System "Testing students' knowledge"

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The system "Testing students' knowledge" was built. This system has the following features: easy to use, allows you not only to test students' knowledge, but also gives results for improvement the set of tests, has a relatively simple interface and doesn't require separate programs to work with databases (if your computer has Microsoft Office).

Introduction

Systems which automates the process of testing are used in schools and universities. The main advantages of checking knowledge of pupils and students using computer-based testing are the following: systematic storage of a large number of the tests, easiness of editing and modification tests, automatic fixation and saving the data of student's results, quality control of the educational process by statistical processing of test results, ability to check quality of the test [1].

System structure

System "Testing students' knowledge" consist of two modules, written on the programming language C++. Both modules are connected to a database created in Microsoft Access. The database contains the following information:

- students' names and patronymic;
- the groups in which they are studying;
- teachers' names and patronymic;
- disciplines' names;
- themes for each of the disciplines;
- questions with correct answers;
- results of the tests for each student with date of the testing.

Configuration module allows you to add the group number, the names of the students (provided the ability to import names from the file) and teachers, names of disciplines and themes, and easy input of questions and answers to the test or import them from a file (provided the ability to add pictures to the questions and answers).

The system also lets you view the results of testing for the group. This ability helps the teacher determine effectiveness of his work and correctness of created tests.

It is possible to check quality of the test by calculation of reliability and validity with respect to some criteria. After that you can remove some tasks, which do not meet the requirements, from the test. It should also be noted that it is planned to add a password entry for the limited access to the database. It means that the teacher will have access only to the information about his group. The head of the department, in his turn, will have access to the data relating to the students of the department. Students will not have access to this module.

Testing module was created specifically for students, so its installation on the computers of the teachers is not required. A student can choose a discipline and a theme of the test. After testing, he is able to work on the mistakes by reviewing questions of the test, to which he gave the wrong answers. In the future it is planned to create six types of test's questions (single choice, multiple choice, setting the order of conformity, an indication of truth or falsity of the allegations, putting words in the correct order).

The ability to work with a database via a network and simultaneous launch modules of testing and configuration were checked. The system has been tested in Zaporozhye Medical University.

Advantages of the project:

- identical style of the tests in various disciplines;
- simple interface;

- the ability to save the results for further processing, i.e., the user can check the tests according to some criteria of reliability, validity, etc.

An indication of the complexity of task will be associated with a part of the sample of students who solved or did not solve this task. For example, if only 20% of students correctly completed the task, it may be considered difficult for a given sample, if 80% – easy.

The reliability will be defined like a degree of stability of the results. Let the coefficient of reliability (R) be the correlation coefficient between the results obtained in the same method under the same conditions but in the different points of time. It shows how results agree with each other.

Let us calculate the indicators of communication between the tasks. Define x_{ij} equals to 1 if student i gives the right answer to question j, otherwise it equals to 0.

Then we can calculate arithmetic average by using the following formula:

$$\overline{x} = \frac{\sum_{i=1}^{N} x_i}{N} \tag{1}$$

where x_i – quantity of scored points for a student with number i, N – quantity of the students.

The sum of squares of deviation will be determined as:

$$SS_x = \sum_{i=1}^{N}(x_i - \overline{x})^2 = \sum_{i=1}^{N} x_i^2 - \frac{(\sum_{i=1}^{N} x_i)^2}{N} \tag{2}$$

Then we could define the variance of results:

$$S_{x^2} = \frac{SS_x}{N-1} \tag{3}$$

For calculation the correlation coefficient between two tasks we can use such formulas:

$$SP_{x_k x_m} = \sum_{i=1}^{N} \overline{x_{ki}} * \overline{x_{mi}} - \frac{\sum_{i=1}^{N} \overline{x_N} * \sum_{i=1}^{N} \overline{x_{mi}}}{N} \tag{4}$$

$$SS_{x^k} = \sum_{i=1}^{N} x_{i_k}^2 - \frac{(\sum_{i=1}^{N} x_{ik})^2}{N} \tag{5}$$

Then we can receive the Pearson's correlation coefficient for two different tasks (k and m) by entering the results to the following formula:

$$r_{x_k x_m} = \frac{SP_{x_k x_m}}{\sqrt{SS_{x_k} SS_{x_m}}} \tag{6}$$

I choose two following formulas for calculation the reliability of the test:
- KR-20(the authors are Kuder, Richardson, it is the 20-st variant of this formula)

$$r = \frac{k}{k-1}\left(1 - \frac{\sum_{j=1}^{N} p_j q_j}{S_x^2}\right) \tag{7}$$

where p_j – percentage of correct answers on the task with number j, q_j – percentage of wrong answers on the task with the same answer, $\sum_{j=1}^{N} p_j q_j$ – the sum of variances, k – quantity of the tasks in the test.

- The Spearman-Brown prediction formula, also known as the Spearman-Brown prophecy formula, is a formula used to predict the reliability of a test after changing the test length [2]. The method was published independently by Spearman (1910) and Brown (1910). Let us divide our results of the test into two parts. The first part (x) consist of tasks with add numbers, another part (y) - with even numbers. Then we will calculate SS_x, SS_y with formula (2).

$$SP_{xy} = \sum_{i=1}^{N} xy - \frac{\sum_{i=1}^{N} x \sum_{i=1}^{N} y}{N} \tag{8}$$

$$r_k = \frac{SP_{xy}}{\sqrt{SS_x SS_y}} \tag{9}$$

The last formula helps us to calculate Spearman-Brown coefficient.

Suitability results of the test for the purpose for which the test was conducted is called disabilities.

The system exports data to Microsoft Excel file and then all calculations are being done there.

Conclusion

An easy-to-use system was created. This system allows you to check knowledge of students from different disciplines and to check the quality of tasks on four criteria.

References

[1] Oliinyk M.(1991).The testing as a tool for measering the level of knowledge in the modern technology of studing. Donetsk Univ. (In Ukrainian)
[2] Allen M.; Yen W. (1979). Introduction to Measurement Theory. Monterey, CA: Brooks/Cole.

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