:** In TRAINER1 engineering approach to the semantic analysis of sentence is realized, i.e. method of "productive grammar", that bears certain universalism and is insured from the lack of table compatibility principle. Essence of this method, algorithms and programmed realization are discussed [Tea Munjishvili 2014; Tea Munjishvili 2015]. We describe algorithm of semantic analysis used in TRAINER1 briefly.

Indicative sentences are used in the possible answers of the open tests.

$$G = \bigcup g_j, \ j = 1....n.$$

Elements of the G set $g_i, i = 1.....m,$ are answers to open tests.

***Formulating following conditions for  G set:***

1. G is preliminary known finite set. Elements of the set are natural language sentences or word orders;

2. Indicate sentence with conditional number i by $g_i$ and the word in this sentence with conditional number $\lambda$ by $g_{i,\lambda}$. Then used $g_{i,\lambda}$ words constitute L dictionary. Contents of G depend on demonstration of knowledge by simulator and assessment subjects and sentences used in open answers of these subject tests;

3. Any two elements of G differs by one word at least;

$$\forall (g_i, g_{i_0} \in G) \Rightarrow (g_{i_0} \setminus (g_{i_0} \cap g_i) \neq \{\} \wedge g_i \setminus (g_{i_0} \cap g_i) \neq \{\})$$

4. Any pair can comprise words with similar essence.

5. In TRAINER1 any answer of specific test, phrase $g_i \in G$ is unequivocally matched by certain command $\psi_i$, or $g_i \rightarrow \psi_i$.

$\psi_i$ can be phrase, word, unity of symbols and etc. Hence, elements of $G$ set $g_i \in G$ are represented on $G^*$ set.

$$\psi_i \ \in G^*, f : G \rightarrow G^* \ \text{ i.e. } \ f(g_i) = \psi_i .$$

Desired results will be achieved if $\forall g_i \in G$ , then $g_i$ can be considered as production. $g_i$ words $a_k \in L$ are considered as conditions, while $\psi_i$ respective to $g_i$ - as actions. In this sense "semantic

analysis" of any indicative sentence is brought down to finding production system, organization of dictionary and relevant productions of incoming facts.

In the systems of knowledge demonstration and assessment, including TRAINER1, specific production (in our case – sentence) is selected, because we discuss specific answer with known value. It is necessary to define its relevance with existing one according to the incoming facts (words). Hence:

**We have:** not empty set of predicates (natural language words or word orders used in the open tests of the given subject) $L = \{a_k\} \neq \otimes,\ k = 1...n$ , not empty set of activities $G^* = \{\psi_i\}, \mathrm{i} = 1..\mathrm{m},$ not empty set of productions (indicative sentences) $G = \{g_i\}, \mathrm{i} = 1..\mathrm{m},$ not empty set of informativeness. Elements of this set are scalar functions defined on G and they measure certain parameters of predicate by certain scale. Any criterion of informativeness has certain weight $h_\alpha$ so that

$$h_\alpha \in Q_+, \quad \sum \mathrm{h}_\alpha = 1.$$

Our tasks:

1.  Reveal set of criteria of informativeness and ranging them according to their values;
2.  Evaluation of each predicate from $a_k \in L$ dictionary by the given informativeness coefficient while organizing dictionary;
3.  Understanding of the sentence given in the answer while entering n number of predicats in the system:
    *   While changing word order in $g_i$ ;
    *   While omitting and inserting words in any part of the sentence $g_i$ .

Basis of the organization of knowledge base are answers to the open tests – G set of the sentences (productions). We can consider G as a text consisting with semantically unrelated indicative sentences, while in the production system – choosing production as searched form.

We have answers of two types – R and RT. In the first type of problems in R or RT type answers where the words and their synonyms can't be used in different case, only the words used in the answers of the tests or their incorrect versions will be selected and directed to the entrance of the system. Morphological basis, wrong versions and synonyms aren't indicated in the dictionary. In this case

described algorithm for sentence identification is used only with the difference that at the entrance of the system in $L_w\{a_1, a_2, ...a_s\}$ phrase the order of the words must be strictly protected and $L'_w \equiv L_w$ .In the second type of problems while searching for relevant information for R or RT type answers written by the student synchronization can be broken. Words can be used in any case and conjugation, wrong versions, and excess-any number words that exist or not in the dictionary can exist.

Despite its simple character proposed way of understanding indicative sentence can be considered unnecessary because, in many cases students try to write a sentence with the sequence familiar to them. Words are used in many cases and the words are omitted and inserted frequently. Writing erroneous versions of the words is rare.

Identification of open test answer – sentence is made in a following way: /Fig. 6/

**1.** Suppose natural language words $a_0 \in L$ , $L_w\{a_1, a_2, ...a_s\}$ have come into the system. $a_0$ word can be wrong version of the word written in the answer, word written in any case, synonym or abbreviation.

**2.** $a_0$ Word is being searched in $L_1$ dictionary. If one of the words from $g_i \subset G$ phrase regardless of its position coincides with $a_0$, or its base regardless of its position coincides with $a_0$, word is identified, otherwise next step is made.

3. Finding synonyms. $a_0$ Word is being found in $L_1$ dictionary. If morphological basis of $a_0$ is found, then identification of the respective $g_i \subset G$ word is made by using $L_1$ dictionary.

**4.** $a_0$ Word is being searched in $L_3$ dictionary. If the words respective to abbreviation in the dictionary coincide with the words $a_k \in g_i$ used in the answers in sequence then abbreviation is identified.

**5.** If all words in open test answer $g_{i,\lambda} \subset G$ regardless their position coincides to $L_w\{a_1, a_2, ...a_s\}$ set or $L'_w \in L_w$ sub-set, then the searched phrase is identified, otherwise the message regarding specification of the answer shows up.

Figure 3. Stages of semantic analysis of the sentence in TRAINER1

TRAINER1 program is written in VB.NET 2010, database is organized on SQL Server 2008. System is multilingual. Information on the same subjects can be represented in several languages.

**Implementation of results**

Down we discuss the process of starting and running of training with TRAINER1:

Any person interested in can conduct training. Person is identified by ID number or any number consisted of 16 digits. After identification and subject selection window will appear with the list of standard exercises from selected topic written by the teacher according to the sub-topics. Student can change number of the tests for the training and training time in any standard exercise. Before selection of sub-topic student can view at the tests in the exercise. /pic 1/



Pic. 1. Formation of individual task of training by the student on the basis of standard exercise

Following situation is depicted on the picture:

- Table pillars: number of the tests for training, training time. Values that can be changed are colored;

- Number of tests for the training on third sub-topic of second topic is changed (5 is written instead of 4);

- Total time for the training is changed (7000 seconds is written instead of 8000 seconds);

- Third, seventh and eighth lines in the table are marked to bring on training, i.e. second and third sub-topics from topic 1 and third sub-topic from topic 2;

- After pressing on a button "formation of exercise by student" message of choosing training time will appear.

Window appearing after pressing on a button "formation of exercise by student" is following: /pic.2/



Pic. 2. Individual task for training formed by the student

It is showed on the picture that time for the training is 7000 seconds, from the 6 tests of third sub-topic of second topic 5 tests are brought on the training. In total 9 tests are brought on the training, possible points to get is 15. 5 tests are open and 4 tests are closed (assessment of the open tests are partial, while that of closed tests isn't).

After pressing the button "start training" the training starts. On the /pic.3/ open type test is shown with two answers for it. Respective points for answers are also shown. "help on test" button is active in the same window. Pressing on it window will appear providing solution (solution method, algorithm, model and etc.) for the problem.

Student can conduct training everyday N times, get advices and recommendations for error correction made in the test. After finishing any training student can see training report, advices, recommendations and statistics of the errors made by him/her. /pic. 4/
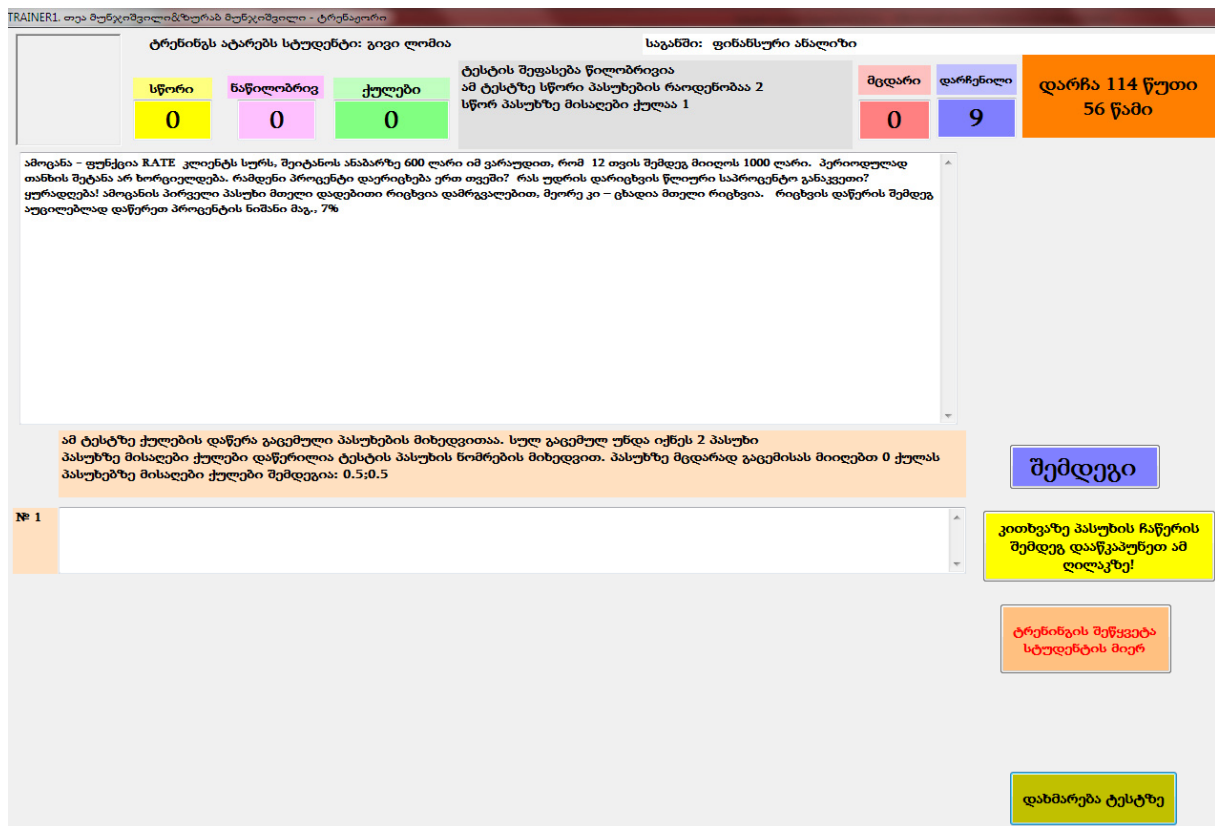


Pic. 3. Window for listing problem solution results for open tests
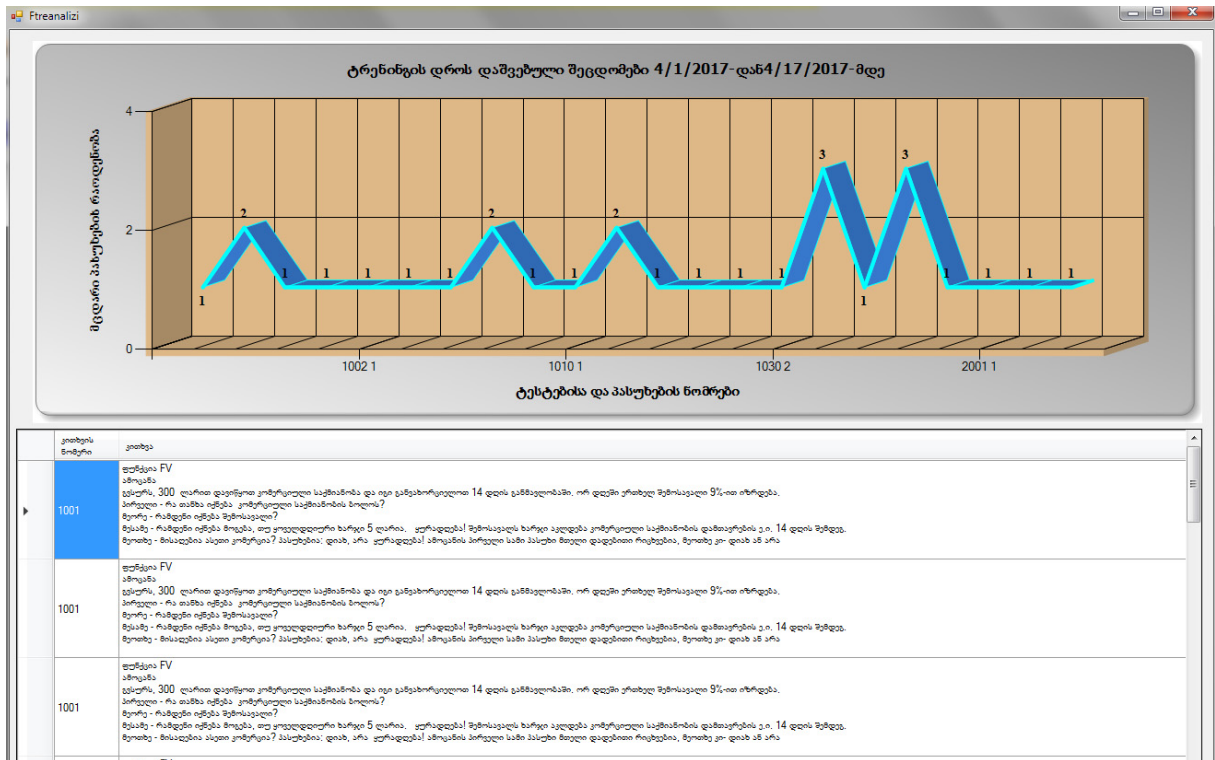
Pic. 4. Statistics of errors made at training

Errors made in the certain time of trainings conducted by the students with the test number and correct answer are given on the picture. In the table in same window contents of the tests given on the diagram are shown.

Below we will discuss modeling of financial stability of enterprise by FINSIM1.1 simulator Altman model. In FINSIM1.1 three models of Altman are given. One of them named Altman1 is following /7/:

$$Z = 1.2X_1 + 1.4X_2 + 3.3X_3 + 0.6X_4 + 1.0X_5$$

where:

$X_1$- working capital/ total assets

$X_2$- undistributed profits/total assets

$X_3$- profit before interest and taxes/total assets

$X_4$- market value of capital/liabilities

$X_5$- sales/total assets

As it can be seen from the model, coefficient X1 represents the measure of liquidity. According to the author Altman losses in the company reduces this coefficient first of all.

Coefficient X2 is a kind of financial leverage, because in the firms with high level of this coefficient assets are financed more by own sources than by borrowed financial resources.

Coefficient X3 shows actual profitability without taxes and interest rates paid.

X4 market value of capital includes common and preferred stocks, short-run and long-run liabilities. Actually, using this coefficient lower threshold of the value of company's assets is defined, when it is below the liabilities.

X5 shows number of sales company's assets can ensure.

Actually 7 variables are included in the model. After systematization of names of variables formula (1) gets following form:

$$Z = (1.2 * X2 + 1.4 * X3 + 3.3 * X4 + X7) / X1 + 0.6 * X5 / X6 \qquad (2)$$

Where:

X1 – total assets;
X2 – working capital;
X3 – undistributed profit;
X4 – profit before interest and taxes;
X5 – market value of capital;
X6 – liabilities;
X7 – sales.

Based on the values of Z we can talk over financial conditions of the firm, particularly:

| | | |
|---|---|---|
| Firm is in a safe zone | | $Z > 2.99$ |
| Firm is in a grey zone | = | $1.81 < Z < 2.99$ |
| Firm is under the risk of buncrupcy in two years | | $Z < 1.81$ |

We make simulation using actual data of actual enterprise. In the table 1. Values of $X_i$ i $= \overline{1,7}$ variables for "X" JSC 2010-2016 are given:

| Name | Years | | | | | | |
|---|---|---|---|---|---|---|---|
| | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 |
| Total assets ( GEL) | 29334 | 39107 | 45953 | 40776 | 21 762 | 20 089 | 14 002 |
| Working capital(GEL) | 12198 | 15879 | 17776 | 14482 | 10 182 | 9601 | 6454 |
| Undistributed profits(GEL) | 10136 | 13228 | 17177 | 16294 | 11 580 | 10 488 | 7 548 |
| Profit before interest and taxes(GEL) | 2128 | 2690 | 4339 | 4325 | 6 403 | 6 195 | 3 368 |
| Market value of capital(GEL) | 736 | 1886 | 3424 | 2511 | 4 788 | 2961 | 2530 |
| Liabilities(GEL) | 439 | 1523 | 2521 | 1767 | 519 | 699 | 741 |
| Sales(GEL) | 5 597 | 6 324 | 4 233 | 5 983 | 6760 | 3040 | 4 1644 |

After calculating minimum, maximum and mean values of variables in program based on the table 1 we get new table with these results.

Using Altman model FINSIM1.1 simulation of financial stability of the enterprise is done in a following way:

1. After calling out the program window will be showed up in which working language with the system can be selected – Georgian. After selecting the language window will appear in which after student identification and selection of subject and topic the list of simulators regarding selected subject and topic will be scrolled down /pic. 5/.
2. After clicking on the name of the simulator respective window will appear.

Basis of the simulation is Altman model. Values of arguments (variables) can be changed by the student. Modeling the process is made by one or two variables, because of this, indication of $\vee x_i$ variable and modeling with this variable are taken into account. Result of the modeling will be received in a form of diagram and table. /pic. 6./

Pic.5. Window after student identification and selection of subject and topic.



Pic. 6. Result of the simulation by one and two variables

On the diagram dependence of Z coefficient (function) on the changing of value of variable $X_i$ is shown, while in the table dependence of change in values of Z coefficient on the changes in $X_i$ and $X_{i+1}$ variables is shown. After clicking on an "explain" button window will appear showing explanation of simulation result.

## Modeling by multiple variables

Minimum, maximum and actual data of $X_i$ $i = \overline{1,7}$ variables calculated based on table 1 are given as a basis plan for modeling. In case of absence of the data minimum, maximum and initial data of variables are brought in by the student. Value of Z coefficient is calculated for the minimum and maximum values of variables and multi-variant modeling is being made by certain step in $Z_{min} < Z < Z_{max}$ range. As a result of modeling $\forall Z_J \rightarrow X_i$ , $i = 1 \ldots 7$ can be seen, i.e. value of any Z coefficient from selected values is defined by certain values of the variables. This allows us to define optimal values of the parameters of financial stability of enterprise using Altman model and after that control and manage their values in the process of functioning of enterprise. On a picture 10. Values of the variables respective to the different values of Z coefficient taken by modeling are shown. Multiple variants of plan is given on the picture 8.
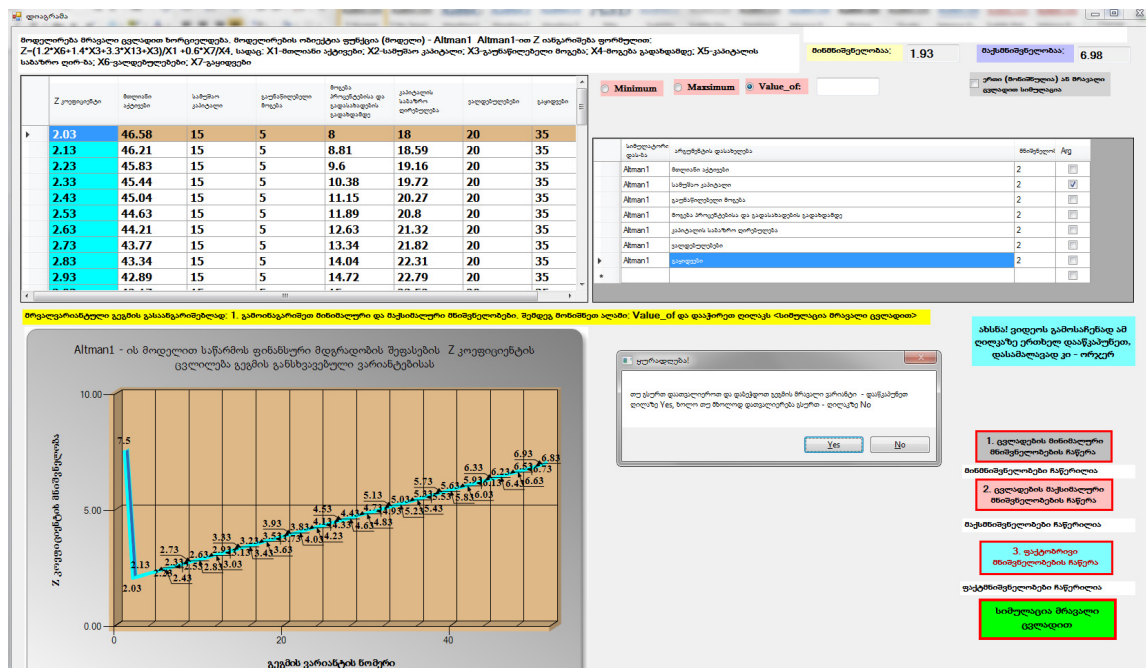


Pic. 7. Results got by multiple variable modeling using Altman's 5 factors model

| | Current Values: | 2.03 | 2.13 | 2.23 | 2.33 | 2.43 | 2.53 | 2.63 | 2.73 | 2.83 | 2.93 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Changing Cells:** | | | | | | | | | | | |
| მიღლიანი აქტივები | 25.00 | 46.58 | 46.21 | 45.83 | 45.44 | 45.04 | 44.63 | 44.21 | 43.77 | 43.34 | 42.89 |
| საშუშაო კაპიტალი | 28.96 | 15.00 | 15.00 | 15.00 | 15.00 | 15.00 | 15.00 | 15.00 | 15.00 | 15.00 | 15.00 |
| გაუნაწილებელი მოგება | 10.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 |
| მოგება პროცენტებისა და გადასახადების გადახდამდე | 15.00 | 8.00 | 8.81 | 9.60 | 10.38 | 11.15 | 11.89 | 12.63 | 13.34 | 14.04 | 14.72 |
| კაპიტალის საბაზრო ღირებულება | 30.00 | 18.00 | 18.59 | 19.16 | 19.72 | 20.27 | 20.80 | 21.32 | 21.82 | 22.31 | 22.79 |
| ვალდებულებები | 10.00 | 20.00 | 20.00 | 20.00 | 20.00 | 20.00 | 20.00 | 20.00 | 20.00 | 20.00 | 20.00 |
| გაყიდვები | 35.00 | 35.00 | 35.00 | 35.00 | 35.00 | 35.00 | 35.00 | 35.00 | 35.00 | 35.00 | 35.00 |
| **Result Cells:** | | | | | | | | | | | |
| $O$1 | | | | | | | | | | | |

Pic. 8. Multiple variances of plan got by multiple variable modeling using Altman's 5 factors model

## Conclusions and recommendations

1. It is not a panacea to use simulator in the teaching process including our simulator. It is one of the means for deep understanding of the issue in a short time. Effect of the simulator is achieved with the use of using simulator with respectively designed electronic textbook. Under electronic textbook we consider a textbook designed using hypertext technology, subtle search system, represented by the graph and video;

2. Integral part of training, simulation is discussion and analysis of the results – debriefing. For conducting group debriefing by the teacher using FINSIM1.1 the report describing training, simulation is made;

3. Knowledge acquisition system TRAINER1 is attributed to the class of intellectual systems for knowledge acquisition. It is an integral part of distanc learning;

4. Defining individual exercises by the students within the training allows taking into account abilities of student as much as possible and paying attention by the student to the key issues for him/her;

5. Giving advices and recommendations timely in case of mistakes allows repeating solution of the problem several times that makes the process of knowledge acquisition easy and fast;

6. Semantic analyzer of indicative sentence in TRAINER1 allows for taking into account peculiarities of problem solution;

7. Adaptation of TRAINER1 to specific subject is made by inclusion of information describing this subject in the database of TRAINER1;

8. Necessary condition for using TRAINER1 is preparation of information describing the subject, particularly: single out topics, sub-topics; form typical problems in any sub-topic; explain problem solution method, algorithm; experience for solving such problems; characterize typical errors made in problem solving and show the ways of their improvement;

9. TRAINER1 allows the information describing the same subject to be represented by different teachers (indicating their authorship): problems, solution methods and etc.

## Bibliography

1. https://www.bpsimulator.com/ru/business/

2. А.В. Трухин, АНАЛИЗ СУЩЕСТВУЮЩИХ В РФ ТРЕНАЖЁРНО-ОБУЧАЮЩИХ СИСТЕМ, http://ido.tsu.ru/files/pub2008/8.pdf

3. Методы и принципы симуляционного обучения, Свистунов Андрей Алексеевич, http://rosomed.ru/kniga/metodi_i_principi_simulationnogo_obucheniya.pdf

4. qumcpo.minsk.edu.by/ru/main.aspx?quid=1761

5.  Гипертекстовые тренажеры для обучения по экономическим дисциплинамтема диссертации и автореферата по ВАК 08.00.13, кандидат экономических наук Ельцин, Андрей Владимирович, http://www.dissercat.com/content/gipertekstovye-trenazhery-dlya-obucheniya-po-ekonomicheskim-distsiplinam#ixzz439UL0S43

6.  Рышкевич В. М. Симуляционные формы обучения в практике преподавания экономических дисциплин и повышения квалификации [Текст] // Теория и практика образования в современном мире: материалы III междунар. науч. конф. (г. Санкт-Петербург, май 2013 г.). — СПб.: Реноме, 2013. — С. 162-163. http://www.moluch.ru/conf/ped/archive/70/3864/

7.  Altman Edward I., Predicting Financial Distress Of Companies: Revisiting The Z-Score And Zeta® Models, July 2000

8.  Tea Munjishvili, Zurab Munjishvili, Knowledge demonstration and assessment system "Cyber1", international Journal "Information Technologies & Knowledge" Volume 8, Number 3, 2014, pp. 271-279.

9.  Tea Munjishvili, Zurab Munjishvili, Knowledge demonstration and assessment system "Cyber1", international Journal"Information Technologies & Knowledge" Volume 8, Number 3, 2014, pp. 271-279.

10. Z.Munjishvili, problem-oriented method of semantic analysis for sentence of natural language. Collection of Knowledge, dialogue, decision, Kiev, Ukraine, "Naukova Dumka", 1990.

11. Munjishvil T., Munjishvil Z., Nakashidze V. System of knowledge revealing and rating – "Cyber 2". 9th MIBES ANNUAL INTERNATIONAL CONFERENCE 2014 THESSALONIKI, GREECE, 30/5–1/6 .CD ISBN# 978-960-93-6161-3. pp. 111-121.

12. Thea Munjishvili, Zurab Munjishvili.  "The system of Discovery and Estimation of Knowledge "Cyber2"", Scholars' Press, Saarbrucken HRB 18918.Published on: 2015-01-15 Number of pages: 108. Book language: English. ISBN-13: 978-3-639-76094-1.

13. Tea Munjishvili, Zurab Munjishvili. The semantic analysis method and algorithms of open tests answers on "Cyber-2" patternin the Knowledge revival and evaluation systems. 2015 IEEE Seventh International Conference on Intelligent Computing and Information Systems(ICICIS 2015), Volume 3, 12 - 14 December, 2015, Cairo, Egypt pp. 50-55

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