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## **WEB-BASED SYSTEM FOR ASSESSMENT OF LEARNING ACHIEVEMENTS OUTCOMES**

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*The description of authoring educational web-based testing system is presented in the article. The proposed web-based system provides the process of inputting the test material and implementation in academic activity. The aim of the web-based system is to improve learning efficiency with a help of methods presented to form students' knowledge structure and estimate the students' level of learning throughout academic activity.*

**Key words:** personalized learning path, educational web-based testing system, examination question papers, bank questions, testing item

Modern information and communication technologies, integrated into academic activity, enable students' academic potentialities to be significantly extended. Virtual and network communication opens up opportunities of the personalized learning path choice. A lot of factors, including the level of professional and communicative competencies, students' interest, aims and personalities, have an effect on this path (Chen, 2008). Pedagogical measurement of learning achievements is one of the possible methods to identify and estimate the level of competence. Different methods can be used to estimate the level of learning achievements, there are three groups of methods: a) traditional measuring procedures (verbal and written examinations, rating); b) testing technologies (pedagogical and psychological tests), and also c) method of expert assessment. Experience in certification exams (for example, <http://act.org>, [sat.collegeboard.org](http://sat.collegeboard.org)) showed that computer-based testing is an effective academic performance rating. Psychological tests make it possible to measure personality traits (level of intellect development, peculiarity of character, personality characteristics). The aim of computer-assisted web interviewing is to familiarize students with opportunities of higher and graduate education (for instance, project U-Multirank), and therefore, to form the personalized learning path.

Application of test approach for educational and psychological measurement, sociological researches require the use of standardized materials (items, texts of a form or a questionnaire), processing and analysis of results obtained with a help of mathematical apparatus. In practice, testing is the in-

teraction of the user and the testing system. This interaction is completed with results assessment and immediate feedback. Experimental results, obtained due to electronic learning resources (Stefansson, 2004; Chen, 2008; Mustakerov, 2011), allow us to come to conclusion about important role of such resources in learning of students.

Within the context of the article, we focus on the description of an authoring educational web-based testing system opportunities in terms of formation of students learning level. The web-based system was developed and put into service in Tomsk polytechnic university (TPU). The web-based system is a source environment to estimate students' knowledge structure and the students learning level throughout academic activity. The web-based system is available at exam.tpu.ru.

The web-based system consists of a) bank questions, b) standardized procedure of testing, and c) processing and analysis of test results. This system was put into practice by way of the distributed client-server web-based application. The web-based system provides tests generation and their presentation to user according to specific algorithm, as well as processing of test results, data selection with the use of prestored queries, report preparation (MS Office format), and timetable planning for performance of event. All web-based system modules are stored on server side and loaded on user side in browser. The interactive user interface does not depend on the platform and does not require installation.

Capabilities of the web-based system make it possible to organize the item design, expertise and approbation, as well as processing of empirical test results and implementation of these results as standardized tests in academic activity.

Web-based testing system requires the skills and expertise of some specialists. The following groups of users (roles) such as a student, a teacher, a staff, a subject-matter expert and an administrator are selected in the web-based system in order to organize collaboration. The first group of users "Student" is the most numerous. There were more than 22 000 active users in September, 2015. The following activities such as selection and registration on the event, execution of tests, view of test results are available for the group of users "Student" in the web-system. Other groups of users serve as organizers of the events. We will use further a short writing of the group's name, for instance, *teacher*.

The process of the bank questions design includes the following stages: a) *teacher* designs the structure of the bank questions; b) *teacher* determines number of items, which should be included in the examination question pa-

pers (unique items set), as well as the estimation scale; c) *teacher* designs tests; d) *staff* inputs test materials; e) *expert* and *staff* carry out an expertise of test materials; e) *staff* generates a package of papers; f) *staff* sets parameters of event; g) the group of *students* participates in approbation of event; h) *staff* and *expert* evaluate results and do required adjustments.

The testing item composition has to include a question and answers variants (or answer placeholder), and also the answer key in order to expertise the item and to check students answer. A designer can use various kinds of data (text, equations, special symbols, graphics and multimedia elements such as audio, video and animation) to prepare an item. The web-based system supports the event planning (testing, questionnaires, interviewing, leaning game) both in the format of computer and the format of printed form (hard copy).

The web-based system supports different approaches in order to estimate quality of learning outcomes: a) disciplinary approach, b) competency-based approach (Rogers, 2010). It is known that the particular item is connected with subject content in web-system by means *hierarchical classifiers*. They make it possible to systematize test material. It is necessary for *teacher* to select controlling element (topic, module, and course unit or performance indicator of the learning outcomes) from *classifier* for every item.

The web-system supports true-false, multiple choice, multiple select, ordered items, fill-in-blank, matching pairs type item, as well as free answer. Using items mentioned above, a designer can compose the structured sequence of items combined by case study. If an item assumes free answer (for instance, user has to write a specific topic essay), the answer is estimated by *expert*; as for other types of items, they are estimated using computer-aided procedures.

According to the type of item, *teacher* should indicate the item estimation algorithm (assessment guideline), the difficulty of the item (easy, basic, advanced). Every item should be provided with instructional elements for *student* and *expert* (for example, rounding a numerical value for fill-in-blank answer, need for use of table values, formulae, or calculator).

Designed items for the same educational subject are combined in a new or existing bank questions. The bank not only includes the content of each item, but also characteristics of regarding test development: title, type of assessments (in-course, pre-test, post-test), bank target (testing, questionnaires, interviewing, leaning game), academic program level (bachelor, master, PhD-student, trainee).

The expertise of test includes analysis of the content, spelling correction, item representation. In the process of filling bank questions, statistics is

formed due to the following items such as number of items in the bank; item assignment due to forms and topics of subject or indicators of the learning result achievement. According to these data, the test material structure is determined. *Coverage map of the bank* was implemented in web-based system to visualize this structure. In accordance with the coverage map, *expert* can recommend to change the structure of test material.

According to the bank questions or series of banks, *staff* generates packages of examination question papers (*papers*) to perform the tests with the control group of users. Every package includes required number of papers on subject (subject's topics and modules) or educational programs of the university. Number of *papers* and controlled elements in the package are parameters, which *staff* indicates according to type of assessments. Minimum number of items from the section classifier defines number of unique papers in the package. Due to generated papers' package, *staff* adjusts parameters of the event: location, date, time limit, number of attempts. Evaluation of the event results is based on comparison of the suggested answer with the reference type of assessments one. According to results in the control group, *staff* evaluates quality of test material (reliability, validity). *Staff* or *expert* can recommend changing the difficult level of the item. It is the end of the bank design process, and the bank implementation process in academic activity begins.

The main aim of e-learning is to have a capability to choose and implement the personalized learning path in open educational environment. The interaction algorithm with *student* deals with it. Web-based application allows *student* to participate in different events: testing, questionnaires, interviewing, leaning game. Information and communication technology development, including social networks as means of communication, makes it possible to say about gradual transition from traditional communication to virtual one and communications networking. Authorization in the system is implemented through social networking accounts (facebook.com, vk.com) or the TPU login and password. User feedback is implemented by means of notifications (e-mail, short message service, social networking profile record, Push-notifications).

The web-system supports the measure participation demo and official modes. Demo mode is used for self-learning, and official mode is used for assessment of academic progress, official examination, applicants selection, independent work of students, as well as e-learning.

Suggested authoring educational web-based testing system allows forming workspace to organize students' independent work via simulators system, academic competitions, learning games and contests, certification of educa-

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tional and professional achievements. The web-based system will be able to be used both for self-learning, and official assessment of basic knowledge and competences. It requires minimum efforts of administrative maintenance.

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