

## Test Control Module of the WEB-based system SEDL

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**Abstract:** A variant of a test control module of WEB-based System for Electronic Distant Learning SEDL is developed in the present report. The basic points of the methodical basis of the System for Electron Distant Learning have been formulated. A linear analytical model has been developed to form the mark of the test. The structure of the test control module has been built up. Test control questions have been created and input in the system, and test control has been implemented, proving the proper operation of the module.

**Keywords:** Methodical basis, Test control, Teaching courses, Theme model, Estimation model, Examination model, Test control technology,

### 1. INTRODUCTION - METHODOICAL BASIS OF THE LEARNING COURSES

The teaching courses in the higher education depend on the number of the faculties, the number of the subjects, the number of the disciplines in a subject, and on the individual learning courses. Every learning course consists of a definite number of lecture themes, labs themes, group and individual themes for assignments and course assignments, and also tests to control the learning of the material. The methodical basis of the learning courses is shown in Fig.1. The theme and learning resources model is shown in Fig.2 [1,2,3].

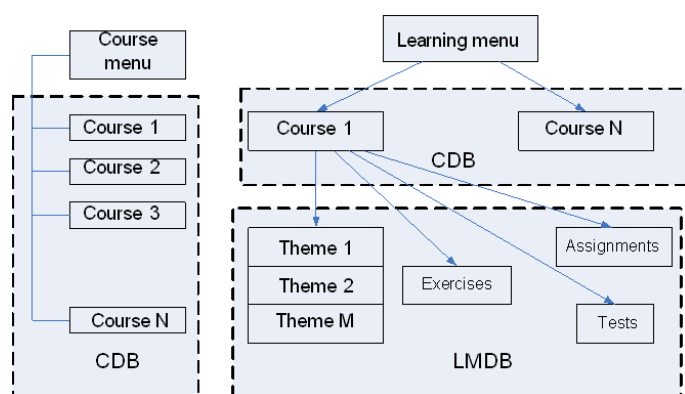


Fig.1. Methodical basis of learning courses

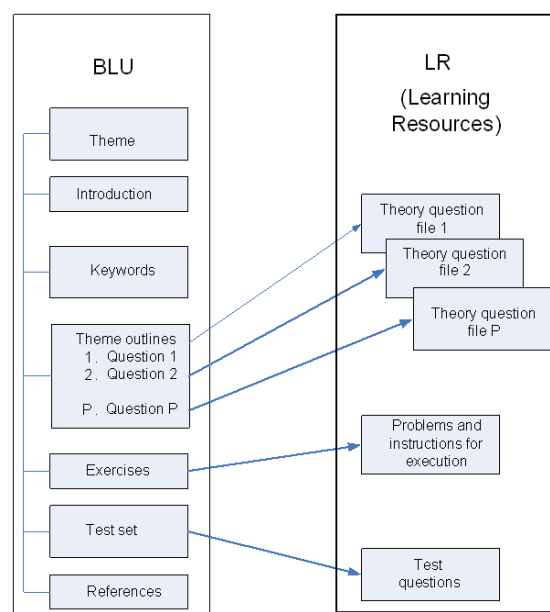


Fig.2. Theme and learning resources model

where:

CDB – Course database

LMDB – Learning materials database

where:

BLU – Base learning unit

LR – Learning resources

### 2. TEST CONTROL OF THE STUDENTS KNOWLEDGE

#### 2.1. GEOMETRICAL AND ANALYTICAL MODELS FOR TEST CONTROL

The test control of the students' knowledge in a subject may be accomplished 2-3 times currently for every section 2-3 and once for the whole course.

It is necessary to include all the material from the lectures and the labs into the test. The test consists of questions and some variants of answers for each of them. Each variant of an answer has a definite number of points, that depend on the complexity level of the question and it is defined at the creation of the question by the tutor [4].

The test control system allows using one of the following **two models of estimation**:

➤ Estimation model by adding/subtracting points to the whole number of points depending on the correct/incorrect answer to the current question.

➤ Estimation model by adding points for a current answer or clearing the points for a wrong answer, or if there is no answer. The number of the wrong and the correct answers may be more than one. If the answer is correct but not full, the points added are less.

The questions for the test control can be chosen from a big number of test questions, and for every student the test questions **have been chosen in random order**, in order not to repeat the questions.

**When choosing the estimation model the following points have to be defined:**

- The unit to which the questions belong
- Complexity level of the questions
- The number of the questions from the corresponding complexity level

At the test control for each of the students the maximum sum of the points when all the questions have received correct answers, and a second sum of the real number of points have been formed. **The relation of the two sums, multiplied by 100, gives the percentage mark K% for the results of the student in a definite learning course.**

$$K\% = \frac{C(k)}{C_{\max}} \cdot 100, \quad (1)$$

where:

$C(k)$  - the real number of points from the test for a concrete student and for a concrete course

$C_{\max}$  – the maximum number of points if all the questions have been answered

$k\%$  - the real mark in percents

Except the percentage mark the test control system forms the value of the mark depending on the range from poor to excellent results for the corresponding test and this can be made using one of the following three models to form the mark of the test. /Fig.3/.

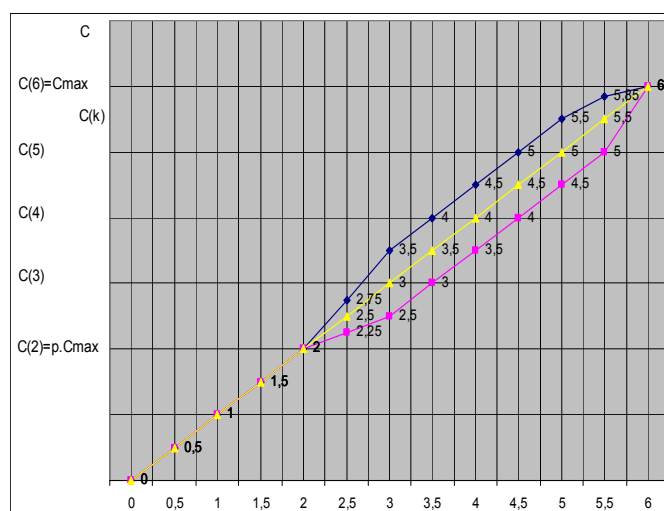


Fig.3. Models for forming the mark from the test control

The geometrical solution for calculating the mark at the linear model, where  $C(K)$  is the real number of the achieved points, is by drawing a straight line  $q$ , parallel to  $OK$ , beginning from the initial point  $C(K)$  the intercrossing line with the model line  $M2$  - point  $R$ , has been defined. The point  $P$  corresponds to the needed solution for the mark  $K$ .

The analytical solution at the linear model can be represented by the equation (2) using the similarity of the two triangles.

$$K = K_B + \frac{C(K) - C(K_B)}{C(K_B + 1) - C(K_B)}, \quad (2)$$

where:

$K_B \in 2, 3, 4, 5$  and  $6$

$C(K_B)$  - The number of the points, corresponding to the integer part of the mark

$C(K_B + 1)$  - the number of the points, corresponding to the mark  $K_B + 1$

Let us introduce the coefficient  $0 < P < 1$ , (3)

where:

$p$  – the coefficient setting the lowest level of the number of the points  $C(2) =$

$P \cdot C_{\max}$ , which corresponds to a poor mark.

Then for the linear model we can define  $C(K_B)$  at  $K_B = 2, 3, 4, 5$  и  $6$  by the equations (4).

$$C(2) = p * C_{\max}$$

$$C(3) = p * C_{\max} + \frac{C_{\max} - p * C_{\max}}{4} = \frac{p+3}{2} * C_{\max} \frac{3p+1}{4} * C_{\max}$$

$$C(4) = p * C_{\max} + 2 * \frac{C_{\max} - p * C_{\max}}{4} = \frac{p+1}{2} * C_{\max} \quad (4)$$

$$C(5) = p * C_{\max} + 3 * \frac{C_{\max} - p * C_{\max}}{4} = \frac{p+3}{4} * C_{\max}$$

$$C(6) = C_{\max}$$

The denominator in the Eq. (2) can be represented by Eq. (5).

$$C(K_B + 1) - C(K_B) = \frac{1-p}{4} * C_{\max} \quad (5)$$

Substituting Eq. (5) in Eq. (2) the final equation (6) for the real mark, corresponding to the received number of points  $C(K)$  can be calculated.

$$K = K_B + \frac{4}{1-p} * \frac{C(K) - C(K_B)}{C_{\max}} \quad (6)$$

From the upper equation it is obvious that except the values of  $p$ ,  $C_{\max}$ ,  $C(K)$ , it is necessary to define also the values  $C(K_B)$  and  $K_B$ .

If we consider that:

- When creating the test questions model there is information about the maximum number of points  $C_{\max}$ .
- When creating the model forming the mark the coefficient  $p$ , defining the lowest level of the  $C(2) = p * C_{\max}$  of the number of the points for the poor mark, has been set.
- At the test performance the real number of the points  $C(K)$  has been calculated.

Then **the algorithm for calculating the mark of the test** after its completion consists of the following actions:

1. After completing the test the current number of the points  $C(K)$  and the maximum number of the points  $C_{\max}$  have been calculated.
2. The number of points  $C(K_B)$  at  $K_B = 2, 3, 4, 5$  и  $6$ , using Eqs. (4) has been calculated.
3. Comparing the current number of points  $C(K)$  with  $C(K_B)$ ,  $C(K_B + 1)$  by the inequalities  $C(K_B) \leq C(K) < C(K_B + 1)$  for  $K_B = 2, 3, 4, 5$ , and  $6$ , the values for  $K_B$  and  $C(K_B)$  have been calculated.
4. Substituting the values of  $K_B$ ,  $C(K_B)$ ,  $C_{\max}$ ,  $C(K)$ , and  $p$  in Eq. (5) the real value of the mark  $K$  can be calculated.

To use the non-linear models M1 and M3 to form the test mark in the suggested program it is provided for except the coefficient  $p$ , to set also the values  $C(K_B)$  for  $K_B = 2, 3, 4, 5$ , and  $6$ , varying from these for the linear model calculated using Eqs. (4).

## 2.2. ARCHITECTURE OF THE TEST CONTROL AND THE STATISTICS MODULES

The architecture of the test control module is shown in fig.4.

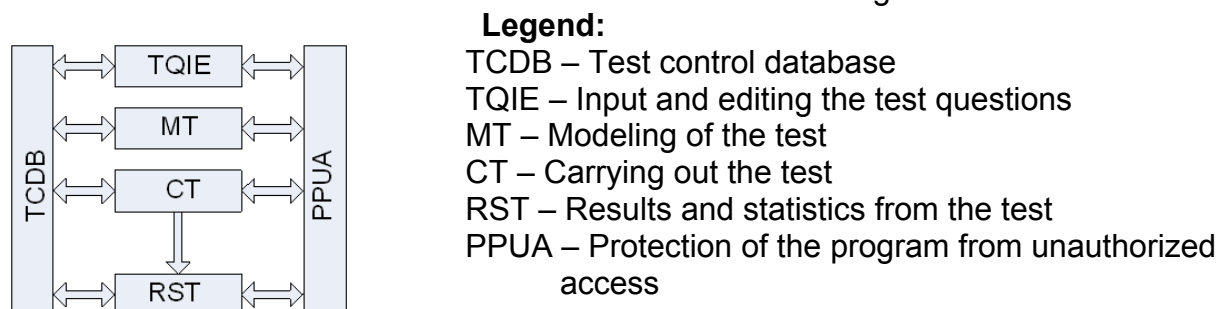


Fig.4. Architecture of the test control module

The architecture of the test statistics module is shown in fig.5.

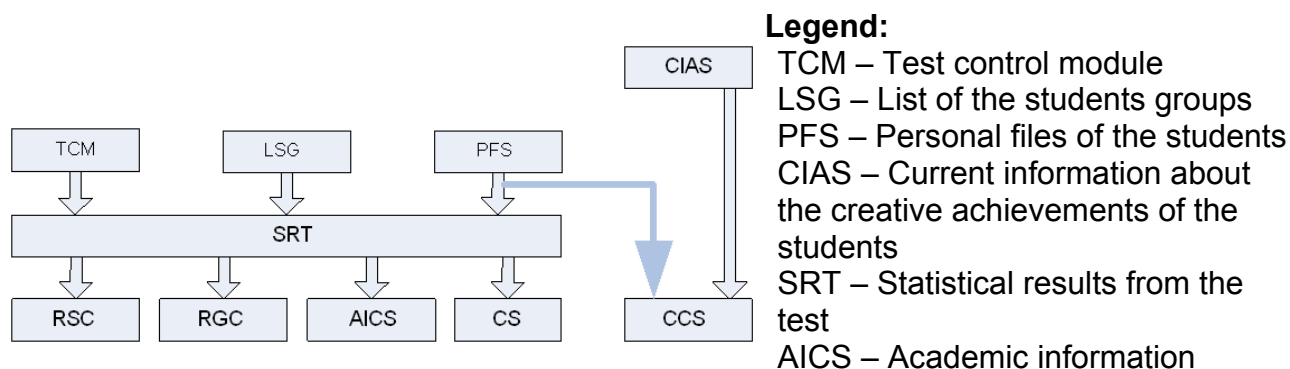


Fig.5. Architecture of the statistics module about the current state

CCS – Creative characteristics of each student  
 RSC - Results of the subject by courses  
 RGC – Results of groups by courses  
 CS – Candidates for scholarships

### 3. TECHNOLOGY FOR PREPARATION AND IMPLEMENTATION OF A TEST CONTROL

#### 3.1. FILE MANAGER OF THE SYSTEM SEDL FOR CREATING THE DATABASE FOR THE TEST CONTROL

The **tutor file system** includes **Files** for the corresponding courses and **A Personal site** of the tutor for announcements and news. It is included into the “Active courses” in the tutor menu. Here the tutor can manage the files in his courses – to rename, delete, add, create, copy and perform other file operations. By clicking on „P” in the column „Action” a special editor is opened. In the column “Action” for the corresponding file, its content is opened into the editor, which is similar to the editors like Open Office Writer, Micorosoft Word, etc. The tutor file system is shown in Fig.6.

**Creating/editing test questions by the tutor.** By clicking on the link „Add” a form to input a new question in the corresponding test has been opened. The unit, complexity level, four answers, the number of points for each of them, whether it is included in the test or not, etc. has been filled.

When the number of the points is negative, the answer is **wrong**; when it is positive, the answer is **correct**, and when it is 0, the answer is not included in the test.

**Списък с файлове**

Основна директория  
09-09-2005 13:37:33

☐ Използвай нормално разширение

Изб.	Към	Име	Размер	Дата	Само за Четене	Действие
<input type="checkbox"/>		[Копие]		08-27-2005 16:15:54		
<input type="checkbox"/>	C	1234-A		08-16-2005 21:47:46		
<input type="checkbox"/>	C	9003-A		08-27-2005 17:00:19		
<input type="checkbox"/>		index.html	140	08-27-2005 19:42:28		P Г 3
2 директории, 1 файлове (0 Kb)						

Преместване на избрани файл(ове) или директории към избраната директория :  Преместване

Изтриване на избраните файл(ове) :  Изтриване

Преименуване на избраната директория :  Преименуване

Преименуване на избрания файли директория към :  Преименуване

Копиране на избрания файл въ :  Копиране

Създаване на псевдоним на избрания файл :  Създаване

Създаване на нова директория :  Създаване на директория

Създаване на нов файл :  Създаване на файл

Качване на файл :  Browse... Качване

Качване на файл от URL :  http:// Качи URL

Fig.6. File manager of the system SEDL

### 3.2. PREPARATION AND IMPLEMENTING THE TEST CONTROL

The tutor creates the tests for a definite course. Using the contents of the course units, the tutor makes the test questions, which have to include the whole unit. The input of the test questions and the variants of the answers is made using the basic lector menu, submenu **Test number** of a course and the command **Add question**. As a result on the screen appears the structure, shown in Fig.7.

Редактиране на Въпрос - Курс 9003-A

Въпрос:

URL:

Участва в теста: ☒ Да ☐ Не    Тема №:     Ниво №:     Коментар:

Вариант отговор №1:  Брой точки:

Вариант отговор №2:  Брой точки:

Вариант отговор №3:  Брой точки:

Вариант отговор №4:  Брой точки:

Изпрати



The text of the question, the URL where the question will be saved, the number of the unit, the complexity level, the variants of the answer and the number of points is input. Clicking on the button **Send** sends the corresponding

Fig.7. Creation/Editing of the questions for the test by the lector

question to the URL. This is the way to input all the test control questions for the corresponding learning course.

The tutor **models a test** by a table, including from which unit, which level and how many questions to include for each of the courses /Fig.8/.

By clicking on the link „**Add to the model**” a window is opened, in which there are fields to input the unit, the level, the number of the questions. After filling in the fields, the button „**Add**” is clicked, and the corresponding data is added to the current estimation model for the corresponding course.

To **Edit** the necessary group of questions, which will be included in the test use the icon , and to **Delete a group** use the icon .

Изпитен модел - <a href="#">Добави към модела</a>							
eid	Инструменти		Тема	Ниво	Бр. Въпроси	Всички	Активни
8			20	1	6	Не	39
9			21	1	6	Не	40
29			22	1	6	Не	18
10			23	1	6	Не	18
30			24	1	6	Не	13
31			25	1	6	Не	32
32			26	1	6	Не	19
33			27	1	6	Не	31
34			28	1	6	Не	19

Брой на темите : 9 , Сумарен брой въпроси: 54 , Максимален брой въпроси: 229


Модел за оценяване						
Оценка 2	Оценка 3	Оценка 4	Оценка 5	Оценка 6	Време	Модел
0.5	0.62	0.75	0.87	1	01:00:00	0 
Линеен модел за 2=0.5, за 3=0.62, за 4=0.75, за 5=0.87, за 6=1.00						
Записване						

Fig.8. Creating of the examination model and the estimation model

> Изход  Тест - 9003-A July 27, 2005 > Въпроси > Модел > Оценяване > Достъп	Активни курсове - Добави				
	Потребител	Номер на курса	Валиден от	Валиден до	Инструменти
	11111	9003-A	2006-01-09 00:00:00	2006-01-31 00:00:00	<a href="#">Изтрий</a>

Fig.9. Permitting the students to join in the test during the set time

After completing the test the results for each of the students can be seen – a student, total number of points, maximum number of points, the mark and the duration of the test /Fig.10/.

<div>Меню Преподавател</div> <div>July 27, 2005</div> <div><div>&gt; Портал</div><div>&gt; Курсове</div><div>&gt; Моят профил</div><div>&gt; Изход</div></div>	Резултат от изпитване- <a href="#">Добави</a>								
	Инструменти	Студент	Точки	Макс. точки	% оценка	оценка	Начална дата	Крайна дата	Модел
		07200500129-S	95	100	95.0	5.62	2005-08-24 16:17:13	2005-08-24 16:23:27	0
	Брой изпитвания : 1								
	Задисване								

Fig.10. Results of the students after completing the test

Allowing a students and/or a group of students to perform the test in a definite time interval can be made in the same way as allowing the access to the courses, considering that it is an access to the relative test of the course /Fig.11/.

Курсове достъп - добавяне			
Потребител	Номер на курса	Валиден от	Валиден до
<input type="text"/>	<input type="text" value="9003-A"/>	<input type="text"/>	<input type="text"/>
<input type="button" value="Изпрати"/>			

Fig.11. Setting the time for accessing the test of a course

#### 4. CONCLUSION

The contributions in the presented work can be summarized as follows:

- The basic points in the methodical supplement of the System for Electronic Distant Learning have been formulated;
- A linear analytical model to form the mark of the test has been developed.
- The architecture of the test control module has been built up.
- The technology of preparation and test control implementation has been verified in practice.

#### REFERENCES

- [1] Distance Learning – [HTTP://dl.nw.ru/software](http://dl.nw.ru/software)
- [2] [HTTP://ecet.ecs.ru.acad.bg/bvu/](http://ecet.ecs.ru.acad.bg/bvu/) - ARCADE – Software platform for e-Learning, SU „St. Kliment Ohridski”, National Seminar, Sofia, May 2005. (in Bulgarian)
- [3] MSCS – Software platform for e-Learning, National Seminar, Sofia, May 2005. (in Bulgarian)
- [4] H. Karailiev, V. Rankovska. Automated Program System for Test Control in Microprocessor and Microcomputer Technics. “Current Trends in the Development of Fundamental and Applied Science” Conference Proc. volume III, Stara Zagora, 1999, pp.65-68, ISBN 954-9794-15-6 (in Bulgarian)

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