LIFELONG EDUCATION CONCEPTION USING COMPUTER TESTING

Belous N., Voytovich I.
Kharkov National University of Radio Electronics
(61166, Kharkov, Av. Lenin, 14, Software department, tel. (057) 70-21-446)
E-mail: belous@kture.kharkov.ua

В приведенной статье описывается концепция, основанная на проведении компьютерного тестирования, предлагается трехуровневая модель контроля знаний. Также приведена классификация форм тестовых заданий. Предлагается своя система оценивания знаний тестируемых. В данной статье приводится методика вычисления оптимальной длинны теста, так чтобы задания охватывали либо все вопросы рассматриваемого раздела, либо все вопросы изучаемой дисциплины, либо комплекса дисциплин.

People are trained during all the life: at school, then at university, at various courses, by books and by materials from the Internet.

The valuing of education is in knowledge acquisition. Different learning techniques are produced to increase the interest of the students. In connection with the "Lifelong education" conception and constant necessity of long life level increasing a matter of diagnostic means construction for educational and professional training appears. Involved standard assumes computer-based knowledge control during the estimation of acquired knowledge that take place after learning of every topic, section, discipline or professional training at large or during practical and laboratory training.

In Ukraine similar knowledge control standards founded on computer-based technologies are intensively developed now. Kharkiv National University of Radio Electronics is one of the leading educational institutions which develop such technologies.

This article introduces you our Kharkiv National University of Radio Electronics development works in this area. Three-level control and acquisition knowledge model has been suggested. In fact the given conception is used both for training the students and retraining the specialists.

Three-level control and acquisition knowledge model

This article proposes to use three level knowledge control and acquisition procedure:
- Access test (preliminary test).
- Individual self-instruction that includes electronic multimedia teaching aids.
- Total estimation of educational and professional training and control of professional skills by section, discipline or professional training at large.

Each of the levels assumes various forms of test application and various processing and analysis techniques application.

The first level is optimally represented by one- and multialternative tests intended to determine the level of primary skills of the trainee. The multialternative test is preferred. This kind of tests have many advantages: more detail test question alternatives analyses, decreasing probability of guessing the right answer.

At the second level a trainee is offered to execute practical exercises represented by Fill questions i.e. embeddable programs, multimedia files, tables and execution of sequenced questions. To increase the reliability of the test the next approach is used. Test exercise is added up to multistage testing where every stage represents an answer alternative. The

exercise is completed when every stage is passed correctly. The accent of the multistage test is the next rule: trainee is not able to follow the next stage until he won't give the right answer for the previous. One of the estimating parameters is a mistakes counter which counts the ones introduced during the exercise execution.

The third level – total test – includes questions of different forms except the Fill one but they are more difficult. Questions of this level allow making conclusion about as so good trainee to learn the content of disciplines.

Proposed conception does not discard traditional approaches of education (lectures, seminars, laboratory woks etc.) and knowledge level control and skill control (examinations, tests, colloquium), but with accordance with it the main features are self-instruction and individual training of every trainee based on the work with the computer-learning programs.

The realization of circumscribed conception is represented by the software environment for training and testing. We implement the training of all degrees – masters and bachelors and post-education as ordinary education so for the distance learning.

Forms for test questions

Test is convenient tool of pedagogical process results measurement. They include a set of test questions of various forms. It is necessary to determine optimum length and quantity of tasks of different forms to receive qualitative test that will cover a whole area. This test development approach allows optimizing time of execution of the test wholly on the one hand, and a variety of the forms allows to minimize guessing of the answers and to cover wide area of knowledge and skills trained on the other hand. For this purpose it is necessary correctly to determine form test questions depending to result should be received after realization of testing.

This model is based on test questions. Before we shall describe this model, it would be correct to define what test questions and how much of them must be included in offered model. .It is recommended to use the various forms test questions to develop qualitative test question, or to check the level of knowledge, or to training any section or discipline. The variety of the forms allows minimizing guessing of the answers on the one hand and different forms cover various sorts of knowledge and skills trained on the other hand.

It is offered to use the following forms test questions.

Test questions can be classified by forms in the next way:
- multiple choice questions;
- fill questions;
- matching questions;
- right consequence questions.

Table 1 – Form of the test questions and knowledge aspect, determined by them

Test question form	A kind of the task	Defined sort of knowledge
Multiple choice questions	Tasks with offered variants of the answers where one or few are correct	Orientation in group of similar concepts, currencies, processes; check of completeness of knowledge and skills
Fill questions	Tasks with freeform answers	Checking knowledge of the terms, definitions, concepts and etc.
matching questions	Establishment of conformity between left and right elements of the task	An establishment of knowledge of the facts, interrelations and knowledge of a terminology, definitions, methodics.
Right consequence questions	Establishment of correct consequence of actions or	Testing of skills and knowledge of a correct consequence of operations (normative

	words in the sentence that are carried out	activity), algorithms, consequence, technological receptions, and also formulation of definitions, rules, laws, fragments of normative documents and etc.

Forms of test questions are subdivided by principles of construction of the answers.

One-alternate test questions are represented by test questions, containing 3-5 variants of the answer, where only one is correct. Multialternate test questions are represented by test questions, containing 5 - 8 variants of the answer where two and more are correct. Test questions of the closed form are frequently considered as easiest, but actually if necessary they always can be made by more difficult, using so-called "traps" or by increasing of amount of right answers in test questions. "Trap" is a variant of the answer very similar to correct by any separate sign, which is offered together with real by right answer outwardly perceived less attractively from the point of view of surface or incomplete knowledge.

Right consequence test questions are used, as a rule, as model of operations. In these test questions from testee it is required to determine what correct consequence - teams, operations, events, stages, which are offered in test questions. These test questions have larger learning potential than closed test questions.

Matching test questions represent two (or more) set of concepts, titles of commands, characteristics, graphics images, digital or letterings, which are given as two (or more) columns. Testee should place informative correspondence between their units and express it in the answer with the help of installation of correspondence between codes of units from different columns.

Open test questions foresee that the answers are inputted by testee. So they are test questions without the stipulated answer variants. Testee is solving test questions in his own way. Content of open test questions represent the statement with an unknown variable. Test questions of the open form are frequently called as more difficult, as they demand independent playback of the answer without any hint as variants for choice. But with the help this test questions can be checked up only by knowledge of commands, nomenclature, and facts. It is impossible to estimate skill to apply acquired in new situations material independently, depth of understanding of a material through this form test questions.

Form for each of the test questions is intended to determine the knowledge type of a testee and has a specific view. For total test production all forms need to be included.

Calculation of the test length

Test is a set of N questions. It is important to choose the optimal length of the test originally. Questions must cover all topics of current section or current discipline. Tests can be short (10-20 questions), middle length and long (up to 500 and even more questions). The optimal number of questions is 30-60. Therefore it is recommended to produce the test with the length no more than 60 questions.

$$N = \frac{60}{1 + e^{1-C}} \, ,$$

N – The test length
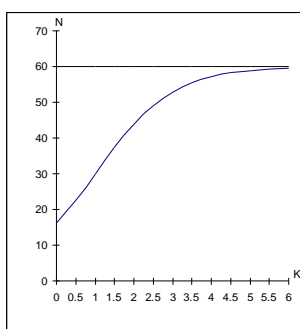K – The number of credit for a discipline

Figure 2 - Plot of test length against credit number for a discipline

1 C (credit) equals to 54 hours. Given plot has hyperbolic shape and does not exceed 60 questions mark for a test.

Multialternative question for test

The result of executed questions for each form is estimated differently. For each form exists the own technique of test estimation. For onealternative test estimation it's enough to use dichotomic scale (1 – right answer, 0 – wrong answer). But this scale does not fit to multialternative test because testee can give the incomplete answer, or one of the chosen answer variants will be inexact. Such answers cannot be estimated in the same way as questions, in which complitely wrong answer was chosen. For multialternative testing it is necessary to take into account the percent of correctly chosen alternatives in addition to correctness of the answer at large. matching test questions are processed through the same rules as for the onealternative test. matching questions are processed as multialternative test.

The mark for every multialternative question calculated as:

$$r_i = \frac{Q_2 * B}{(Q_1 + Q_3)N}$$

r_i The mark of the i-th test question
Q_1 The number of right chosen alternatives for a question
Q_2 The number of right alternatives chosen by a testee
Q_3 The number of wrong alternatives chosen by a testee
B The number of marks in the estimation system

Multisteps question

It isn't enough to use only closed tests form for practic class . It is expedient to use open tests form chiefly for reception of the maximal results for learning. One of the kinds of open test questions are multistep test questions. Multistep test question consists of questions solved step by step, when the transition to next step of the task is carried out **only** after the correct answer is given on the previous step. It enables testee to analyze not only task as a whole, but also to understand each component of the task. Thus testee finds out where he admited mistakes immediatly and in the further steps he will receive the correct initial data, so mistakes in the tasks don't collect. However objectivity of his answer and depths of knowledge can be judged by quantity of mistakes, admitted by him. Thus there is an issue of evaluating of such evaluating of such questions. Simple dichotomizing scale does not fit to such questions. Therefore here's recommended formula for calculation of result of the multistep test task:

$$R = \frac{B}{N*n} \sum_{i=1}^{n} \frac{1}{m_i + 1} \tag{1}$$

R – result of performance of the multistep test question

i – number of the step

m_i – number of mistakes admitted on i-th step

n – number of steps

Formula (1) is fair for the multistep test questions, in which one-alternative test tasks or test tasks for an establishment of a correct sequence are used on each step. If test questions on conformity or multialternative test questions is used on any steps it is expedient to use the formula (2).

$$R = \frac{B}{N*n} \sum_{i=1}^{n} \frac{m_i Q_{2_i}}{\sum_{j=1}^{m_i} (Q_{1_{i_j}} + Q_{3_{i_j}})} \tag{2}$$

$Q_{1_{i_j}}$ – Number of right chosen alternatives for a step

Q_{2_i} – Number of right alternatives chosen by a testee on the i-th step by the j-th attempt

$Q_{3_{i_j}}$ – The number of wrong alternatives chosen by a testee on the i-th step by the j-th attempt

j – number of attempt to give correct variant of the answer

The suggested concept does not discard traditional methods of learning (lecture, seminars, laboratory works and etc.) both knowledge control and practical skills (examinations, credits). The main part is based on independent, individual preparation everyone studding for students, with computer-learning programs.

Implementation of the circumscribed concept is the complex of learning and testing software. The programme can be used for all level students both bachelors and magisters studding. It also useful as post-education specialists.