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TABLE OF CONTENTS

16. Melnikov A. Yu. Object-oriented analysis and design of information systems: a textbook / A. Yu. Melnikov. - Ed. 2nd, remaking. and ext. - Kramatorsk: DGMA, 2013. - 172 p.
17. Leonenko AV The UML Tutorial / AV Leonenko. - 2nd ed., Remaking. and ext. - St. Petersburg: BHC-Petersburg, 2004. - 432 p.
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INFORMATION SYSTEM FOR WORKING WITH EDUCATION PROGRAMS AND HIGHER EDUCATION STANDARDS

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Abstract. *Higher education standard is a set of norms that establish the main purpose and objectives of education, requirements for the content of education, the level of training of specialists, determine the way to diagnose the quality of higher education. Each institution of higher education, on the basis of an approved standard, develops, for each specialty, an educational (vocational, educational or scientific) program that can be approved or modified annually. Creating educational programs based on existing standards, comparing and improving them is a creative process, but the need to constantly update materials and conduct quality assessments requires the involvement of information systems and technologies.*

The purpose of the work is to develop in a system of visual programming (application) that would allow to work with the standards of higher education and educational programs, the list of competences and subjects, and program results of training. The system should be able to import all available data, make changes to any partition, while working with XLS-format data.

The object of study is higher education standards and educational programs. The subject of the study is the automation of the processing of these documents.

The first section looks at existing approaches to working with higher education programs and standards. The second section develops an object-oriented model of the software system using UML visual design tools. The third section provides a user guide and an example of a developed model system software.

Key words: *standard of higher education, education professional program, competences, software learning results, subject matters, information system, list of literature, higher education institution, unified modeling language, object-pascal*

I. Introduction

Modern education requires considerable accumulation of funds and resources, and most importantly - a competent management approach, strategic planning, control and transparent financing. The number of higher education institutions that need automated systems to operate is steadily increasing. The developed database will serve as an example of what skills are needed for a student to successfully master the discipline. Students should have a level of training based on the competencies of the bachelor's specialization in some areas, namely: training professionals who will have the skills to develop methods and tools of system analysis to solve complex problems, regardless of field of activity, and also be able to apply them directly in work.

Higher education standard is a set of norms that establish the main purpose and objectives of education, requirements for the content of education, the level of training of specialists, determine the way to diagnose the quality of higher education. Each institution of higher education, on the basis of an approved standard, develops, for each specialty, an educational (vocational, educational or scientific) program that can be approved or modified annually.

Creating educational programs based on existing standards, comparing and improving them is, of course, a creative process, but the need to constantly update materials and conduct quality assessments requires the involvement of information systems and technologies. The purpose of the work is to develop in a system of visual programming (application) that would allow to work with the standards of higher education and educational programs, the list of competences and subjects, and program results of training. The system should be able to import all available data, make changes to any partition, while working with XLS-format data.

II Current approaches to work with educational programs and higher education standards

By 2016, the standard of higher education [1] consisted of two parts - "Educational and qualification characteristics" (EQC) and "Educational and Professional Program" (EPP). Educational qualification characteristic of a graduate of a higher education institution (EQC) was an industry normative document, which summarizes the content of higher education, ie reflects the goals of higher education and vocational training,

determines the place of a specialist in the structure of branches of the state's economy and requirements for its competence, other social competences and qualities. Five types of competences were envisaged: social-personal, general-scientific, instrumental, general-professional, specialized-professional. Skills were divided into subject-practical, subject-mental, sign-practical and sign-mental, typical tasks of activity - professional, social-production and social-everyday life. The educational-professional program was an industry normative document, which defines the normative term and content of training, normative forms of state attestation, establishes requirements for the content, volume and level of education and professional training of a specialist of the relevant educational and qualification level of a certain area. Also, the educational and professional program contained a recommended list of subjects and a list of competences on educational and qualification characteristics that are formed in each discipline.

According to the new rules adopted by the Ministry of Education and Science of Ukraine [2], the Higher Education Standard now defines the following requirements:

– the amount of ECTS credits required to obtain an appropriate higher education degree;

– list of competences of the graduate;

– the normative content of training for higher education applicants, formulated in terms of learning outcomes;

– forms of attestation of applicants for higher education;

– requirements for the availability of internal quality assurance system for higher education;

– requirements for professional standards (if any).

That is, it does not now contain a breakdown of the educational and vocational program and educational qualification characteristics, it has only two types of competences (general and special, or professional), regulatory content in the form of a list of knowledge and skills, as well as two annexes: the correspondence matrix of national framework descriptors qualifications (knowledge - ability - communication - responsibility) of each competence; Matrix of correspondence of programmatic learning outcomes (ie list of knowledge and skills) to the list of competences [3].

Each higher education institution, based on the approved standard for each specialty, develops an educational (vocational or educational-scientific) program that contains general competencies, special competences, program learning outcomes, educational components (list of disciplines of the curriculum), structural and logical scheme and Matrix of correspondence of competencies and program learning outcomes (PLO) to program components (ie disciplines). The program results of study in the educational program should, as a rule, ensure at least 50% of the competencies of the HES. The number of competences and PLO may be greater than or equal to its HES counterparts. As a rule, a vocational program is drawn up in a higher education institution and may be approved or modified annually.

Higher education institution independently determines the list and content of components [4], in accordance with subparagraph 17 of the first article of Article 1 of the Law of Ukraine on Higher Education [5].

Ukrainian higher education institutions use the competent approach [6] recommended by the European TUNING project [7]. This approach proposes to describe

the learning outcomes of the competencies that a graduate must possess, that is, the result is the degree of the graduate's willingness to demonstrate relevant competencies [6].

In general, the TUNING project [7] proposes to shift the emphasis of the educational process to teachers, when the result is largely influenced by the combination of the areas of interest and experience of the teaching staff, to the students, so that the key knowledge, skills and skills that the student must master during their studies, determine the content of the curriculum.

The search for common principles and recommendations for the process of creating educational programs in European countries revealed that the autonomy of European universities does not imply the existence of uniform standards that would be available on the Ministry of Education's website [8-9]. Each university creates its own programs, taking into account local, national and pan-European needs. For example, there is a "Single European System of Electronic Competences 16234-1" [10], which contains a guide to 40 competences applied in the workplace in information and communication technologies (ICT), using a common language for competences, skills, knowledge and skills .

In [11] the experience of Russian universities on the integration of professional and educational standards in the design of higher education education programs in the field of information and communication technologies is analyzed. A number of aspects of current versions of educational standards have been identified that present a challenge for combining professional standards in the development of basic educational programs. Methodical recommendations on updating the FSES HE and selection of professional standards, developed by leading Russian universities as a result of implementation of international and domestic projects, are presented. The analysis of conformity of generalized labor functions and their components from the professional standards of general and professional competencies with the FSES HE in the direction of preparation "Fundamental Informatics and Information Technologies".

In [12] the analysis of conformity of the educational process with the requirements of educational standards on the example of the Faculty of Economics and Management is given, but attention is paid not to the structure and content of the educational programs, but to the staffing of the educational process.

[13] presents an analysis of the experience of upgrading undergraduate programs using the TUNING methodology. The algorithm of reforming curricula in the subject area of information technologies in accordance with the TUNING methodology is explained. Comparisons are made between existing Russian and European standards in the field of ICT education, including the European e-Competence System, with a focus on relevant competences, and some guidelines for the preparation of educational programs are provided.

Research [14] addresses the issues of applying a competent approach in higher education in formulating the requirements of state educational standards for the quality of education. For the quantitative characterization of the quality of training, groups of criteria (indicators) and their weight coefficients are defined. An indicative methodology for assessing the quality of education is proposed, which involves surveys of expert teachers and expert employers.

But all the above studies were carried out without the use of information systems, and their results cannot be easily developed in other fields. Most automated system projects (eg, [15]) are aimed at analyzing the quality of student learning and differ in the

method of processing the collected material without analyzing the content of educational programs.

The analysis of available sources of information revealed that at present there is no computer system that allows to solve complex problems related to the processing of educational standards and educational programs. One of the systems [16-18] allows to enter, store and process most of the information. It provides the ability for users of three levels: the system administrator (admin) changes the basic data, the main user (main user) generates and corrects EQC and EPP, the ordinary user (user) receives the information in the right form (each of them has access to all information, only the possibility of changing it is closed). The system works with the databases Competence Classes, Production Functions, Types of Typical Activity Tasks, Activity Task Classes, Types of Skills, and Skills Formation Levels. In EQC mode, Tables “Competencies”, “Typical Activity Tasks”, “Skills for providing typical activity tasks”, “Skills for providing selected competence” are created. In the mode of work with the EPP the tables "Names of disciplines", "Names of disciplines", "Names of blocks of content modules", "Names of content modules", "List of content modules for providing each skill", "List of blocks of content modules for state certification are processed ».

This system does not have a clear division of data into standard ones (ie the "Higher Education Standard") and created in a higher education institution ("Educational Program"), does not allow the assessment of compliance with the EPP standard and is generally based on an outdated list of competences.

III Design of specialized software

The task was to create a software system that would allow to work with the list of formed competencies in both subjects and program results of training. The system should be able to import all available data, make changes to any partition, while working with XLS-format data:

– provide the information available in one application (for ease of use);

– to establish the reference of each item of the EPP to the EQC (which competence of the EPP provides the competence of the EQC, etc.);

– to work with EQC - to study the matrix of correspondence of program results of training to competencies;

– work with the EPP - to create a matrix of correspondence of programmatic learning outcomes to competencies, as well as to determine which programmatic learning outcomes are appropriate for each discipline;

– to work with EPP - to get a list of competences that a student receives in each discipline;

– conduct a simple analysis of the compliance of the EPP with the EQC and the presence of unsecured competencies;

– to calculate how seriously these or other PLO and competencies are analyzed by analyzing the educational components (credits);

– to calculate student success in terms of competences and program outputs;

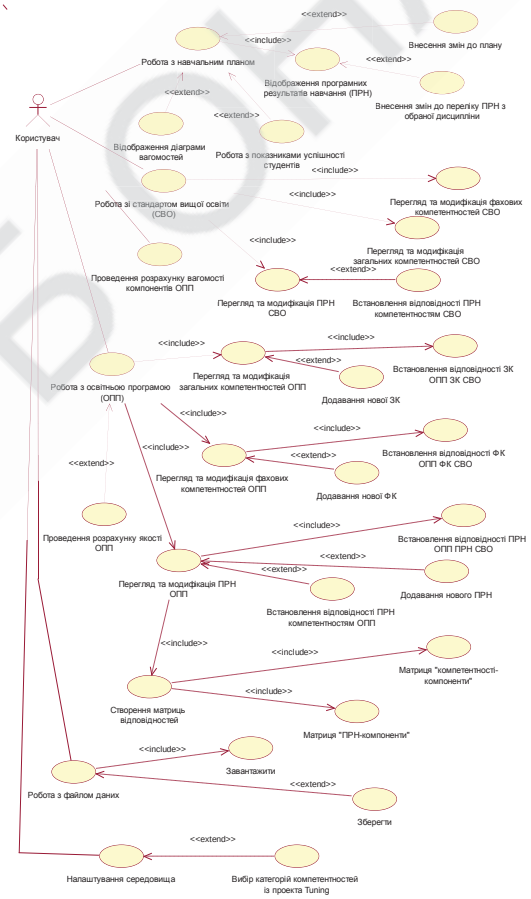
Using such a system will make it easier to work with educational and methodological documents at the departments when preparing materials for licensing and accreditation.

The information model of the system was created by the Unified Modeling Language (UML). Visual modeling using UML is a step-by-step descent from the most general conceptual model of the system to the logical and then to the physical model, and the model is a collection of so-called diagrams [19-20]. System features are presented in the use case diagram (use case diagram), which reflects the conceptual model of the system (drawing 3.1).

One user of the system (teacher or other employee) is envisaged. He has the basic precedents of "Work with the curriculum", "Work with the standard of higher education", "Work with the educational program", "Calculate the weight of components of the EPP", "Work with data file" and "Setting up the environment".

"Work with the curriculum" requires mandatory ("include" ratio) "Display program learning results" and not necessarily (ratio "extend") "Making changes to the plan", "Making changes to the list of program learning outcomes from the selected disciplines "," Working with student performance indicators "," Displaying the chart of weights ".

"Working with the higher education standard" requires (include "ratio") "Review and modification of professional competencies of the higher education standard", "Review and modification of the general competencies of the higher education standard", "Review and modification of program results of higher education standard training" and not necessarily (the "extend" ratio) "Matching programmatic learning outcomes to the competencies of the higher education standard."

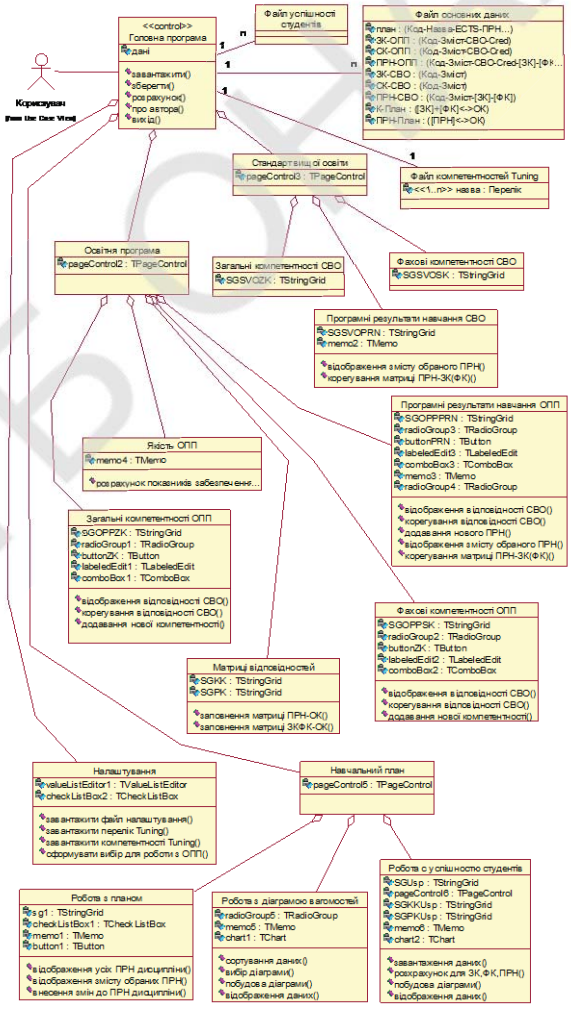


Drawing 3.1 – Use case diagram

"Working with the educational program" requires ("include" relation) "Review and modification of the general competences of the educational and professional program", "Establishment of conformity of the general competences of the educational and

professional program of the general competencies of the higher education standard", "Review and modification of professional competences EPP", "Establishing the correspondence of professional competences of the educational and professional program to the professional competences of the higher education standard", "Review and modification of the program results of educational training professional program", "Establishment of compliance of program results of training of educational and professional program of program results of training of the standard of higher education", "Creation of matrices of correspondence" (matrix "competence-components", matrix "PLO-components") and not obligatory (relation "extend") "Adding a new general competence", "Adding a new professional competence", "Adding a new program learning result ", " Establishment of conformity of program results of training to the competences of educational and professional program", "Carrying out the quality calculation of educational and professional program".

The structure of the system in terms of object-oriented design is shown in the class diagram (drawing 2.2). The structure is not too complex: the user is associated with a management class ("Main Program"), which contains (aggregation ratio) classes for working with a higher education standard, a vocational program and curriculum, as well as classes - data files.



Drawing 3.2 – Class diagram

XLS is selected as the output format. It allows you to make any changes to the data without using the system, and also removes the requirements for installing additional

software. One file is one specialty (educational program). Each letter carries its functional load (name is irrelevant, sequence is required):

– Syllabus - a list of disciplines of the syllabus (code, title, volume in ECTS credits);

– GC-EPP - a list of general competencies in the educational and professional program (code, content, compliance with the standard, the estimated amount in ECTS credits);

– SC-OPP - a list of special competences in the educational and professional program (code, content, compliance with the standard, the calculated amount in ECTS credits);

– PLO-EPP - a list of program results of training in the educational and professional program (code, content, compliance with the standard, the calculated amount in ECTS credits, compliance with the competences of the EPP);

– GC-EQC - a list of general competences in the higher education standard (code, content);

– SC- EQC - list of special competences in the higher education standard (code, content);

– PLO- EQC - a list of programmatic learning outcomes in the higher education standard (code, content, compliance with the competences of the higher education standard);

– C-Plan - conformity of competences of the educational and professional program to its components (disciplines of the curriculum);

– PLO -Plan - correspondence of program results of training of educational and professional program to its components (disciplines of the curriculum).

Only the first seven sheets should be loaded; the last two are to be created by the system and then stored in a file upon user request.

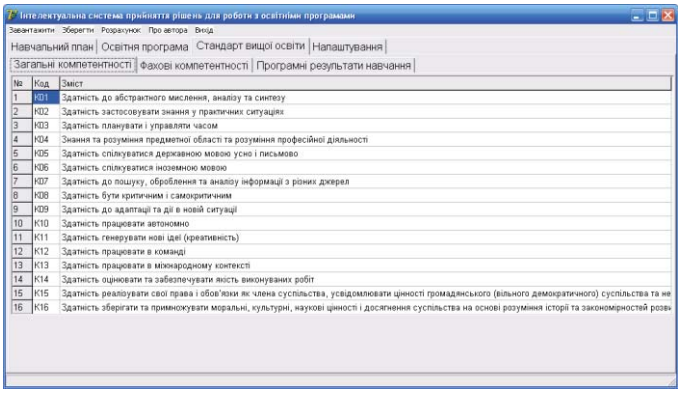
As an example, the standard of bachelor's training in specialty 124 "System Analysis" and the educational and professional program "Intelligent Decision Making Systems" were used.

IV Computer implementation of specialized software

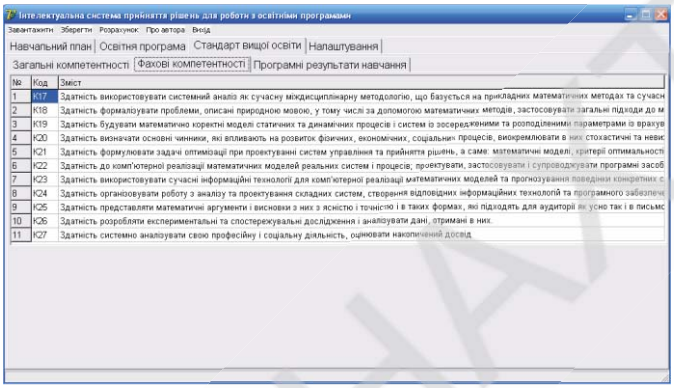
The developed information model of the software system for work with educational programs and standards of higher education was implemented in the Object Pascal environment [21-22].

The application form contains four main tabs: "Curriculum", "Education Program", "Higher Education Standard" and "Settings".

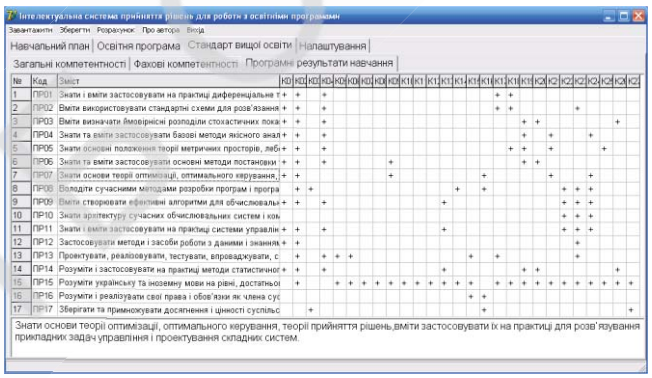
Working with the standard of higher education (drawing 3.1-3.3) allows to review the general competences, special competences and program results of training in the form of a correspondence matrix [3]. The user is given the opportunity to make changes to the text, but it is assumed that the standard is approved and unchanged.



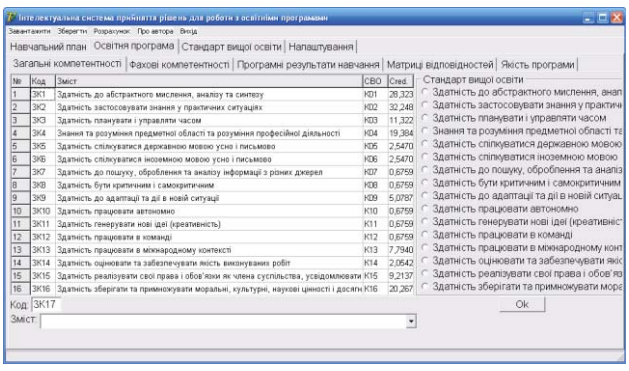
Drawing 3.1 – Working with EQC: general competencies



Drawing 3.2 – Working with EQC: professional competencies



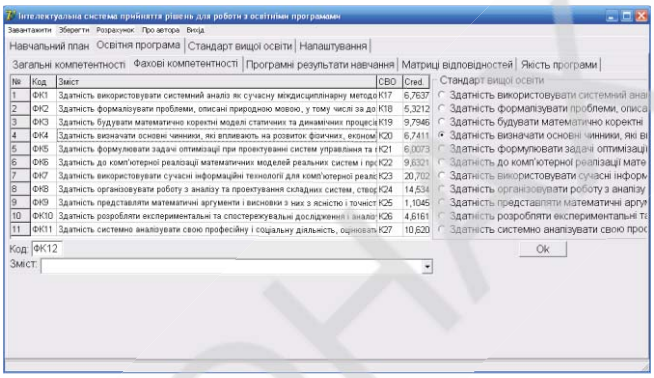
Drawing 3.3 – Working with EQC: programmatic learning outcomes



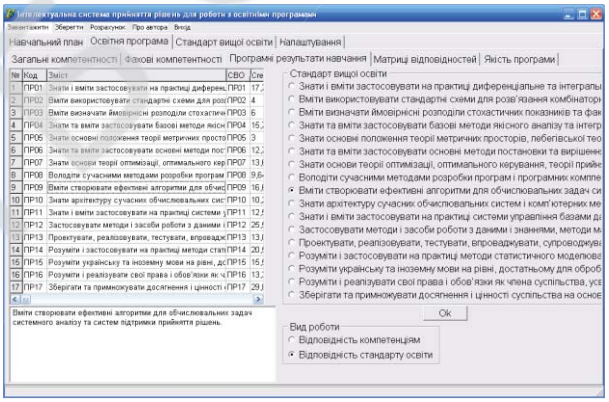
Drawing 3.4 – Working with EQC: general competencies

Working with the educational program (drawing 3.4-11) also allows you to review general competencies, special competences and programmatic learning outcomes, including in the form of a compliance matrix. The user can make changes to the text, set the compliance of each item of the educational program with the item of the higher education standard (if such conformity is envisaged), and also add new data (new lines). The new code is calculated automatically, but the user can change it. A new line can be added from a helper file.

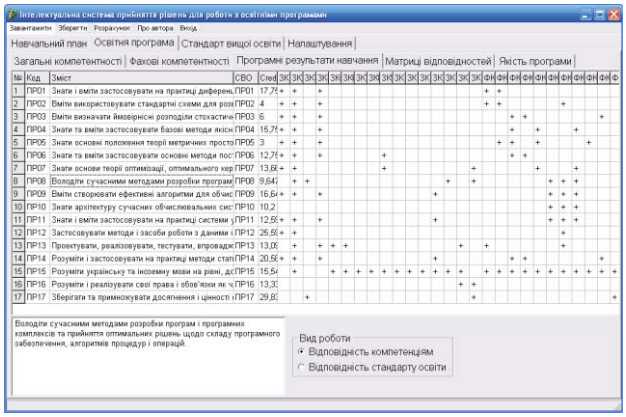
It also provides a Compliance Matrix for Components and a Software Matrix for Software Learning Outcomes, which can be adjusted using the mouse and keyboard. The user, when working with the software learning outcomes, has the choice to work with a window of competence or a window of conformity with the standard of education, as in the case of general and professional competencies.



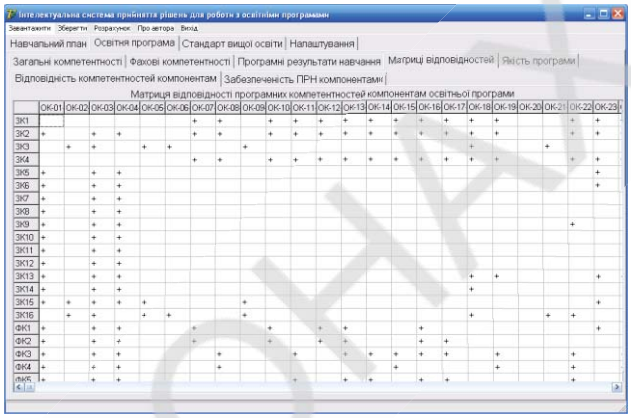
Drawing 3.5 – Working with EPP: special (professional) competencies



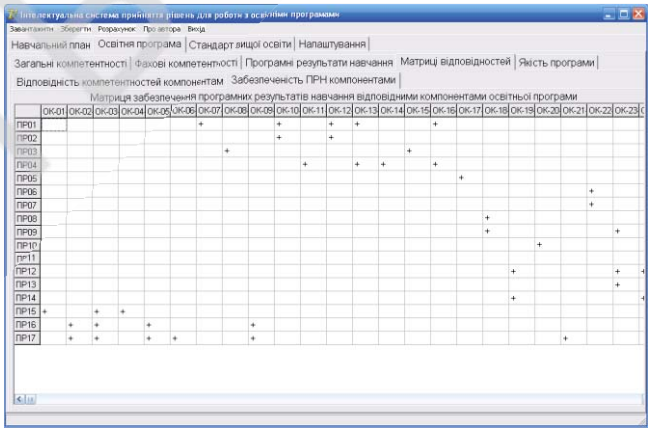
Drawing 3.6 – Working with EPP: programmatic learning outcomes (EQC compliance)



Drawing 3.7 – Working with EPP: programmatic learning outcomes (competence-relevant)

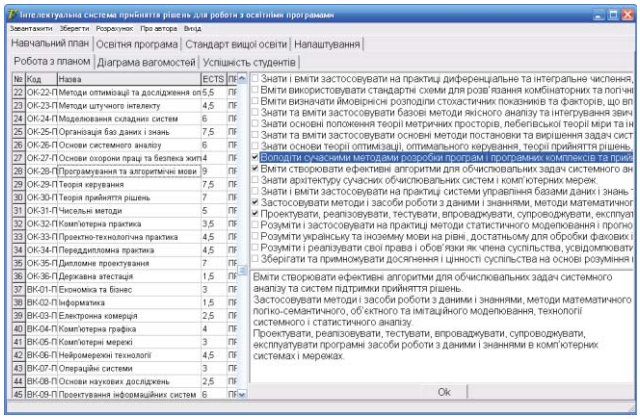


Drawing 3.8 – Working with EPP: compliance matrix of components



Drawing 3.9 – Working with EPP: a matrix of software results learning components

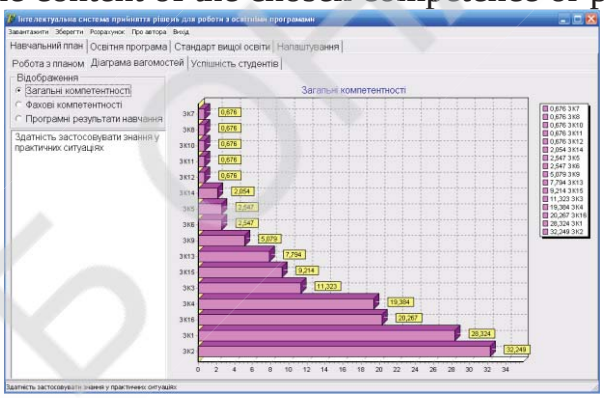
Working with the curriculum involves establishing the relevance of each discipline to the program results on the basis of its study (one-to-many ratio, up to 10 positions). The bottom right of the window displays all the program results of the chosen discipline. If the user needs to change the selection, he must confirm it by pressing the "Ok" button (drawing 3.10).



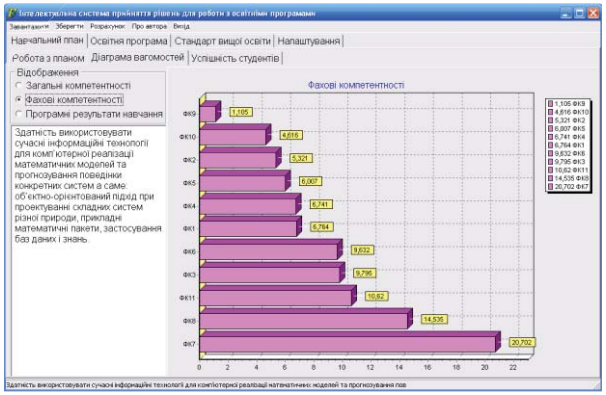
Drawing 3.10 – Work with the curriculum

The peculiarity of the developed system is the ability to work with the weights of each competence or learning outcome. When selecting the Calculation menu item, the system fills in the credits cell to which ECTS credits each competency or program result is based on the available data from the correspondence matrix. The user has the opportunity to review the weight of each general competence (drawing 3.11), professional competence (drawing 3.12) and program output (drawing 3.13).

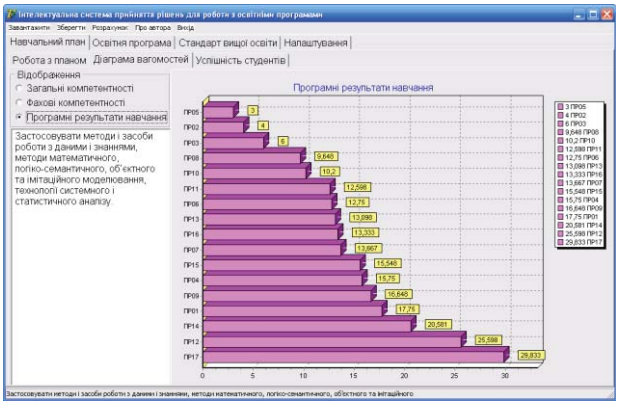
The columns of the charts show the values (indicators) of weights in ECTS credits, on the left in the text box - the content of the chosen competence or program output.



Drawing 3.11 – Working with kettlebells: general competencies



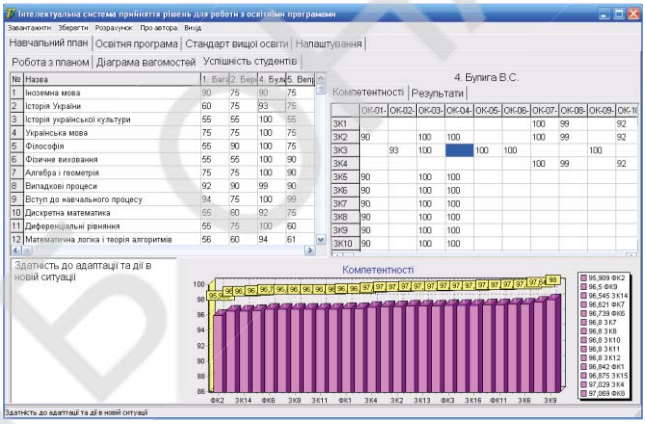
Drawing 3.12 – Dealing with weights: professional competencies



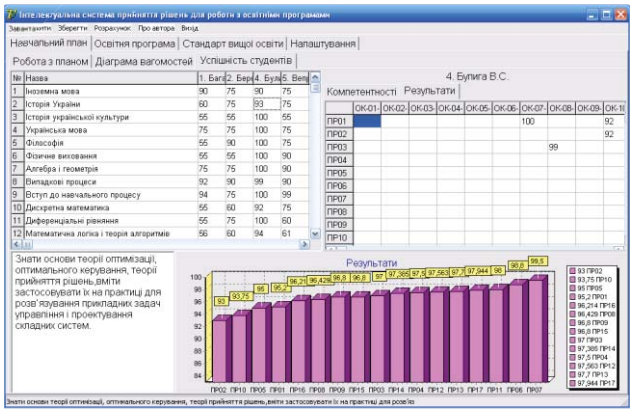
Drawing 3.13 – Working with weights: program outputs

Another feature of the system is the ability to analyze the student's or entire group's performance in terms of the competencies or program outputs they have learned. The "group1.xls" input file contains student grades (in columns) x for each discipline of the syllabus (in rows). If for some reason the student has not studied this or that discipline, it is set to "zero" and the line will not be taken into account in the calculations.

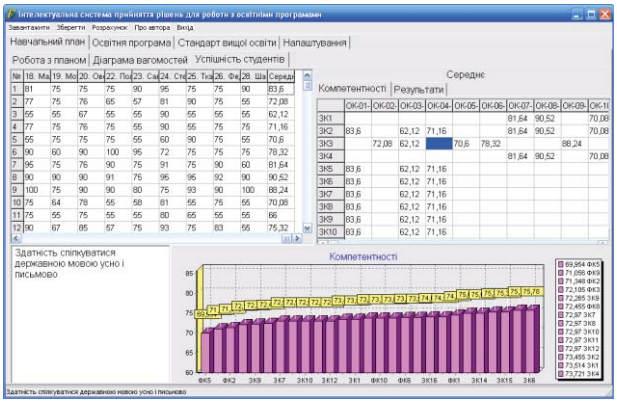
In drawing 3.14-3.15 presents examples of calculating student success by competencies and program results of study, respectively, in drawing 18-19 is the same for the student group average.



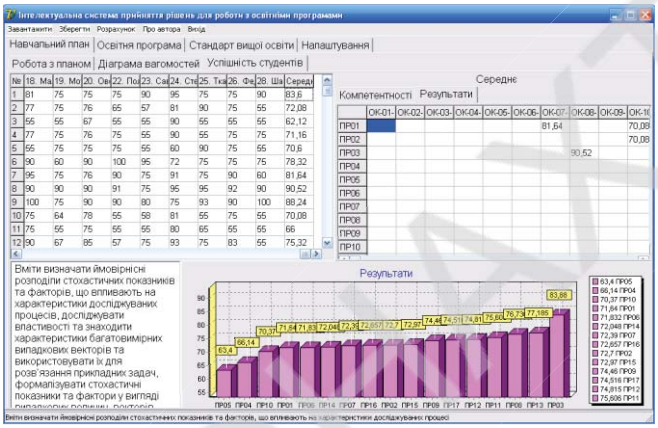
Drawing 3.14 – Work with student's competencies by competencies



Drawing 3.15 – Work with student's success on program results of study



Drawing 3.16 – Working with the success of the group by competence



Drawing 3.17 – Work with the success of the group on the program results of training

Conclusions

The structure of higher education standards and educational and professional programs was analyzed, the information model of the software system for work with educational programs and higher education standards was created, and its program implementation was carried out. Examples of the work of the system with the standard of preparation of the bachelor in specialty 124 "System analysis" and educational and professional program "Intelligent decision-making systems" are given.

Using the developed application will make it easier to work with teaching documents at the departments when preparing materials for licensing and accreditation.

Prospects for further research include filling the database with real data on the disciplines of student choice, introducing a comparison of educational programs of different specialties of one institution of higher education and one specialty of different institutions of higher education, as well as the creation of a holistic model of quality assessment of EPP, taking into account the compliance with the EQC and the results of success.

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AUTOMATION OF PROCESS CONTROL FOR POSITIONING PISTON ACTUATORS

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Abstract. *The paper considers a control model for positioning piston actuators, briefly discusses the issues of existing analogues, the advantages of pneumatic and hydraulic drives. The main goal of the work is autonomous accurate positioning of piston mechanisms and the development of a prototype for a practical experiment, as well as for practical work. Advantages of using pneumatic drives:*

1. Long service life.

2. Reliability, warranty.

3. High speed start-up, operation, response to operator signals.

4. Simplicity of design for easy maintenance.

5. Production efficiency (low cost of the work environment along with the absence of taps).

6. Fire safety. This makes pneumatic actuators common in the chemical or mining industry.

Keywords: *piston mechanisms, pneumatic drives, hydraulic drives, efficiency.*