Computer Aided Education Systems in Knowledge Based Society: from *SUPER-Test* to *MULTIMEDIA&OFFICE-Test*

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This paper analyzes the testing and self-testing processes for the Computer Aided Education System (CAES) SuperTest Package [14], used at the Academy of Economic Studies of Chişinău, Moldova and recently implemented at the University of Bacău, Romania and Ciprian Porumbescu" College, Chişinău. We also discuss here the development of such type of CAES as MULTIMEDIA and MULTIMEDIA&OFFICE Testing Methods - the CAES software - from the Information Society and Knowledge Society point of view.
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1 Introduction

Computer assisted instruction refers to instruction presented on a computer. Educational computer programs enhance teacher instruction in several ways. They are interactive and can illustrate a concept through attractive animation, sound and demonstration. They allow students to progress at their own pace and work individually or solve problems in a group. Computers provide immediate feedback, letting students know if their answers are correct (this way, they cannot continue to practice with wrong skills). They keep track of the student's errors and progress. Computers capture students' attention and engage their spirit of competitiveness.

An important category of educational programs is represented by testing software. Teachers' experience shows that many students give up the study, having a false impression that they already understood. The role of self-testing is to guide them towards the learning components that they haven't got thoroughly into. On another side, evaluation gains a plus of objectivism when realized on a computer.

Considering the complexity of nowadays environment, the goals that teachers must establish for their students and for their own instructional activity, testing systems appear as useful instruments [9]. In what follows we present such a system, elaborated for computer science courses and already tested with students in economics and informatics.

2. *SuperTest* basic ideas

SuperTest is a testing software, representing only a piece of the complex system of computer-aided instruction, in the education process at the Academy of Economic Studies of Chişinău, Moldova as well as in the distance-learning process that is currently developing at the University of Bacău, Romania and "Ciprian Porumbescu" College, Chişinău. In Figure 1 we emphasize some of the processes that are combining, for now, traditional teaching methods with e-learning, at the University of Bacău.

The current stage is defined mainly by the developing of the databases [1-6,14] of *SuperTest*. Experience gained while using this software will indicate what improvements have to be realized, in order to make it flexible and adaptive, modern and intelligent, friendly and rigorous altogether.

The *SuperTest* knowledge databases are made up using items; each of them belongs to one of the following categories: True–False, Multiple Choice, Matching, Filling, and Cross–Word. Based on these categories, and using the Randomize function, tests are constructed for these purposes: information gathering, personal training, self-evaluation and control.

In information gathering phase, the teacher extends and/or actualizes the knowledge database. In personal training phase, the teacher and/or the student select the knowledge base in order to complete future tasks. In self-

evaluation phase, the student chooses the item categories in order to prepare for the evaluation step (he or she could observe the time needed to complete the tests). In the control phase, the teacher chooses the data-

base(s) for the tests, sets the number of items per test and the allowed time. Using a more sophisticated randomize method, the CAES *SuperTest* constructs a test and proceeds with the evaluation.
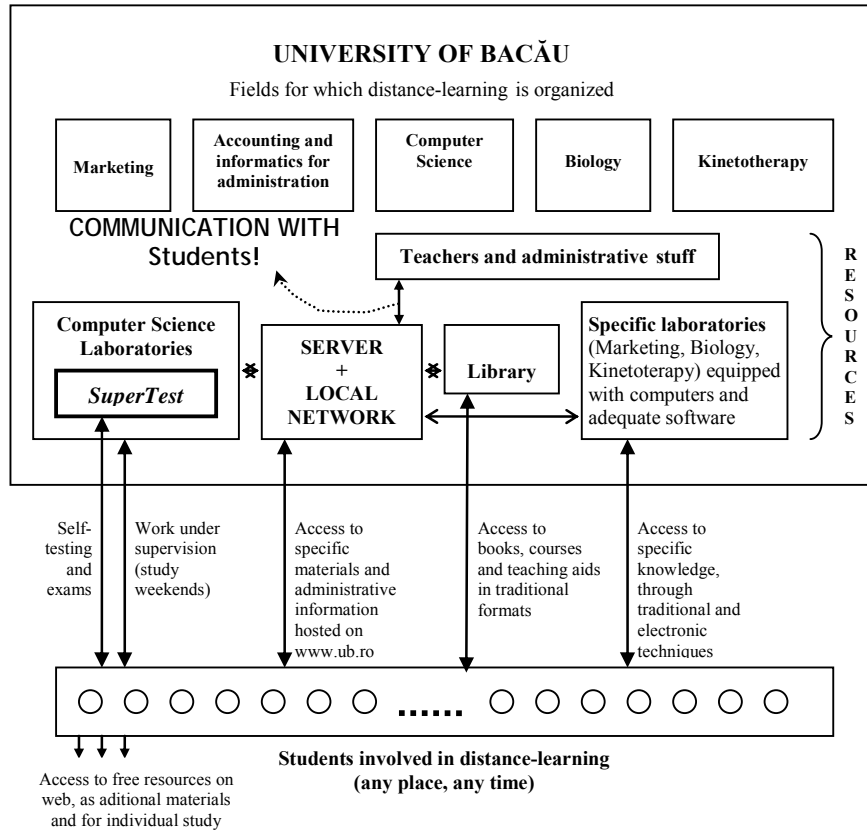

Fig.1. E-learning plus traditional teaching methods

The infrastructure of the automatic control process is based on *Monitor* - a system that sets the personal data of the student, the course title and section of the course, the

score and other internal data. There exists the possibility of setting various parameters of the software, as one can observe in Figure 2 below.
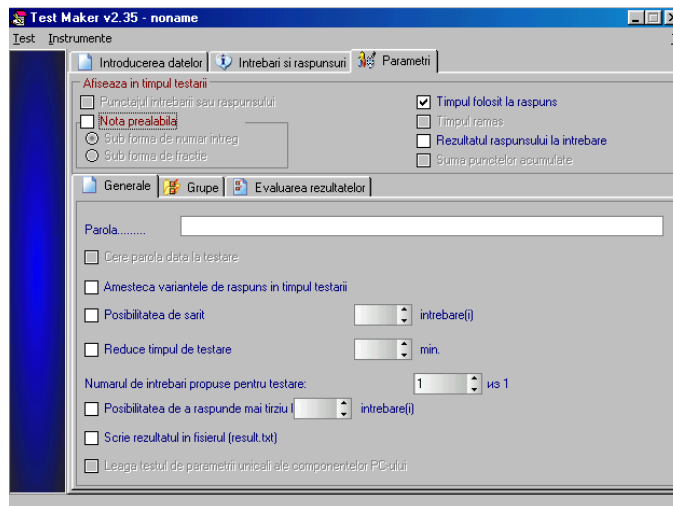

Fig.2. Setting the parameters of *SuperTest*

The *SuperTest* [14] knowledge databases use [1-6] while the administration part is based on [11-13]. The theoretical level is based on [7,9] and the semantic interpretation of the natural language is as in [10].

3. *SuperTest* knowledge bases

The *SuperTest* knowledge databases are structured on the needs of coherent presentation and safe management of the tests.

Each course database BC_i ($i=1,2...$) consists of a set of chapters BC_{ij} ($j=1,2...$). The whole BC_i is used at the course end to test the student in order to compute his or her final grade. The chapter databases are used in cumulative evaluation method (CEM). The score at chapter j from course i influences the final grade for course i. As an example, if the teacher sets two chapters ($j=2$), each of them having 20% weight in the final grade, then the formula is:

$$final\_grade=test\_1*0.2+test\_2*0.2+final\_test*0.6$$

Comment. Usually, these formulae are set by the University Senate.

Any knowledge database has five types of items: True–False, Multiple Choice, Matching, Filling and Cross–Word. The True-False item has the lowest number of points in case of correct answer. The Matching item has n elements in a first column that have to be linked with other n elements from a second column. The number of points for all correct matching is the highest. The Multiple Choice item has a requirement and l ($l=3,4...$) choices, each of them close to that requirement. The number of points in case of correct answer is set by the teacher. The Filling item has a part that has to be written by the student. The Cross-Word item is based on the Course Dictionary, and the student has to fill in a table containing item of Filling and Matching type.

The testing database could adapt the tests and extract only the types selected by the teacher.

4. The courses and knowledge bases

The courses from *SuperTest* Computer Aided Education System (CAES) consist of lectures, laboratory works, fixing themes, dictionaries, methodic specifications and items for testing and self-testing. A special attention is paid to electronic lectures.

SuperTest implements the courses: Informatics Bases, Databases and Communication Systems, Economic Informatics and Birotics [1-6].

The Informatics Bases course has the following chapters: History of Informatics, Software and Hardware, Computer Based Informatics Systems, Present and Perspectives in Computer Systems, Networks, Information Societies and Knowledge Societies. This course is a basic one, with 500-items knowledge databases. It is designated for all students enrolled in first year at ASEM, both at English and Romanian line of study.

The knowledge databases are compiled by prof. univ. dr. hab. Dumitru Todoroi, the *Computer Aided Education Systems Project* coordinator and by ass. prof. univ. dr. Elena Nechita, the coordinator of the team from University of Bacău.

The database organization was set up by the team from ASEM Laboratory, leaded by Elena Chicu. Lect. drd. Olga Chicu designed and implemented the *Engine* and the *Monitor* of *SuperTest*, available since 2004. At now, hard work is done by drd. Ion Linga in order to design the *Intelligent Monitor* and by postgraduate student Nicoleta Todoroi to adapt it at DEI-Multimedia [8].

The courses Databases and Communication Systems, Economic Informatics and Birotics contain the chapters: Windows, Excel, Access, Internet and PowerPoint, both in English and Romanian and has a knowledge database with 700 items. The team coordinated by Dumitru Todoroi and Elena Nechita consists of drd. Gloria Cerasela Crişan, postgraduate student Nicoleta Todoroi, drd. Diana Micuşa, comp. Zinaida Todoroi, drd. Iulian Marius Furdu, Elena Chicu and her coworkers.

5. Prospective

The *SuperTest* Computer Aided Education System (CAES) is already successfully used at ASEM for the courses: Birotics, Information Bases, Data Bases and Communication

Tools, International Economy, Microeconomics, Macroeconomics, and others. The formula for the final grade is:

$$final\_grade= test\_1*0.2+test\_2*0.2+activity*0.1+final\_test*0.5$$

The *SuperTest* Computer Aided Education System (CAES) is included in the general management system for ASEM. The next version of *SuperTest* would include the DEI-Multimedia [8], with all its Knowledge Bases in: text, audio, graphics and video forms of its presentation. The workload will reflect the spread of DEI-Multimedia on the courses and the data types included. An intense job has to be done in order to design and feed the database with True–False, Multiple Choice, Matching, Filling and Cross–Word items.

The use of *SuperTest* at the University of Bacău brings new possibilities for its students to practice and evaluate themselves. For teachers, it offers an easy-to-use instrument for laboratory, while the development of new tests will enrich the databases of this software.

Next few years will bring a revolution concerning the educational process, linking the Knowledge Society with the Conscience Society. A forward step in our work will be the third generation of this software product: to adapt *SuperTest* at probabilistic vocabularies and evolutive text.

5.1. MULTIMEDIA Testing Methods

The collection of testing methods based on multimedia, used nowadays in the Knowledge Society, consists in a set of Multimedia Data Testing methods, of various levels. Each level of Multimedia Data Testing methods is based on some data types that are used within some testing methods.

This kind of multimedia testing methods can successfully use the DEI MULTIMEDIA databases [8] to formulate and modify the subjects [7,9], as well as in the knowledge testing and self-testing phases.

5.1.1. First Complexity Level of MULTIMEDIA Testing Methods

The first complexity degree level of MULTIMEDIA testing methods are represented (as shown in Table 1) by methods of the following type:
- True-False methods
- Matching methods
- Multiple-Choice methods
- Filling methods
- Cross-Word methods.

All of them use either TEXT, or AUDIO, or IMAGES, or VIDEO types of data.

Table 1. The first complexity degree level of MULTIMEDIA testing methods.

Data Type / Testing Method	TEXT (1)	AUDIO (2)	IMAGES (3)	VIDEO (4)
TRUE - FALSE	TEXT - TRUE - FALSE	AUDIO – TRUE - FALSE	IMAGES - TRUE - FALSE	VIDEO - TRUE - FALSE
MATCHING	TEXT - MATCHING	AUDIO - MATCHING	IMAGES - MATCHING	VIDEO - MATCHING
MULTIPLE CHOICE	TEXT - MULTIPLE CHOICE	AUDIO - MULTIPLE CHOICE	IMAGES - MULTIPLE CHOICE	VIDEO - MULTIPLE CHOICE
FILLING	TEXT - FILLING	AUDIO - FILLING	IMAGES - FILLING	VIDEO - FILLING
CROSS-WORD	TEXT-CROSS-WORD	AUDIO - CROSS-WORD	IMAGES - CROSS-WORD	VIDEO - CROSS-WORD

MULTIMEDIA testing methods of type one, such as AUDIO-MATCHING, VIDEO-FILLING, IMAGES-MULTIPLE CHOICE, etc. can be analyzed: they involve creativity and determine the students to participate with a raised interest. These are the simplest methods of the whole multimedia testing methods system.

5.1.2. Second Complexity Degree Level of MULTIMEDIA Testing Methods

MULTIMEDIA testing methods of the second type are represented (as shown in Table 2) by the methods in Table 1, enriched with a new data type, chosen from TEXT, or AUDIO, or IMAGES, or VIDEO types of data.

Table 2. The second complexity degree level of MULTIMEDIA testing methods.

Data Type (second one) / First Level Testing Method	TEXT	AUDIO	IMAGES	VIDEO
A method in Table 1	*Text+ a method in col.2,3,4*	*Audio+ a method in col.1,3,4*	*Images+ a method in col.1,2,4*	TEXT+VIDEO- TRUE - FALSE
A method in Table 1	*Text+ a method in col.2,3,4*	TEXT+AUDIO- MATCHING	*Images+ a method in col.1,2,4*	*Video+ a method in col.1,2,3*
A method in Table 1	*Text+ a method in col.2,3,4*	*Audio+ a method in col.1,3,4*	AUDIO+IMAGES- MULTIPLE CHOICE	*Video+ a method in col.1,2,3*
A method in Table 1	*Text+ a method in col.2,3,4*	*Audio+ a method in col.1,3,4*	*Images+ a method in col.1,2,4*	IMAGES+ VIDEO- FILLING
A method in Table 1	TEXT+VIDEO- CROSS-WORD	*Audio+ a method in col.1,3,4*	*Images+ a method in col.1,2,4*	*Video+ a method in col.1,2,3*

This table is, in fact, a cube representing the set of the MULTIMEDIA testing methods of second level. These methods include, in the testing/selftesting subjects, data of two different data types in the multimedia set, resulting methods such as: TEXT+AUDIO-MATCHING, AUDIO+VIDEO-FILLING, TEXT+IMAGES-MULTIPLE CHOICE, etc.

5.1.3. Third Complexity Degree Level of MULTIMEDIA Testing Methods

MULTIMEDIA testing methods of the third type are represented (as shown in Table 3) by methods like those in Table 2, plus a new data type, chosen from TEXT, or AUDIO, or IMAGES, or VIDEO types of data. We obtain such methods as: TEXT+AUDIO+IMAGES-MATCHING, TEXT+AUDIO+VIDEO-FILLING, TEXT+IMAGES+VIDEO-MULTIPLE CHOICE, etc. This means that three different kinds of data types in MULTIMEDIA set can be found inside the same subject prepared for testing/self-testing.

Table 3. The third complexity degree level of MULTIMEDIA testing methods.

Data Type (third one) / Second Level Testing Method	TEXT	AUDIO	IMAGES	VIDEO
A method in Table 2	*Text+ a method in Table 2, not already containing text, such as:* *TEXT+* AUDIO+ IMAGES- MULTI- PLE CHOICE	*Audio+ a method in Table 2, not already containing audio, such as:* *AUDIO+* TEXT+ VIDEO- CROSS-WORD	*Images+ a method in Table 2, not already containing images, such as:* *IMAGES+* TEXT+ AUDIO- MATCHING	*Video+ a method in Table 2, not already containing video, such as:* *VIDEO+* TEXT+ IMAGES- FILLNG

5.1.4. Fourth Complexity Degree Level of MULTIMEDIA Testing Methods

MULTIMEDIA testing methods of the fourth type consist of sets of testing subjects containing four data types, such as: TEXT+AUDIO+IMAGES+VIDEO-MULTIPLE CHOICE, TEXT+AUDIO+IMAGES+VIDEO-TRUE-FALSE, TEXT+ AU-DIO+IMAGES+VIDEO-MATCHING, TEXT+AUDIO+IMAGES+VIDEO-FILLING. It is the most complex set of methods among all testing and self-testing knowledge methods of MULTIMEDIA Testing Methods type.

5.2. MULTIMEDIA-Office Testing Methods

As a supplement, within MULTIMEDIA Testing Methods, OFFICE sources [1-6, 11-13] can also be used. This is the third axis of components of the framework MULTIMEDIA Testing Methods and is emphasized with the title: MULTIMEDIA-Office Testing Methods.

5.2.1. First Complexity Degree Level of MULTIMEDIA-Office Testing Methods

The testing methods of level one of MULTIMEDIA-Office Testing Methods are represented by the set of methods of the following type: (TRUE-FALSE, or MATCHING, or MULTIPLE CHOICE, or FILLING, or CROSS-WORD method) *containing* (TEXT, or AUDIO, or IMAGES, or VIDEO types of data) *used with* (WORD, or EXCEL, or ACCESS, or POWERPOINT, or ACCESS software).

Combinations of these items, made up of testing methods, containing MULTIMEDIA data types, included into the testing subjects, together with the Office software sources used in the testing/self-testing process, represent the MULTIMEDIA-Office Testing Methods of first complexity degree level. The system is outlined in the following table 4.

Table 4. MULTIMEDIA-Office Testing Methods of the first level

MUL-TIMEDIA Testing Method of level one \ Office Pack	WORD 2007	EXCEL 2007	POWERPOINT 2007	ACCESS 2007
A method in Table 1	A method in Table 1, used with **WORD**, such as: (TEXT, or AUDIO, or IMAGES, or VIDEO)+ **WORD**+ **CROSS-WORD**	A method in Table 1, used with **EXCEL**, such as: (TEXT, or AUDIO, or IMAGES, or VIDEO)+ **EXCEL**+ **MATCHING**	A method in Table 1, used with **POWERPOINT**, such as: (TEXT, or AUDIO, or IMAGES, or VIDEO)+ **POWERPOINT**+ **MULTIPLE CHOICE**	A method in Table 1, used with **ACCESS**, such as: (TEXT, or AU-DIO, or IM-AGES, or VIDEO)+ **ACCESS**+ **FILLING**

Examples of MULTIMEDIA-Office Testing Methods of the first complexity degree level are:
 a. TEXT-ACCESS- MATCHING,
 b. IMAGES-WORD- FILLING,
 c. VIDEO-POWER POINT- MULTIPLE CHOICE, etc.

5.2.2. Second, Third, Fourth and Fifth Complexity Degree Level of MULTIMEDIA-Office Testing Methods

Testing methods of MULTIMEDIA-Office type of the second, third, fourth and fifth complexity degree level are represented by the corresponding sets of methods.

For example, MULTIMEDIA-Office testing

methods of the second type consist of methods of the following type:
   a. **WORD** + AUDIO-TRUE-FALSE+MATCHING,
   b. **EXCEL+ACCESS** + VIDEO-FILLING,
   c. **ACCESS** + TEXT+IMAGES-MULTIPLE CHOICE, etc.

Office resources will be called subject to the needs of the user of MULTIMEDIA - Office Testing Methods and concerning the data that represent the semantics of the testing subjects.

In a similar manner, MULTIMEDIA-Office Testing Methods of third, fourth and fifth level can be obtained.

Testing is a component of the Computer Aided Education Systems (CAES) in the Knowledge and Conscience Society of today. As a part of their methodology and methodic, methods based on natural language processing and probabilistic methods will certainly represent the next development stage.

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