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A.O. Ovezgheldyyev, D.Tech.Sc., Prof.
O.I. Prylypko, Ph.D., Ass.Prof.
Zhytomyr State Technological University

MODELS AND ALGORITHMS OF THE EXPERT PROCEDURE
OF THE FORMATION OF THE CURRICULUM OF A SPECIALITY

A model of quantitative theory of planning and management processes of preparation of highly qualified specialists that meets modern requirements of society is developed. In the process of constructing this model, quantitative evaluation of ranking of academic disciplines at the formation of the curriculum training specialist is studied. The paper considers the process of forming a general list of academic disciplines to study questions concerning their inclusion in the curriculum. A quantitative assessment of each academic discipline with a common list in the form of local, absolute and relative rankings is formulated. Also the method of selection of subjects according to their categorization by rating, and regarding the similarity of the disciplines is offered. The paper considers the process of distribution of the academic hours between the disciplines, which complete the entire process of formation of the curriculum of specialist training according to specialty.

Keywords: *model; specialist; expert; the curriculum; rating; discipline; examination; expert evaluation.*

Statement of the problem in general and its connection with important practical tasks. Preparation of highly qualified and competitive professionals is a priority task of the educational system of the state. Today it is unambiguously obvious that the achievement of state sovereignty is impossible without intellectual parity. For this reason, the main capital of the state is the human capital, the quality of which is determined by the development of modern science, education, culture and medicine at the most favorable environmental conditions. Modern high-tech information society determines the required standards of the model specialist, and scientific and technical progress achievements specify extremely important requirements to them. Eventually, all this requires educational institutions to be more flexible and competitive on the international market. So, this can be achieved only under condition of conformity of the national model of a specialist to the world standards of training for the needs of sectors of the economy.

In the preparation of highly qualified specialists curricula play an important role. Therefore, the aim of this article is the formalization of the process of formation of the professional curriculum, which would correspond to the model of a specialist of an international standard. As already noted, the quality of specialists that are available depends on the professional standards of specialities. We will assume that the model of a specialist is determined by two documents: a passport (qualifying characteristic) of a speciality and curriculum. Passport is a verbal description of the concept of speciality and on a declarative level determines the area of the possible use of specialists and knowledge and skills that they should have. This declaration with more or less precision is implemented by curriculum that defines the list of academic disciplines; volumes of academic hours of each discipline; the order of priority of passing subjects one after another and their distribution during studying semesters.

Thus, it is the curriculum determines the quantitative and qualitative characteristics of the model of a specialist. It should be emphasized that the formalization of the process of formation of the curriculum will allow us to further automate this process. Moreover, the grading of subjects in order of priority and distribution through the semester, usually does not cause fundamental difficulties. In addition, there is a powerful formal apparatus of network planning, which allows you to organize the educational process in time, not only at the level of the training courses, but also separate topics, provided the task in order of priority and the volume of hours planned for their study.

Analysis of recent research and publications. Issues of simulation of synthesis of the variant components of the curriculum were studied by Nefodov L.I. and Bespalyi V.O. [5, 6]. Принципи моделювання навчального плану, процедуру формування та аналіз якості навчального плану вивчали Архипова О.М., Белгородцева В.О, Шахгельдян К.Й. та Цуранов Е.В. [1]. Formalized representation of curriculum using graph theory was carried out by Kharitonov I.M., ShyrokovA.I.

and Lisovska I.M. [9, 10]. The issue of the formation of the curriculum and expert polls in conditions of indeterminacy were studied by Naikhanova L.V. and Dambaeva S.V. [4]. Expert methods and evaluation, particularly in the formation of the curriculum, were investigated by Hrabovetskyi B.E., and Tsidylo I.M. [2, 10]. However, modeling of expert procedures of formation of the curriculum of a speciality today requires further study.

The aim of the article. Statement of the problem. The aim of the article is the formalization of processes of the definition of the list of subjects and volumes of academic hours for each of them to form a curriculum of training of highly qualified specialists, as well as to create a quantitative theory of planning and management processes of this training.

The validity of the formulation of this problem is due to the fact that, despite the seemingly democratic character of the traditional procedure of forming a model of expert, is that this process involves quite a lot of experts, repeated discussion and coordination of opinions on methodical councils at various levels, the results are subjective and often do not reflect the collective opinion. This is due to the fact that, as a rule, at all stages of the discussion a fundamental rule of making collective decision is violated which is turning off the ability of authoritarian pressure on decision-makers (DM) [3,8]. Under real-life conditions, although it is assumed that all the members of the group of experts are equally qualified and equal, decisions are taken under the authoritarian pressure of those members of the group, who represent the most authoritative organization, endowed with some administrative and financial authority etc. Another feature of the traditional approach is the lack of quantitative assessments of the ranking of the subjects included in the curriculum. It doesn't allow to compare the results obtained at different stages or by different groups of experts, and most importantly, allows to randomly change the ratings of disciplines under the distribution of volumes of academic hours.

Summary. We describe one of the possible approaches to the formalization of the process of forming a model of a specialist, that allows to eliminate the above mentioned disadvantages.

The methodology involves three stages:

1. The development of the list of academic disciplines.

The aim of the stage is the development of a list (perhaps superfluous) of subjects, which can be probably included in the curriculum of a speciality. In this regard, the methodology of generating possible solutions, known as brainstorming is ised. Its peculiarity lies in the fact that each expert could make any suggestions that are necessarily fixed, but has no right to criticize or even comment already made proposals [3].

The work can be organized under the following scenario. Experts have already been familiarized with the passport (concept) of a speciality, besides they may be offered the original version of the list of subjects. Each discipline is accompanied by a brief abstract that allows you to understand which content is embedded in the name of the course. Experts complement the list with their proposals, each of which contains the name of the course and its brief annotation. However the possible cases when some subjects will differ only by names, or the proposed course is partially or completely overlap in content with previously included ones in the list of disciplines. Irrespective of this, all suggestions are included to the list without comments. The procedure lasts up to depletion of suggestions.

The stage ends with a discussion of the list of subjects in which the experts can come up with argumentation and motivation of their offers in the context of all proposals. After this, the list of educational disciplines should be arranged by grouping in courses with close or intersecting annotations. It should be noted that the procedure described above can be distributed in time and space. For example, the original information can be distributed among various specialists or departments, and then after getting their reviews all the proposals can be generalized.

2. The determination of the ranking of the subjects.

The aim of the stage is the determination of quantitative assessments of the rankings of each discipline included in the list. Each expert is given an identical list of possible subjects with their short annotations to specify with the points the significance of each of the disciplines for the professional training of the specialist of a specified profile. The grades are put according the 11-point scale from 0 to 10. A zero grade corresponds to the opinion of the expert of the need to exclude subjects within an existing list. The expertise is carried out by each expert individually and anonymously, that eliminates the above mentioned authoritarianism.

According to the results of the expertise the rating of each discipline included to the list is determined. The following quantitative assessment can be formulated.

2.1. The local rating of discipline:

$$Q_{jл} = \frac{1}{10n} \sum_{i=1}^{n} S_{ij} \; , \tag{1}$$

where is the number of experts; -number of points, provided − and discipline i − an expert; $10n$ − the maximum possible amount of points for the 10th-discipline.

2.2. The absolute rating of discipline:

$$Q_{ja} = \frac{1}{10nm} \sum_{i=1}^{n} S_{ij} \; , \tag{2}$$

where is the number of subjects in the source list. $10nm$ − the maximum number of points for the whole list.

2.3. The nominal rating of discipline:

$$Q_{jв} = \sum_{i=1}^{n} S_{ij} \Bigg/ \sum_{i=1}^{n} \sum_{j=1}^{m} S_{ij} \; , \tag{3}$$

where the denominator determines the amount of the actual points for the entire list. All three scores vary in the range from 0 to 1, and for the relative ranking (3) satisfies the condition:

$$\sum_{j=1}^{m} Q_{jв} = 1 \,. \tag{4}$$

On the basis of relative ranking (3) a quantity grade of priority index of subjects can be formulated:

$$P_j = \frac{Q_{jв}}{Q_{в\max}} \; , \tag{5}$$

where $Q_{в\max} = \max\limits_{1 \le j \le m} Q_{jв}$ the maximum relative ranking of all the disciplines of the source list.

It should be noted that the ranking of academic discipline on each of the above offered grades gives the same results as between the scores differ only in scale. The choice of a specific assessment or its group is defined by own preference of an expert.

Teachers, members of the methodical commissions of various levels, practitioners, potential employers, etc. can be experts on various stages. According to the results of the expertise a descending ranking list of academic disciplines, which excluded all the disciplines with a zero rating is created. After that, we proceed to the next stage.

3. Clarification of the list of subjects and distribution of academic hours.

The aim of the stage is the formation of the specified list of educational disciplines and determination of the volume of hours. It can be done with the following analytical operations.

3.1. The exclusion of disciplines that are similar in content.

As it was noted above the initial list of subjects may included a group of disciplines different in their names, but with the same or similar annotations. According to the results of the rating grades in such groups that discipline is put above that has the biggest rating, and it is considered as the baseline. All other discipline of a group from the source list are excluded, with annotations are integrated in the basic discipline, and ratings are added with a rating of discipline, adopted as the base. As a result of this step, the source list will be shortened due to exclusion of disciplines with duplicate content.

3.2. Exclusion of disciplines with a low rating.

In the modified during the first step list of subjects disciplines with low ratings remain, which are advisable to exclude from the process of forming a model of a specialist. In order to do this, some quantitative formalization of the concept of "low ranking" is essential.

For this purpose, the following procedure is offered. Assume that the overall amount of hours for the entire training F term for this specialty is known. We will assume that hours should be distributed between educational disciplines in proportion to their ranking. In this case, due to the condition (4), it is advisable to use the relative rating. Then the volume of hours − and discipline will be equal to:

$$b_j = F \cdot Q_{jв} \,, \tag{6}$$

The result will be defined by the primary variant of the distribution of hours between the disciplines.

It is known that there is some minimum of academic hours below which organization of independent course is pointless. Denote this amount through b_{min}. Then all the disciplines for which the condition is met:

$$b_j < b_{min}, \tag{7}$$

should also be excluded from the model. In this case the following options are probable:

- the discipline that is excluded is integrated into similar in meaning and logic of the course material with a high rating; its ratings and hours are added;
- the group with low rating disciplines combined into one course (if it is possible for the content and logic) with the total rating and educational hours;
- discipline is excluded from the process of forming a model of a specialist as insignificant for his training.

In all cases after modification of the list of subjects recalculation of the relative ranking of the subjects is carried out.

3.3. The distribution of hours between the disciplines.

Each discipline, depending on the complexity and volume of material required to study some amount of academic hours, which can vary from the determined by the formula (6) of academic hours. So, the problem of correction of subject volume compared with the reference option, is inevitably appeared and it is calculated by the formula (6). The expert rating priorities of academic discipline should not be violated. For the quantitative control of this condition we will introduce the concept of weight − th discipline v_j of equal:

$$v_j = b_j \cdot Q_{je}, \tag{8}$$

Then in the process of correction of the amounts of material for any pair of subjects, for example, with the numbers k s $(k \neq s)$ the following conditions must be carried out:

$$\text{If, then } v_k \geq v_s, \tag{9}$$

that allow to keep expert assessments of priority of academic discipline. This procedure completes the cycle of forming a model of a specialist. The resulting version of forming a model of a specialist can serve as a source option for the next cycle of expert analysis and other [7].

Conclusions and prospects for further research. The method described above can be used not only for complex analysis of forming a model of the specialist, but also for the analysis of any group of subjects, for example, subjects of fundamental, socio-political, special and other training. Thus, the methodology is only the first step in creating a quantitative theory of planning and management of processes of preparation of highly qualified specialists, which corresponds to the objective needs of modern society.

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OVEZGELDYYEV Ata Orazgeldyiovych – Doctor of Technical Sciences, Professor of Computer engineering in Zhytomyr State Technological University.

Research interests:
- system analysis and multifactor evaluation;
- methods of optimization and decision making;
- modern Internet-technologies.

E-mail: metanova@yahoo.com.

PRYLYPKO Oleksandr Ivanovych – Ph.D, Associate Professor of Physics and Higher Mathematics in Zhytomyr State Technological University.

Research interests:
- mathematical modeling;
- multifactorial assessment and decision-making;
- theoretical and algebraic systems of differential equations.

E-mail: poizh@ukr.net.

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