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SINGLE-PAGE APPLICATION DESIGNING METHODS TO STIPULATE THE OPTIMAL VARIABLE COMPONENTS BLOCKS WITH SPECIALIZATION PURPOSE OF EDUCATIONAL TRAJECTORY

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Abstract. *On critical analysis basis of results of the world scientists studies in context of introducing variable components problem into engineering profile educational program, a number of unsolved tasks for design and integration of information technologies for selective disciplines formation in academic system of educational process implementation are shown. The presented study describes the stages of building an analytical apparatus, which is the software engine of up-to-date client-server solution for modeling the blocks of optimal list of academic disciplines of free choice, taking into account interdisciplinary links, dynamics in related fields of knowledge, and personal aptitudes of students.*

Key words: *variable components, educational trajectory, personal approach, modeling, one-page application.*

Introduction.

By creating a flexible and individualized educational program, academic discipline of free choice in higher education play an important role in the professional development of students and formation of their subject competencies. The variables components of curriculum provide students with the opportunity to explore a new subject area that may be outside their academic major. This expands range of notions and interests, and also allows to gain knowledge in related fields, develop various skills, actively influence on their educational trajectory, increasing competitiveness.

The ability to freely choose disciplines allows students to develop critical thinking and scientific creativity as they study different approaches and methods in different fields. Educational process adaptation depending on changing needs of labor market and new technologies development, as well as interdisciplinary cooperation become the key to success in the modern world. In general, the variable components of the educational program perform an important function in the higher education system, stimulating students to independence and lifelong learning.

Analysis of last research

The problem of adequate variable components introducing into the educational program of engineering profile becomes relevant in modern requirements context for specialists training in the engineering field. Analysis of latest studies by world scientists in this context identifies several key areas that are worth considering in detail.

The results [1, 2] show that the inclusion of interdisciplinary components in the educational programs of engineering specialties contributes to the development of flexible skills and teamwork abilities. Analysis of disciplines integration from different fields can reveal optimal combinations for expanding the professional students arsenal [3]. Emphasizing the key need to solve typical tasks from profiled activities, works [4, 5] point to the importance of introducing cross-subjects practical

constituents, which allows students to acquire applied skills and experience that meet the modern requirements of the labor market [6].

The effective evaluating methods development for variable components forcefulness in educational programs, the use of modular approaches and operational corrections to improve the quality of education are particularly important measures in qualified specialists training [7]. Methods of determining key characteristics to ensure the academic success of engineering students are proposed to be implemented on the basis of constructs of multiple intelligences, which provide timely recommendations for the implementation of appropriate learning strategies [8]. At the same time, the variable component of educational programs is best suited to the deployment of an accessible model for the joint use of information resources with an improved selection and expanded functionality [9, 10]. Performed domestic and international research analysis made it possible to single out the best practices and innovative approaches to introduction of variable components into educational programs of engineering degree, thereby contributing to quality improvement of specialists training who meet of modern technological environment needs.

Problem statement

Presented results of latest thematic publications review also contributed to identification of unsolved problems number in the design and integration of information technologies for formation of variable components blocks using the computing power of automated academic system for educational process implementation. Thus, one of the main problems is the insufficient focus on the students individual characteristics and needs. Another problem is the lack of a clear mechanism of interaction between educational institutions and branch enterprises in variables components blocks formation. Industrial partners are not always involved in developing process of educational trajectories, thereby limiting their real practicality and compliance with the needs of the labor market.

Also, there are difficulties in guaranteeing the availability of variable components for all social categories of students, in particular, for applicants with special needs [11], academic refugees [12], etc. Often, this problem is not taken into account at the stage of designing educational technologies, which creates inequalities in the possibilities of obtaining quality education. Consequently, there is a timely and urgent necessity to improve existing approaches and develop original, modern solutions for the selection of variable components, taking into account interdisciplinary links, students personal inclinations and needs, dynamics in related knowledge fields and contemporary challenges.

Methods and Materials

When designing information technology for target determination of variable components blocks, it is necessary to use a comprehensive approach, which involves use of statistical methods for data processing and analysis, which allows identifying patterns and trends in results of student learning and scientific research work [12]. Therefore, adequate models build allows taking into account various pedagogical strategies and their consequences when individual educational trajectory modeling.

Results and discussion

To automate the stages of determining the optimal disciplines of free choice

when designing information and communication technology, it is extremely important to build an adequate analytical apparatus. Formalization of student's previous achievements, his preferences, inclinations, strengths and weaknesses allows determining the optimal variable disciplines list. The model *I* of assessment of scientific interests was introduced to predict the development of students' strengths (1):

$$I=cP+eS, \quad (1)$$

where: P – personal inclinations and other factors influencing scientific interests;
S – level of available experience and skills;
c,e – respectively, coefficients for determining the degree of influence of personal inclinations and available skills.

Surveys and similar methods of collecting sociological information are used to formalize personal tendencies *P*. The level of available experience *S* is determined by psychometric tests and the results of participation in professionally oriented scientific projects and competitions. The level of student academic results *D* also depends almost linearly on the level of previous training *T*, which is obtained through the analysis of academic success in professionally oriented courses, results of standardized tests, participation in additional educational programs. Also, to take into account possible limitations or variability, it was decided to use the factor ε, which will represent some error, uncertainty or other passive characteristics (2):

$$D=aT+b+\varepsilon, \quad (2)$$

where: a – coefficient of determining the degree of influence of the level of preliminary training on the level of academic achievements;
b – coefficient of reflection of the basic (initial) level of knowledge, which does not depend on the level of previous training.

Now we have obtained all the arguments of the weighted sums necessary for the construction of the decision matrix to determine the recommended specialization (3):

$$FA=\{I(P,S), D(T), \psi\}, \quad (3)$$

where: ψ – subjective recommendation factor reflecting external influence or current fashion trends.

The magnitude of outside influence is determined through questionnaires or interviews with departmental advisors, industry experts, alumni, and other authority persons. Current latest craze trends are formed under the imposition of targeted advertising and social networks, pressure from the environment, suggestions of current market trends in popular fields of activity. Each of these methods can be used to collect objective and subjective data that will help determine the appropriate model element. The combination of the above methods made it possible to implement a comprehensive approach to determining the recommended specialization, which takes into account both dispassionate factors and student individual characteristics.

For each specialization provided for in the preparation of applicants, there is a list of disciplines, the content of which fully corresponds to the subject area of professional orientation. Other disciplines are considered as moderately relevant and weakly relevant. The task of the designed analytical apparatus at this stage is to determine the optimal combination of variable educational components for at least the next two semesters, which would correspond to the recommended specialization and would not destroy interdisciplinary links. Thus, model for of interdisciplinary

links analysis when choosing the optimal combination of disciplines for the selected professional orientation can be represented by a maximized objective function (4):

$$max\ I_C(FA) = \sum_{i=1}^{aSem}(w \cdot Y_i x_i) + \sum_{j=1}^{sSem}(w \cdot Y_j x_j) + w_{FA} \cdot D(T), \quad (4)$$

where: *aSem*, *sSem* – number of free choose disciplines in the fall and spring semesters, respectively;

$Y_{i,j}$ – alternative that determines the relevance of (i,j) variable discipline: $Y \in \{-1, 0, 1\}$;

$x_{i,j}$ – binary factor of discipline entry into modeled combination: $x \in \{0,1\}$.

The first and second terms (4) represent the weighted sum of grades for variables academic disciplines within the fall semester and spring semester. The third term is given by the product of the weighting coefficient and the alternative of the influence of the level of student academic achievements on predicted success in the selected specialization. Weighting coefficients determine the importance and relevance of selected disciplines for specific professional orientation. The obtained result can serve as a recommendation for the student regarding the choice of disciplines that most correspond to his/her scientific interests and acquired competences, and can provide the closest possible level of interdisciplinary links.

The built analytical apparatus is the basis of developed web service for optimal list determining of variable educational components focused on student motivation, prior training level, natural inclinations and scientific interests. First screen of web service, implemented in single-page application, invites the applicant for an engineering degree in one way or another using the methods of explicit data collection [12] to choose a professional orientation (Fig. 1, *a*) or simply to indicate the desired specialization on one of the following screens (Fig. 1, *b*).

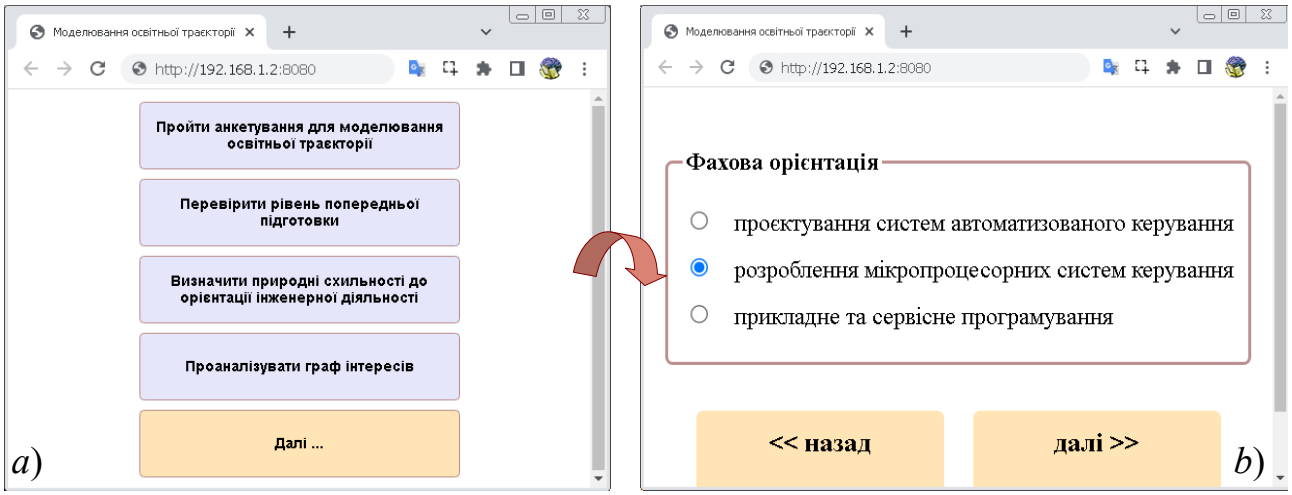

Figure 1 – Stages of automated determination the professional orientation
Author's development

On the final screen, modeled blocks of optimal variable educational components are displayed by semesters of the next academic year (Fig. 2).

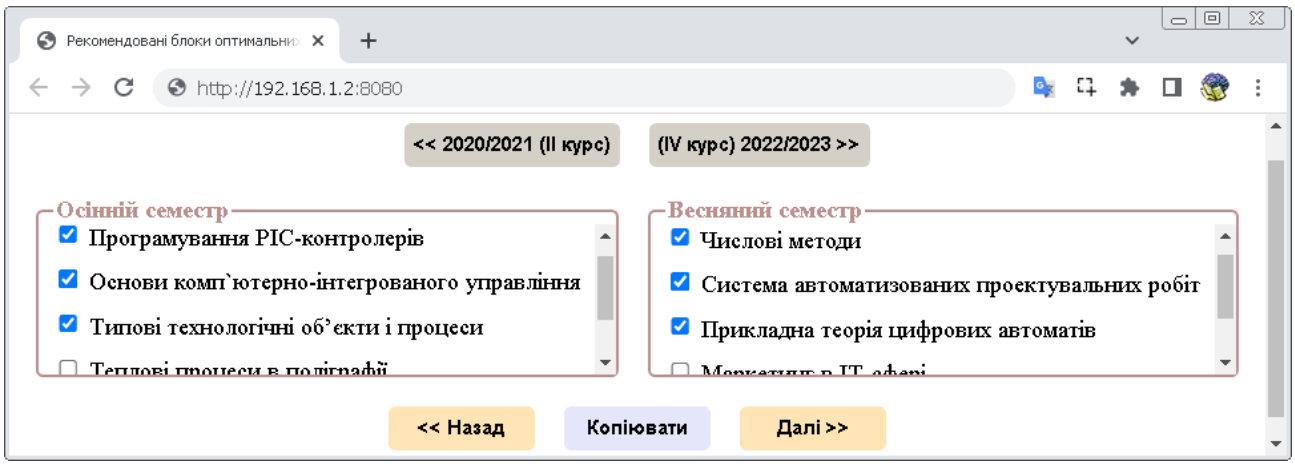

Figure 2 – Recommended blocks of optimal variable educational components
Author's development

Summary and conclusions.

The developed analytical apparatus will allow the academic information system to provide students with well-founded recommendations and promote the conscious selected of optimal free choice disciplines. The presented client-server single-page application serves as a means to personalize the educational process and support students in choosing and developing career paths, taking into account the current needs of the labor market and industrial trends to offer academic disciplines that are most useful for obtaining a high-quality engineering profession.

The described information and communication technology for the optimal selection of combined variable components of the educational and professional program takes into account the individual characteristics of students, scientific interests and natural inclinations, as well as the previous level of training, and ensures flexible adaptation to changes in the field of technology, increasing the quality and efficiency of the provided educational services.

Further development of the project will be focused on researching strategies for involving stakeholders in the process of forming selective components and clarifying standards that will contribute to the provision of quality and affordable educational services for all categories of students.

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