FUZZY MODEL OF THE AUTOMATED SYSTEM OF MODULE KNOWLEDGE CONTROL

Elena Prisyazhnyuk

Annotation: The author analyzes some peculiarities of information perception and the problems of tests evaluation. A fuzzy model of tests evaluation as means of increasing the effectiveness of knowledge control is suggested.

Keywords: fuzzy sets, test

Introduction

Changes in the sphere of education as a result of the integration of Ukraine in the Bologna process require full and comprehensive modernization of education on the basis of information teaching technologies. Practicing credit-module system of the learning process organization makes important working out effective means of students' knowledge control. The research analysis of this problem shows the tendency of enlarging tests usage as the instrument of the studied material quality evaluation. The main advantage of computer tests is the opportunity to ask all the students within the assignment in equal conditions and according to the equal grades scale. It increases the objectivity of knowledge control in comparison with the traditional methods.

Usage of computer technologies considerably decreases time of conducting control of knowledge quality in the academic discipline; teacher's engagement is decreased; the degree of objectiveness of knowledge evaluation is decreased; working with the testing program is a good training for studied material reviewing; on the basis of the testing results the teacher can analyze the learning process according to the definite topic and make the correction of the tempo, accents and methods of teaching.

On the other hand the traditional tests application is supposed to choose the answers (and their evaluation correspondingly) on the basis of two-positional logic. It is supposed to use them adequately only in terms of strictly formally asked questions. It leads to absolutely simple questions formulations which "lie on the surface". At the same time knowledge appropriation includes not only (and not so much) memorizing a priori veritable facts but the capability to understanding general phenomena, tendencies [Мелецинек А., 1998]. To control this knowledge "indirect" questions are more effective. Such questions formulation (and, correspondingly, the answer variants) is supposed to have less formal semantics [Нариньяни, 1994]. From the other side such questions cause the problems of simple answers evaluation. Application of verbal scales for the evaluation {false, not quite right, almost right, true} and mechanism of fuzzy logics seems more proved.

Fuzzy model of the automated system of module students knowledge control in the discipline "Informatics" for pedagogical major "Mathematics and informatics" is described.

Some questions of the effectiveness of testing conducting

The effectiveness of testing conducting depends first of all on such factors as:

- individual perception and, accordingly, tests understandings;
- objective analysis of the data base and completing results analysis according to the methods used.

The peculiarities of perception are studied in particular by informational psychology: the models of conscious processing of information by a person are described and analyzed. Technical characteristics of perception, schemes of information processing by a person are used. Let's discuss some perception characteristics which should be taken into account while formulating tests questions.

The first advantage of knowledge control conducted in written form is: power of man's perceptional optical channel is one step higher than of acoustical. According to the research given in [Мелецинек А., 1998] the power of optical channel is about 107 byte/sec, the power of acoustical 106 byte/sec. So the information perception in a visible form (written form, in a type of a picture) promotes perception speed and, consequently, its comprehension.

The second advantage deals with the psycho-physiological characteristics of people who take tests. As we eliminate the teacher's direct participation in testing we eliminate the opportunity of "psychological pressure",

teacher's preconceived attitude. On the other hand, some students will feel more comfortable in the situation of module control without a teacher. Let's see the example: if they experience inner disturbance which increases while communicating with a real examiner; in case of a permanent conflict with a teacher, etc.

The choice of the tests questions length should be done taking into account the capability of their processing by a tested person. It is connected with the power of the apperception process (transmission of semantic irritation into short-term memory), in other words, with «comprehension of information». In [Мелецинек А., 1998] they give the apperception speed about 16 bite/sec and time of information awareness in short-term memory approximately 10 seconds. It means that the formulation of the question must not be too long. Simple calculations show – not more than 160 bites (it is, approximately, a sentence with 14-16 words).

Selecting tests questions it is necessary to take into account their motivation and natural forgetting processes. It means delivering from the excessive details of the material. As information is memorized much better when it possesses more sense and is structuralized [Мелецинек А., 1998], it is necessary to clear up not separate facts and fundamental details but typical structures of the material in maximum logical semantic interconnections. The situational test questions are more appropriate in these situations, i.e. a problem situation is set and you are suggested to choose the optimum way out strategy.

The question of motivation in teaching and, in particular, in testing is pretty problematic and deals with the personal interest and success expectation. Among the situational motivational factors the probability of success and attractive value of the task are especially important. In [Мелецинек А., 1998] such approach is suggested according to which motivation of result can be the highest with the average level of the task difficulty, i.e., when probability of success achieves 50%. Motivation of result stimulates especially effectively in such task and problem setting when it is possible both to solve and not to solve them. In testing it is necessary to choose the questions of average level of complication coming from the evaluation of students' knowledge level.

The effectiveness of students' perception in testing depends also on their maximum concentration at this time. It depends indirectly on the physiological state of a person at this moment: ability to work, fatigability, etc. Person's fatiguability is subjected to changes during a day. In [Мелецинек А., 1998] they give the scheme of changes of organism physiological readiness (in percents) to activity during 24 hours. «Tops» of physiological activity during a working day are on the time interval from 8 to 12 hours. A substantial «decline» of working activity during a day (except of natural «falling out» from 21 to 23 hours and at a night-time) is from 14 to 16 hours. Taking into account these factors control means, testing in particular, should be organized if possible, in the period of concentrated attention. It is a period when the concentration of the students is maximal.

Fuzzy model of results evaluation

The other important element of the effective testing is an objective analysis of the data base. In the basis of it there is the certain model of results evaluation. The traditional system of evaluation within the framework of two-positional logic suggests a choice on every question of the only right answer from the offered list. As a result of accumulation points on every correct answer they make identification of the points amount with the appropriate range and summarizing the total for testing. The procedure is easily formalized and programmed.

But the basic question of the similar testing is a problem of questions (tasks, situations) selection with the only right answer. What type of students' knowledge is presented as a result of such testing? How is it possible to formulate the questions of «average level of difficulty» in such conditions?

Application of fuzzy model of testing results evaluation allows to put questions and situations more flexibly. It motivates students not to reproduce separately memorized facts but to be able to solve the problem. They demonstrate not only "declarative" knowledge, knowledge "on the surface" but the understanding of the situation, its processes and structure.

Let X^i be a set of the answers to i-question presented in the test, i є {1…n}, x^i - variant of the answer to i-question, $x^i \in X^i$. A^i - fuzzy set of «correct answers» to the first question. The list of answers on every question is analyzed on its belonging to the fuzzy set A^i and is accordingly evaluated by the function of belonging

$$\mu_{A^i}(x^i) \quad , \quad \mu_{A^i}(x^i) \in [0,1] \quad , \quad x^i \in X^i \quad . \tag{1}$$

During testing not the points but functions of belonging are accumulated and general fuzzy grade A of "the correct answers" on the set of answers X appears as distinct combination of fuzzy sets A^i with such kind of the function of belonging:

$$\mu_A(x) = \sum_{i=1}^{n} \mu_{A^i}(x^i) \quad . \tag{2}$$

Additionally evaluating questions it is possible to take into account their importance coefficients that reflect their contribution degree into general grade. Thus they can differentiate the questions levels of «complexity». Then (2) will be presented as:

$$\mu_A(x) = \sum_{i=1}^{n} \lambda^i \mu_{A^i}(x^i) \quad , \quad \lambda^i > 0 \quad , \quad \sum_{i=1}^{n} \lambda^i = 1 \quad , \tag{3}$$

where λ^i - coefficient of importance of the first test question.

After giving fuzzy grade on formulas (2), (3) the traditional procedure of comparison of general grade with an appropriate range and putting a general grade for testing takes place.

Thus, fuzzy model of evaluation (1) - (3) includes not only the traditional procedure of ranges agreement in which the integrated testing evaluation with a general grade in testing in 5 or 7 points scale ECTS is suggested, but the set of expert procedures for determination (1) on every test question.

For integration of expert evaluation one of procedures discussed in work [Voloshin, 2003] determining a group evaluation as «fuzzy function of belonging» can be applied:

$$\mu^{*(\min)}{}_{A^i}(x^i) = \sum_{j=1}^{m} \alpha_j \, \mu^{(\min)}{}_{A^i}(x^i_j)/m \quad , \quad \mu^{*(\max)}{}_{A^i}(x^i) = \sum_{j=1}^{m} \alpha_j \, \mu^{(\max)}{}_{A^i}(x^i_j)/m \quad , \tag{4}$$

where m is a number of participants of examination, a_j is a coefficient of j-expert's competence.

After defining the fuzzy function of belonging as a resulting interval $[\mu^{*(\min)}{}_A(x_i), \mu^{*(\max)}{}_A(x_i)]$ on each variant of the question a set (4) is presented to a person who makes decisions (to the teacher who conducts testing) for a final choice (scalarization of fuzzy function of belonging into discrete).

After conducting expert procedures (1) - (4) the procedure of testing conducting and evaluating can be programmed in the appropriate automated system of module knowledge control.

Architecture of the system of module knowledge control

Architecturally the system of module knowledge control consists of a few interrelated subsystems (SS).

SS of adjusting system work is intended for:

- system preparations for the concrete group of participants (creation of the folder and the file which identify a participant);
- Adjusting to participants' network or autonomous work.

SS of data introduction provides:

- installation and saving information about the participants of module control;
- the user's choice of the answer variant to the test questions in the dialogical mode;
- returning to the previous dialogical box with the opportunity of answer's editing.

SS of verification and analysis is intended for:

- formalization of the procedure of putting grades that allows to promote the process objectivity of module control conducting.

Service SS includes:

- making report on results of testing verification and presenting it to the student;
- presenting information about the criteria of work evaluation to the student.

Conclusions

Fuzzy model of the system of module knowledge control allows to conduct testing taking into account some factors described in engineering pedagogics [Мелецинек And., 1998], as factors which make the process of knowledge control more effective. Fuzzy grades application gives an opportunity to use "indirect" situational questions in the tests. It allows evaluating students' knowledge level more precisely and more objectively.

Bibliography

[Мелецинек А., 1998] Мелецинек А. Инженерная педагогика. – М.: МАДИ, 1998. – 185 с.

[Нариньяни, 1994] Нариньяни А.С. Неточность как Не-фактор. Попытка доформального анализа. – Москва-Новосибирск, 1994 г. Препринт РосНИИ ИИ, № 2. – 34 с.

[Voloshin, 2003] Voloshin O.F., Gnatienko G.N., Drobot E.V. Fuzzy membership function in a fuzzy decision making problem // International Journal Information theories & applications. – Vol. 10, № 3, 2003. – P. 243-247.

Authors' Information

Elena Prisyazhnyuk - Kirovohrad pedagogical university named after V.Vinnichenko, PhD, associate professor; Kirovohrad, Ukraine, e-mail: elena_drobot@ukr.net

PECULIARITIES OF THE ELECTRONIC EDUCATIONAL AND METHODOLOGICAL COMPLEX UNDER THE POINT-RATING TECHNOLOGY

Olga Lyubova, Natalia Luybova

Abstract: At present in the sphere of electronic learning in the light of solving tasks put by the Bologna Declaration an important place is being taken by electronic educational and methodological complexes (EMC).The authors have put forward new components of EMC necessary for the organization of educational process and for the determination of labour intensity according to modules and students' activity type. They also suggested a technology of defining the rating of the grade in the credit-module system.

Keywords: electronic educational and methodological complex, electrical engineering and electronics, point-rating technology and credit-module system

Introduction

Electronic teaching today is an essential component in the organization of the study process. There are known electronic textbooks and multimedia author's courses [Zainutdinova, 1999], network courses on particular disciplines [Lyubova, 2004], virtual laboratories and electronic tests, electronic educational and methodological complexes (EMC), which start to be especially interesting after Russia's joining the Bologna process.

Main part

Tasks, set by the Bologna declaration, oriented on the unified educational space and creation of possibilities for flexible educational paths require new principles of the study process organization, its global computerization, starting from the formation of individual study plans. The key moment in the unified educational environment is the modularity of a curriculum and point-rating technology (PRT) of knowledge assessment comparable in different educational environments.

Elaboration of PRT principles at the example of generally professional discipline "Electrical engineering and electronics", as well as alterations connected with the introduction of this technology into a study process, have become the main task of the authors.

The basis of study process organization on curriculum disciplines is EMC, the components of which must be as follows:

- Working program;
- Course of lectures;
- Laboratory- based practical classes;
- Autonomous work;
- Tests for self-check;
- Literature;
- Glossary.