SCORM 2004 TRAINING SIMULATORS IN E-LEARNING SYSTEM FOR TRAINING BACHELORS DURING STUDY OF COMPUTER SCIENCE

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This researching is directed on the urgent scientific problem solution which consists in development of high-quality electronic manuals on the basis of modern computer technology for learning computer science. There have been developed and implemented two training simulators in SCORM 2004 for two subjects: Arithmetic and Logical Foundations of Computer Science. Training simulators are used in e-learning systems in National research nuclear university «MEPhI». AdobeFlashProfessionalCS5 using integrated programming language ActionScript 2.0 has been used as the development environment. The results of students learning before and after adoption of training simulators has been analyzed by using cluster analysis k-means. Statistics demonstrate that using information-educational resources in format SCORM 2004 is more effectively than using worksheets.

Keywords: iinformation-educational resources, methodology SCORM, systems of electronic training, program training apparatus, cluster analysis k-means

The development of information technology cause the advent of many tools for development e-learning elements. To use e-learning elements and e-learning systems which have been developed by various technology, the standards are applying. Standard SCORM (Sharable Content Object Reference Model) 2004 have been received the widest recognition among all of the e-learning standards. The standard SCORM 2004 based on the following basic requirements for educational assets, such as accessibility, adaptability, affordability, durability, interoperability, reusability.

At the National Research Nuclear University MEPhI (NRNU MEPhI) has been developed a system of e-learning «MEPhIst» which allows to use courses of various vendors supporting standard SCORM. Standard SCORM assets are formed into a common SCORM package, which is a bundle of several or more packages containing content of Web-pages. The material in SCORM-package presented by individual small blocks which can be included in different training courses and regardless of development tools can be used by e-learning system. SCORM packages may contain the following educational components: electronic lectures and presentations , tests, training simulators, etc. [2, 3].

There are many online – calculator to convert numbers from one system of numeration to another and to study the laws of mathematical logic in the public domain currently. Also there is a set of theoretical programs but they don't formation practical skills of the students. To increase the quality of education have been developed and implemented two training simulators in SCORM format for two subjects: Arithmetic and Logical Foundations of Computer Science.

Materials and methods of research

Training simulators are part of software simulators in SCORM-format packages, the elements of which are also lectures and tests.

This packages also include the xml-file (the manifest). This file describes the structure of the package and the files which included into training unit. This file should be named «imsmanifest.xml» and have to be in the root directory of the package.

Blocks of educational material which included into the package can be of two types: asset and sharable content object (SCO). Asset – an element which interacts with the LMS-server. It could be a html-page, a picture, a flash-file, etc. SCO – an element that interacts with the LMS-server: reports on the progress and results of the study, receiving and transmitting additional data, etc. Sample of the code manifest is represented at Fig. 1.

Adobe Flash Professional CS5 using integrated programming language Action Script 2.0 has been used as the development environment.

Training simulator «Arithmetic Foundations of Computer Science» provides tasks to convert the number of decimal number system to binary, octal, and hexadecimal [6].

Training simulator «Logical Foundations of Computer Science» consists of four tasks on topics such as the distributive law, the law of Blake-Poretsky, law clutching, absorption law [4].

Training simulators are operated in two modes: self-training and knowledge control [2, 3]. While self-training the user can choose the topic of task. If the answer is incorrect, the user can't start other task and the system generates an error. Remarks for the competed task doesn't accrue. While knowledge control user have to go through all the stages of the training simulator to obtain the remarks. In both modes, the student is offering to construct the answers from the given elements.

Passing algorithm and scoring of training simulator «Arithmetic Foundations of Computer Science» is represented at Fig 2.

Passing algorithm and scoring of training simulator «Logical Foundations of Computer Science» is represented at Fig. 3.

Results of research and their discussion

Self-training of the course «Computer Science» in 2011 was provided by lectures, homeworks and written tasks. The difficulty of checking tasks was more than 200 hours because more than 80% of the students were able to take the job in the second or third time only with the help of interactive communication with the teacher.

```
<manifest identifier="FlashTestSCO" version="1.1"
 xmlns="http://www.imsproject.org/xsd/imscp_rootv1p1p2"
 xmlns:adlcp="http://www.adlnet.org/xsd/adlcp_rootv1p2"
 xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
 xsi:schemaLocation="http://www.imsproject.org/xsd/imscp_rootv1p1p2      imscp_rootv1p1p2.xsd
 http://www.adlnet.org/xsd/adlcp_rootv1p2 adlcp_rootv1p2.xsd">

  <organizations default="TOC1">
    <organization identifier="TOC1">
      <title>Arifmeticheskie_osnovi</title>
      <item identifier="ITEM1" identifierref="RESOURCE1">
        <title>Trenazher</title>
      </item>
    </organization>
  </organizations>
  <resources>
    <resource identifier="RESOURCE1" type="webcontent" adlcp:scormtype="sco" href="Kontr.html">
      <metadata>
        <schema>ADL SCORM</schema>
        <schemaversion>1.2</schemaversion>
        <adlcp:location>sco.xml</adlcp:location>
      </metadata>
      <file href="Kontr.html"/>
      <file href="Kontr.swf"/>
    </resource>
  </resources>
</manifest>
```

Fig 1. Code of xml-file (the manifest) for describes the structure of the package and the files which included into training unit «Arithmetic Foundations of Computer Science»

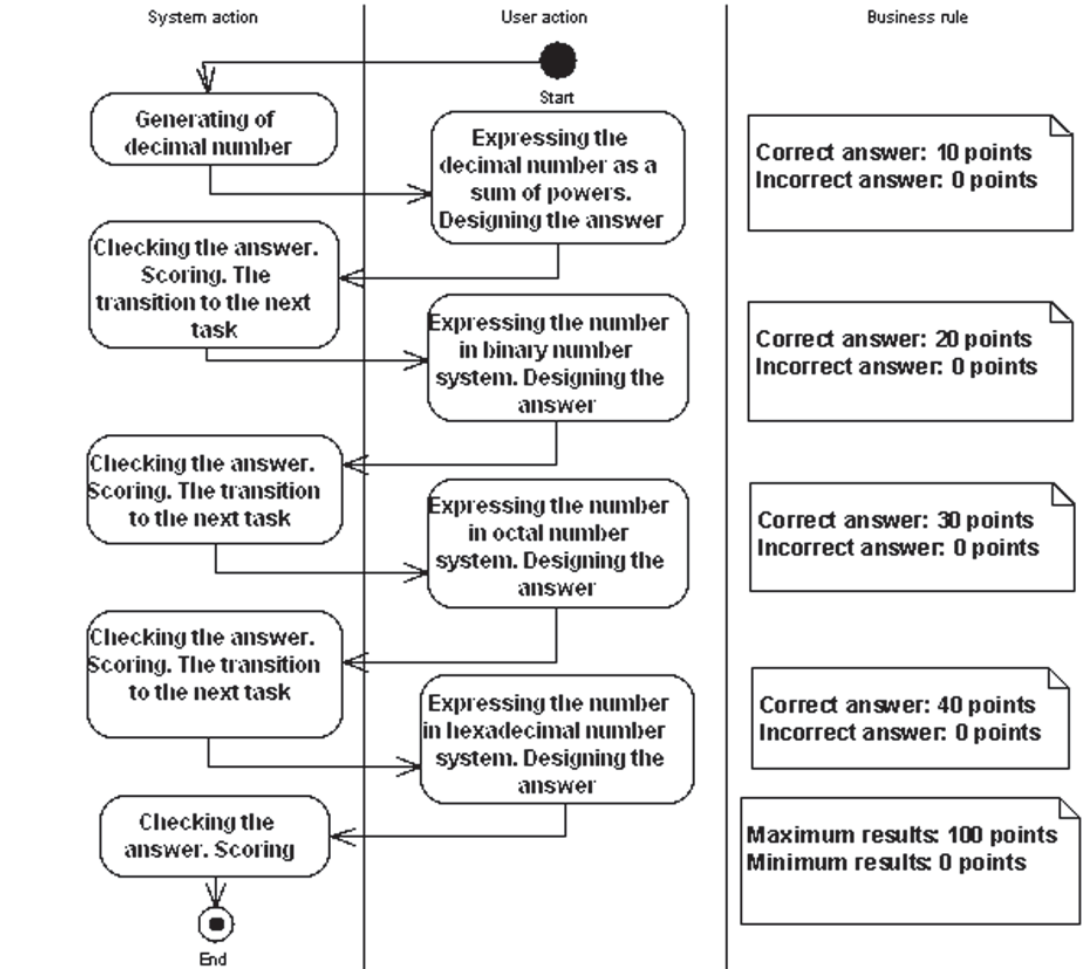

Fig. 2. Activity diagram in Enterprise Architect describing passing algorithm and scoring of training simulator «Arithmetic Foundations of Computer Science»

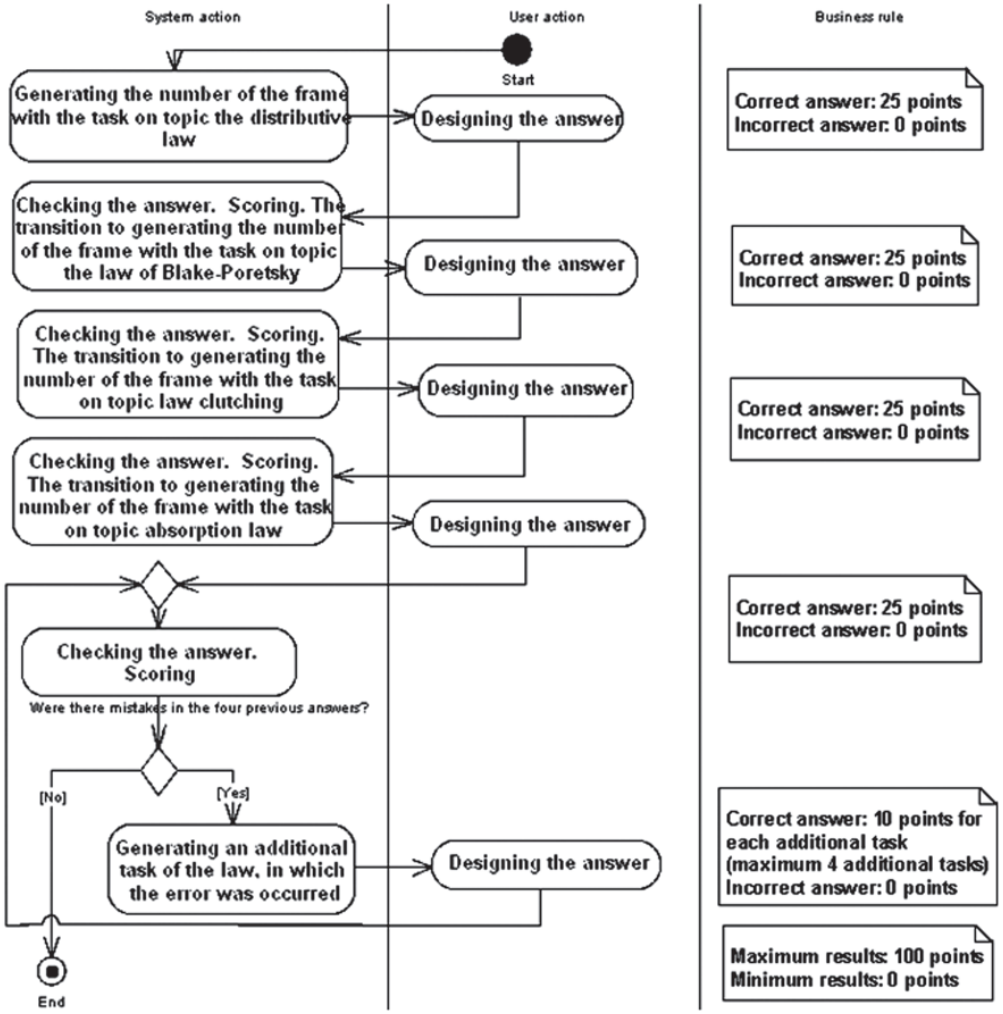

Fig. 3. Activity diagram in Enterprise Architect describing passing algorithm and scoring of training simulator «Logical Foundations of Computer Science»

In 2012, to reduce the difficulty of checking tasks were used two training simulators: «Arithmetic Foundations of Computer Science», «Logical Foundations of Computer Science». Students were suggested to use training simulators in self-training mode for developing skills for solving practical problems. After one week training, was given access to training simulators in the knowledge control mode for students.

The results of final tests of the course «Computer Science» have been thoroughly analyzed. Cluster analysis has been chosen for test's results statistical processing. This method is used for objects classification into relatively homogeneous groups which are called clusters. Objects must be similar together in each cluster and differ from objects in other clusters.

To perform clustering method was chosen clustering k-means (k-means). This method based on the definition as long distances as possible between k-clusters. By using this method could be selected the number of clusters and thus were hypothesized of a partition of test results into four clusters: «unsatisfactory», «satisfactory», «good» and «excellent». Analytical platform Deductor Studio has been chosen for doing cluster analysis.

The partition into clusters in Deductor Studio according to the following algorithm:

1. The initial distribution of objects into clusters. Center of the cluster – the average value of the variables of objects in the cluster. Sets the number of k and in the first step, these points are considered the «center» of the clusters. Each cluster corresponds to one center. The choice of initial centers are randomly. As a result, each object is assigned to a particular cluster.

2. Iterative process. Selected new centers of clusters and objects redistributed. The process of computing centers and redistribution of

objects continues until the centers of the clusters are stabilized that is all objects will belong to the cluster to which they belonged to the previous iteration.

The results of the clustering were divided into 4 clusters. Evaluation results were a hundred point scale. Comparison cluster's volume in 2011 and 2012 years is represented at Fig. 4:

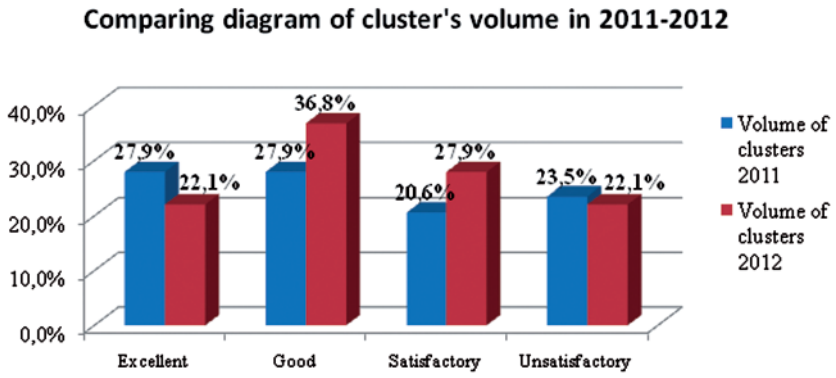

Fig. 4. Comparison cluster's volume in 2011 and 2012 years

The diagram shows that the cluster with the results of «good» increased in 2012, and the cluster with the results as «satisfactory» also increased. In turn, the clusters are «excellent» and «unsatisfactory» decreased due to redistribution of clusters. The cluster with the results of «good» added the results of the clusters «satisfactory» and «unsatisfactory».

Conclusions

Statistics shows that the using of training simulators as effective as the written job almost.

For all clusters using training simulators a smaller spread in the center of the cluster the variance is reduced by half, so that changes of clusters is less than 2%. In this case, the difficulty of test results of each training simulators is less than a minute.

The use of e-learning elements allows to realize systematic monitoring of results of training for the organization of independent work of students. Electronic journals jobs enable not only for automatic collection of student's solved tasks, but they're also create an environment for interactive communication with the teacher for correction and rework tasks. This individual work with the teacher sharply increases the number of students, academically as «good» or «excellent», digestibility of educational material in these groups of students using e-learning elements of the tasks on average 1,5 times higher than without them. However, at high flows of students, the difficulty of test results is overrun at several times the required standards of labor.

In some cases, when performing tasks based on an algorithm the process of learning can automate through interactive software simulators developed methodology SCORM. The results of solved tasks are automatically evaluated and passed to the learning management system LMS. And in this case there is a sharp increase in the number of students, academically as «good» or «excellent». Digestibility of study material in this group of students, only 4% less than when using electronic journals jobs. The difficulty of test results with training simulators is very low.

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