Motto :

Ten kto sa kvôli bezpečnosti bezdôvodne vzdáva slobody, nezaslúži si ani slobodu ani bezpečnosť.

Benjamín Franklin

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www.vsbm.sk
e-mail: rvs@vsbm.sk
tel./fax: + 421 (0) 55 72 010 71

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10 rokov v živote človeka nepredstavuje nijakú závažnú etapu, hlavne keď sú to roky úplne prvé. Človek začína chodiť, učí sa čítať, získava kamarátov. V existencii organizácií, a to za pomoci elektronických a mediálnych informácií, je to však pekne dlhý čas. Tí, čo sme stáli pri zrode Vysokej školy bezpečnostného manažérstva môžeme skonštatovať, že tých 10 rokov ubehlo veľmi rýchlo a my sme si ani neuvedomili, že čas nekompromisne ukrajuje aj z nášho života a že sa to už nedá nikdy vrátiť späť. Ale jednu spomienku môžeme zanechať pre budúce generácie bezpečnostných nadšencov. Je to spomienka a vďačnosť učiteľom a praktickým odborníkom, ktorí nám nezištne podali pomocnú ruku a dokonca častokrát veľký kus práce, hlavne na poli vedy a publikácií, za nás aj vykonali. V kontexte 10. výročia udelenia štátneho súhlasu (7. 6. 2006) nesmieme zabudnúť na tých, ktorí už nie sú na každodennom pedagogickom a bezpečnostno-vedeckom poli, ale určite nám všetkým želajú čo najviac úspechov. Našu úctu si zaslúžia:

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Veľmi si vážime, že dobrému zdraviu sa tešia naši odporovatelia, niektorí už od roku 2001, pri založení Detašovaného pracoviska v Košiciach ŽU v Žiline, Fakulty špeciálneho inžinierstva (15 rokov bezpečnostného vzdelávania v Košiciach), ale aj tí, ktorí už spoznali našu vysokú školu ako sebavedomú vzdelávaciu a vedeckú inštitúciu. Určite my, súčasní tvorcovia ideí a teórie bezpečnosti na našej vysokej škole, oceňujeme a budeme držať v úcte našich podporovateľov, pričom uvedieme niekoľkých z nich:

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Našich žičlivých spolupracovníkov je samozrejme ďaleko viac, pričom sme uviedli len niektorých, ktorí sa nikdy nepozerali na našu školu ako na mladú a súkromnú, ale ako na školu, ktorá si svoj profil vytvorila sama, pričom v žiadnom prípade nepatrí medzi vysoké školy, ktoré si študijný odbor preniesli z verejných škôl a žijú z práce iných.

Vážená bezpečnostno – právna komunita,

každému kto sleduje bezpečnostnú situáciu doma i v zahraničí je jasné, že sa všetci máme čoho obávať. Dekadentné svetové spoločenstvo, založené na jednostrannom chápaní výsledkov globalizácie svetovej ekonomiky, situáciu zhoršuje a uzatvára všetky východiská, ktorými by sa svetová situácia mohla uberať. Je veľmi smutné, že ani oteplenie svetovej klímy o 2 stupne nikoho nevaruje a slovo environmentálna bezpečnosť sa v rámci preferencií prepadá na úplné dno. Slovo „BEZPEČNOSŤ“ je jedným z najčastejšie vyslovovaných pomenovaní. Nikoho však netrápi či všetky varovania o narastajúcom nebezpečí nie sú náhodou posledné. Ničivosť stretu veľmoci by bolo to posledné, čo by sme my, alebo naši potomkovia zažili. Je možné, že len málo ľudí si uvedomuje, koľko rokov ubehlo od strašnej dejinnej udalostí akou bola 2. svetová vojna. Človek má krátku pamäť keď sa jedná o to, čo sám nezažil.

Vážený čitateľ Košickej bezpečnostnej revue,

bezpečnostné vzdelávanie je jednou z priorít výchovy mladej generácie, pričom preniká do všetkých súčastí každodenného života. Absencia vojenskej základnej služby prináša svoje desivé posolstvo. Mladá generácie nemá najzákladnejšie vodítka ku kolektivizmu, úcte k starším a autoritám, žije vo virtuálnom svete kde sa dá všetko vrátiť späť alebo prispôsobiť si to tak, aby bol užívateľ víťazom z pohodlia svojej detskej izby obklopený počítačmi a filmami väčšinou západnej produkcie, ktoré majú na míle ďaleko ku každodennej realite. Naša vysoká škola už dlhší čas ponúka bezpečnostno- výchovný program, ktorý by bol účinný od základných až po vysoké školy. Maturita, ako synonymum skúšky dospelosti už dávno nie je pravdou, pretože sa predbežne posunula na koniec bakalárskeho štúdia a má tendenciu dozrievania až kdesi v 30 – tke dnešnej dospievajúcej generácie.

Po takýchto úvahách by sa dalo tvrdiť, že človek prehral preteky s časom už na štartovacej čiare. Optimista by naopak povedal, že najdôležitejšie veci nie sú veci, ale vzdelanie. Skúsme preto prijať spoločné vyhlásenie, ktoré sa prelína aj obsahom článku tohto zborníka a toto vyhlásenie by mohlo znieť aj takto:

Doba je zlá, sme tu však preto, aby sme ju zmenili...

Za redakčnú radu
Dr.h.c. prof. Ing. Marián Mesároš, DrSc. MBA

OBSAH - CONTENTS

PROCEDURE OF COMPETENCE LEVEL DEFINITION OF POST GRADUATE BASED ON FUZZY ALGORITHMS

Mykola MALYAR[1] - Volodimir POLISHCHUK[2] - Anatolii SHTYMAK[3]

Abstract: The model and the procedure for determining the competence of the university graduate on the basis of ratings obtained in the course of study in high school is being analyzed in the article. The theory of fuzzy sets and fuzzy logic inference algorithms were being used.
Keywords: competence, competency, competence level, fuzzy logic output.

Introduction

The modern world education is in the way of education reform and a significant revision as the main paradigms and implementation mechanisms of the trends that today are the most important to society. Raising the quality of higher education not only affects the economic side, but also is the foundation of national security. A key resource for economic growth of every state is the intellectual and educational potential. In this regard, the system of training of highly qualified personnel acquires strategic importance, becomes the main tool for ensuring high competitiveness of the national economy. All this causes changes in training in higher educational institutions.

An important step in the modernization of education in many countries is to update the content of education and learning technologies, aligning them with the modern needs - namely, educational programs focus on competence approach and create effective mechanisms for its implementation. Competence approach in higher education opens up opportunities for a quality training professionals to real life. In the new educational standards there appears to the forefront the concept of competence as the concept of not only knowledge and skills but also the development of abilities for their use. [1]

Stating the problem

Training students in higher education is based on new state standards that define requirements for the results of development of basic educational training programs in terms of competence approach. The feature of this approach is that there appears the transition from the formation of traditional knowledge and skills to the formation of competencies. The competence to understand the totality of professional, social and personal characteristics that determine the ability to effectively carried out activities in a particular area, confidently using their knowledge and skills. Focusing on the formation of competences determines not only the need to restructure the content and learning technologies, improves assessment procedures and the results of training evaluation tools for individual students. [2]

The problem of evaluation of individual competence and expertise of university graduate remains one of the most difficult in the implementation of competence approach in education. Currently, the most common variants of formation evaluation of competencies described as a test, situational, and monitoring of rating models. To determine the level of competence it is proposed to use methods based on expert data. These methods have different accuracy and efficiency, where we understand the ration and results as efficiency. In addition, many of the proposed approaches are intended to evaluate certain specific competence. [3, 4]

Thus, the problem of evaluating competencies and the determination of the level of competence is relevant, needs improvement for proposed methods and approaches and developing new ones.

Objectives

The purpose of this article is to build a model of determination and analysis of the competence of a graduate student and develop procedures for determining the level of his competence, algorithms using fuzzy logic inference based on ratings received during training. Under the competence we mean the estimated

[1] *Mykola Malyar, Ph.D., Associate Professor, doctoral student modeling complex systems, the Department of Cybernetics, Taras Shevchenko National university of Kyiv. Scope of scientific interests: Decision making, modeling social and economic processes and systems, methods of fuzzy logic. Home. phone. - (0312) 64-47-40. E-mail: malyarmm@gmail.com*

[2] *Volodimir Polishchuk, PhD in technical sciences, Lecturer the Department of Software Systems Uzhgorod National University. Scope of scientific interests: Decision making in investment activity, methods of fuzzy logic. Contact tel.: +380664207484. E-mail: v.polishchuk87@gmail.com*

[3] *Anatolii Shtymak, Senior Lecturer, the Departments of Mathematics, Uzhgorod National University. Scope of scientific interests: Decision making, modeling social and economic processes and systems, methods of fuzzy logic. Contact tel.: +380506667842, E-mail: shtimak_a@ukr.net*

assessment of the objectives of education student using a 100-point scale according to the criteria of the European Credit Transfer System (ECTS).

In this formulation, the problem can be attributed to problems multivariate evaluation based on a need for dependence

$$R = F(x_1, x_2, \ldots, x_n), \quad (1)$$

where $(x_1, x_2, \ldots, x_n)$ is the set of input values (of ratings) R - some output value (level of competence of graduate student).

To achieve this goal it is necessary to solve the following tasks: to develop a quality assessment scheme for graduate student study in terms of competence; to offer tools for processing information obtained by the study of the learning process and individual components of the educational process; to develop procedures for determining the level of competence at various stages of the education process and as a whole.

Main part

Graduate competency model consists of a large number of competencies that characterize graduate student from different sides. Thus, an integrated assessment of competence should be based on a system of individual assessments and include a variety of factors, most competency models of graduate student should be viewed in a hierarchical structure, where the top level is an integral assessment of competence, but on lower the estimation of competence for cycle training and disciplines that form it (Fig. 1). [5]

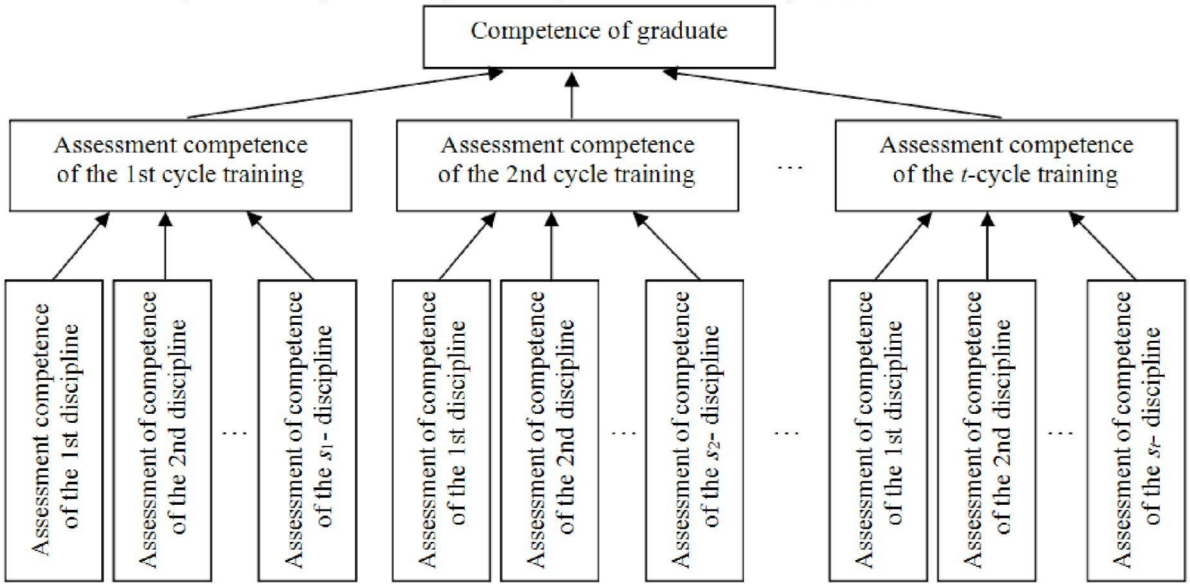

Fig. 1. The hierarchical structure of competency assessment

Despite the terminological inconsistencies in scientific literature regarding the use of terms "competence" and "competency" we note that their essence distinguishes cognitive, activity, emotional and value preparedness of training subject to the use of acquired knowledge and cognitive experience in real life situations. In this case, assessment of competence in students should be based on a comprehensive result that reflects interrelated cognitive, functional, personal, valuable and above subject competence.

Competence of student from study discipline is formed of the above five types of competence, however, the proportion of each may be different. There is no discipline in which at least one of these ingredients would not be represented. Therefore, a holistic view, we should talk about a multi-dimensional structure of competence, the elements of which has a kind of its capacity, has its own special feature. Accordingly, in the competence approach we need to use new tools that make it possible to assess the level of competence as a multidimensional structure. Unlike traditional forms of assessment, these tools should include competence-oriented tasks to determine the full range of abilities of students to use the acquired subject knowledge, skills, attitudes and values in practice.

In higher educational institutions of Ukraine there introduced European Credit Transfer System (ECTS), which promotes academic mobility of higher education applicants. It is based on determining student workload required to achieve specified learning outcomes and recorded in ECTS credits. ECTS system is based on the evaluation of all learning activities required to achieve the expected learning outcomes. The distribution points from which there forms the rating of the student and the level of expertise of the discipline takes place between current and final control. If a student shows willingness to be engaged in other activities, he or she in addition to the final rating of the discipline can be credited additional points for these kinds of work. Evaluation is being

done by exhibiting appropriate points on a 100-point scale. Points are not a number, derived as a result of measurements and calculations, but attributed judgment of scientific and pedagogical worker, which is being justified guided by the logic and the existing criteria. Overall rating on discipline is defined as the sum of points obtained in all types of work from the relevant discipline, and the appropriate level of competence in student discipline depends on the amount of points scored. Unclear, subjectivity in an assessment of teaching staff makes it necessary to apply fuzzy sets and fuzzy logic inference algorithms to determine the level of competence of the university graduate.

The system of fuzzy inference for generalized assessments objects has n inputs and one output - the result of fuzzy inference. The input of the fuzzy logic output system serves input values (impact factors) $x_i,\ i = 1, 2, \ldots, k$. The output of the generalized system gives a clear assessment that is the result of fuzzy inference for given input values. Fuzzy logic output contains the following components:

1) fuzzification: converting clear to fuzzy input variables, that determine the degree of compliance of each input fuzzy sets;

2) block rules: rules of computation based on the use and application of fuzzy implication operators to obtain baseline values rules;

3) power solutions: the aggregation of fuzzy rules outputs in total output value;

4) defuzzification: converting fuzzy output value on clear values. [6]

We offer the procedure for determining the competence of university graduate, using fuzzy logic inference algorithms. It is based on the rating assessments of university graduate gained during university studies at one of the educational levels (bachelor, master). The procedure consists of the following stages.

Stage 1. The data is being collected on educational attainment of university graduate during study by educational qualification (Bachelor, Master), including the results of his creative, intellectual, scientific research and other activities expressed by rating scores due to 100-point scale ECTS. We construct a tree of logic output (Fig. 1), the hierarchy of factors affecting the determination of the level of competence graduate student should have the following ratio:

$$RV = f_{RV}(R_1, R_2, \ldots, R_n), \tag{2}$$

$$R_1 = f_{R_1}(x_{11},\ x_{12}, \ldots, x_{1k_1}), \tag{3}$$

$$R_2 = f_{R_2}(x_{21},\ x_{22}, \ldots, x_{2k_2}), \tag{4}$$

$$\ldots$$

$$R_n = f_{R_n}(x_{n1},\ x_{n2}, \ldots, x_{nk_n}), \tag{5}$$

where $RV -$ levelofcompetenceofgraduatestudent, $R_i,\ i = 1,2,\ldots,n$ – levelofcompetencedueto i - cycleoftraining, $n -$quantity of training cycles, $k_j,\ j = 1,2,\ldots,n_j$ – scores quantity in j - cycle, $x_{ij} -$level of competence i - discipline in j - cycle.

This ratio will be responded by fuzzy logic equation that allows to determine the level of graduate awareness RV , using algorithms of fuzzy inference.

Stage 2. The second stage is needed to develop fuzzy rules and construct fuzzy knowledge base used in the fuzzy inference algorithms. For this consideration we use input linguistic variables "level of competence on discipline" and "competence by training cycle" of linguistic terms: K_1 - "low level", K_2 - "medium level", K_3 - "high level" of the range of points due to 100-point scale; "competence level of graduate" with the linguistic terms: "elementary level", "threshold", "elevated level", "professional level" with respective ranges of points. [7] Each of the terms is the fuzzy set $K_i = \{(x,\ \mu_{K_i}(x)) \mid x \in [1..100], 0 \le \mu_{K_i}(x) \le 1, i = 1,2,3\}$. For each of these terms there are being constructed corresponding functions of belonging.

For building functions of belonging the method of interval points is being proposed. This is because the rating point from the discipline that matches one of the entered competence levels is contained in a certain range. In this case, if we have the interval $[h_l,\ h_r]$ of values that meets certain linguistic terms, the value of the approach to the assessment of the right border, the opportunity to take it to the appropriate of term increases linearly (Fig. 2).

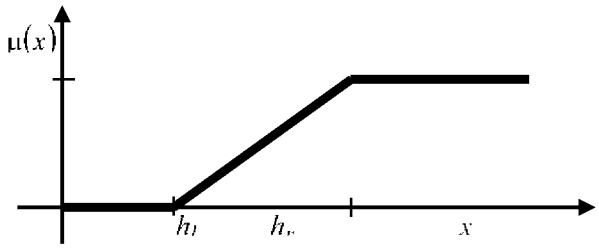

Fig.2. Function of belonging

Thus, the formula for constructing functions of belonging will be as follows:

$$\mu(x)=\begin{cases}0, \text{ якщо } x \le h_l, \\ \dfrac{x-h_l}{h_r-h_l}, \text{ якщо } h_l < x < h_r, \\ 1, \text{ якщо } x \ge h_r.\end{cases} \tag{6}$$

Stage 3. Since it is impossible to accurately express numerically the importance of a separate discipline, it is advisable using weight factors to determine which of them is more important. According to educational and vocational training programs for the study of subjects of a study cycle there is being allocated a certain number of credits. Therefore, as the weight coefficients proposed system of credits allocated to study subjects in educational and professional program. For the purpose of analyzing and adjusting the training a certain direction, to determine weighting coefficients courses and other training and educational activities there can be used other approaches, in particular, to involve experts from relevant field of study and young professionals - graduates of this field of study.

Stage 4. In the fourth stage, using fuzzy logic inference algorithms there is being determined the level of competence of university graduate.

According to the program for professional training, discipline, influencing the level of competence are divided into groups by training cycles. Therefore, the process of determining the competence of the graduate due to a tree of logical inference has a hierarchical structure. The feature of hierarchical fuzzy inference is that the output of a knowledge base is given to the input of another knowledge base. This allows a small number of rules to describe multifactorial dependency "input-output". The disadvantage of this system is that of the interim variables we need to perform operations of defuzzification and fuzzification. Accordingly, function belongings should be set for interim variables.

Implementation of this phase is divided into two steps:

Step 1. *Determining the level of competence for graduate student due to training cycles.*

Here we consider the m cycle of training and discipline within it. Let j - discipline the student received x_j points due to 100 point scale. Thus, the results of student in this cycle can be represented as a vector of assessments $(x_1, x_2, \dots, x_{k_m})$, where k_m – the number of subjects of proposed cycle. Using estimates of put ranges, we replace each discipline assessment on the fuzzy functions of belonging according to (6), and determine the degree of belonging to one of three linguistic terms that match the level of expertise on the graduate student discipline. The result is a matrix M_m containing k_m the strings that correspond to the number of disciplines of proposed m cycle, and three columns corresponding linguistic terms K_i, $i = 1,2,3$:

$$\mathrm{M}_m = \begin{pmatrix} \mu_{K_1}(x_1) & \mu_{K_2}(x_1) & \mu_{K_3}(x_1) \\ \mu_{K_1}(x_2) & \mu_{K_2}(x_2) & \mu_{K_3}(x_2) \\ \vdots & \vdots & \vdots \\ \mu_{K_1}(x_{k_m}) & \mu_{K_2}(x_{k_m}) & \mu_{K_3}(x_{k_m}) \end{pmatrix} \tag{7}$$

Nowweconsidervector $p_m = \left(p_1^{(m)}, p_2^{(m)}, \dots, p_{k_m}^{(m)}\right)$, componentsofwhicharenumbers $p_j^{(m)}$, $j = 1,2,\dots,k_m$, whichcharacterizerelativeweigh j - disciplineincluded into proposed m -cycle, depending to

credits quantity, given for studying the discipline. Components of proposed vector are due to norms, i.e. $\sum_{j=1}^{s_m} p_j^{(m)} = 1$.

To form a fuzzy subset of variables, we combine all fuzzy subsets using the composition operation (denoted as "•"). In this case, the combined output of fuzzy subset is formed as pointwise sum of all fuzzy subsets intended to variable output.

To calculate fuzzy values which determine the degree of belonging to one of three linguistic terms on m -cycle, we use operation of vector composition p_m and matrix M_m composition. As a result of this transaction, we obtain a vector $\mu_m = p_m \bullet \mathrm{M}_m$ whose components are fuzzy values of responding linguistic terms of m -cycle of training. In expanded form we have:

$$\left(\mu_{K_1}^{(m)}, \mu_{K_2}^{(m)}, \mu_{K_3}^{(m)}\right) = \left(p_1^{(m)}, p_2^{(m)}, \ldots, p_{s_m}^{(m)}\right) \bullet \begin{pmatrix} \mu_{K_1}(x_1) & \mu_{K_2}(x_1) & \mu_{K_3}(x_1) \\ \mu_{K_1}(x_2) & \mu_{K_2}(x_2) & \mu_{K_3}(x_2) \\ \vdots & \vdots & \vdots \\ \mu_{K_1}(x_{s_m}) & \mu_{K_2}(x_{s_m}) & \mu_{K_3}(x_{s_m}) \end{pmatrix}. \quad (8)$$

Based on this vector we conduct linguistic recognition of competence level value forgraduatestudentaccording to m – cycle of training, using the formula:

$$K^* = arg\left(max\left(\mu_{K_1}^{(m)},\ \mu_{K_2}^{(m)},\ \mu_{K_3}^{(m)}\right)\right). \quad (9)$$

We apply the same approach to all cycles provided by curriculum training. As a result, we obtain a vector whose components are fuzzy numerical values corresponding levels of competency to training cycles.

Step 2. *Determining the level of competence of the graduate student.*

Using competence assessment by cycles of training, weight coefficient of cycles, we form a fuzzy knowledge base and define the integral indicator of the level of competence of graduate student, using the algorithms of fuzzy logical inference with weighted validity. [8]

After the computation checking the adequacy of the results and, if necessary, recommendations are being given to adjustments of the process of training, the implementation of which leads to optimization of the learning process and improves the competence of graduate students.

Conclusions

Raising the level of higher education quality offers the students new opportunities and for the instructors it gives the chance for exchanging experiences with developed countries. However, to improve the quality level of training there are required appropriate measuring procedures and advanced diagnostic tools. The proposed procedure for determining the level of competence makes it possible to quantify the level of competence of the graduate student. A feature of this procedure is the usage of fuzzy knowledge bases and algorithms of fuzzy logic output with weighted validity, allowing more adequately take into account the results of the evaluation of educational achievements of graduate students. Using different fuzzy algorithms and choice of weighting coefficients will let to take into account the factors of influence, in which the integral indicator of the level of competence will host the most real value.

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Recenzenti:
Dr.h.c. prof. Ing. Vladimír Klimo, CSc. - VŠBM v Košiciach, Ústav humanitných a technologických vied
RNDr. Mária Kancírová - VŠBM v Košiciach, Ústav humanitných a technologických vied