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AUTOMATED SYSTEM OF ACADEMIC PROCESS MANAGEMENT IN HIGHER EDUCATION INSTITUTIONS

The article deals with the problem of creating an automated system for planning the educational process in Ukrainian institutions of higher education, taking into account the current requirements for the organization of the educational process, as well as the professional competence of the teacher. The developed automated system with use of the decision support system (DSS) allows preparing academic and working academic plans, calculating the academic load volume and making decisions on its distribution among the teachers of the department. The advantage of the proposed system is the ability to improve the process of planning the academic load, eliminate possible errors caused by the human factor, takes into account the competence of teachers, and stimulates their professional activity.

Key words: educational process, academic load distribution, competence, DSS, database.

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АВТОМАТИЗОВАНА СИСТЕМА УПРАВЛІННЯ НАВЧАЛЬНИМ ПРОЦЕСОМ В ЗАКЛАДАХ ВИЩОЇ ОСВІТИ

У статті розглянута проблема створення автоматизованої системи планування навчального процесу в українських закладах вищої освіти з урахуванням діючих вимог до організації навчального процесу, а також професійної компетентності викладача. Розроблена автоматизована система з використанням системи підтримки прийняття рішень (СППР) дозволяє виконувати підготовку навчальних і робочих планів, розраховувати обсяг навчального навантаження і приймати рішення щодо його розподілу між викладачами кафедри. Перевагою запропонованої системи є можливість удосконалити процес планування навчального навантаження, усунути можливі помилки, викликані людським фактором, здійснити облік компетентності викладачів, стимулювати їх професійну активність.

Ключові слова: навчальний процес, розподіл навчального навантаження, компетентність, СППР, база даних.

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АВТОМАТИЗИРОВАННАЯ СИСТЕМА УПРАВЛЕНИЯ УЧЕБНЫМ ПРОЦЕСОМ В ЗАВЕДЕНИЯХ ВЫСШЕГО ОБРАЗОВАНИЯ

В статье рассмотрена проблема создания автоматизированной системы планирования учебного процесса в украинских заведениях высшего образования с учетом действующих требований к организации учебного процесса, а также профессиональной компетентности преподавателя. Разработанная автоматизированная система с использованием системы поддержки принятия решений (СППР) позволяет выполнять подготовку учебных и рабочих планов, рассчитывать объем учебной нагрузки и принимать решения по ее распределению между преподавателями кафедры. Достоинством предложенной системы является возможность усовершенствовать процесс планирования учебной нагрузки, исключить возможные ошибки, вызванные человеческим фактором, производить учет компетентности преподавателей, стимулировать их профессиональную активность.

Ключевые слова: учебный процесс, распределение учебной нагрузки, компетентность, СППР, база данных.

Problem statement

The education system solves important problems of cultural and socio-economic development of society, because any educational institution prepares a person to be active in the political, cultural and economic life of society. Therefore, the main factor in the successful functioning of an educational institution is the competent organization of the educational process. Modern information technologies provide wide opportunities in the organization and management of the educational process. Currently, the automation of the educational process is an integral part of the activities of any educational institution that wants to have the right to be called progressive.

The educational (or learning, or academic) process – a focused interaction of the teacher and students, during which the tasks of education, development and train of students; organization of education in the relationship of all components [1]. The goal of this process in a higher educational institution is to prepare a specialist with the necessary qualifications, which is determined by both the state educational standard and market requirements. To achieve this goal it is necessary, first of all, to study the problem of control the educational process and determine its specificity.

Analysis of recent research and publications

A standard is a format approved by a competent standardization institution or accepted by industry as a sample de facto. Both equipment and software are standardized, in particular, programs used in e-learning. The most common standards in e-learning are the following:

– IEEE – Institute of Electrical and Electronic Engineers LTSC – Learning Technology Standards Committee [2];

– AICC – Airline Industry Computer Based Training Committee [3];

– IMS – Instructional Management Systems [4];

– ADL – Advanced Distributed Learning SCORM – Sharable Content Object Reference Model [5];

– ARIADNE - Alliance of Remote Instructional Authoring & Distribution Networks for Europe [6].

However, these systems automate the learning process, the process of obtaining new knowledge and skills, in electronic form. The planning of the educational process in the classical form, taking into account the specifics of the Ukrainian institutions of higher education, is absent in these systems.

The aim of the research

The aim of the study is to create an automated system for planning the educational process in Ukrainian institutions of higher education, taking into account the current requirements for the organization of the educational process, as well as the professional competence of the teacher.

Main part

When planning an educational process, an important task is the preparation of a number of documents that characterize the educational process: curriculum (academic plan), working curriculum, academic load volume per an academic year, academic load distribution among teachers of the department, a consolidated document for the academic load distribution approval. If the first document is prepared by the corresponding existing departments in institutions of higher education, then the preparation of all other documents, as a rule, is transferred to the dean's offices, which assign this work directly to the departments. This increases the amount of work done by the department staff, so it became necessary to automate this process.

In practice, most often the automation of educational planning in Ukrainian institutions of higher education is performed in software packages for automating office tasks, for example, Word or Excel. However, it is worth considering that these packages are not free of charge, and the automation process is reduced to manually filling in tables and entering text, which introduces human factors and possible errors, and the process of optimizing the academic load on the teacher is not automated at all, and some subjective criteria and methods are used .

The problem of developing an automated educational management system at a higher education institution has appeared.

The main task in planning the academic (study) load is the complete distribution of academic load hours among the teachers of the department, which can be formulated as the following objective (goal) function:

$$V = V_0 - \sum_{i=1}^{N} \sum_{j=1}^{M_i} V_{ij} \to 0 , \qquad 1)$$

where V – the number of undistributed hours; V_0 – total number of hours according to the academic load volume per year; V_{ij} – the volume in hours of each academic load type j, $i = \overline{1,N}$, $j = \overline{1,M_i}$; N – the number of teachers at the department; M_i – number of academic load types of a particular teacher i.

When planning an academic load, there are a number of limitations due to the requirements of regulatory documents:

1) the value of the teacher's rate depending on the type of employment must be in the range

$$0 < S_i \le P_k, \tag{2}$$

where S_i – the value of the teacher's rate; $P_k = \{1{,}5; 0{,}5\}$ – the maximum allowed rate for teachers of different types of employment; $k = \{1; 2\}$ – type of employment of a teacher – permanent employment or part-time, respectively;

2) the calculation of the rate depends on the minimum academic load volume per 1 rate and is calculated as

$$S_i = \begin{cases} \dfrac{\sum\limits_{j=1}^{M_i} V_{ij}}{V_l} & \text{if } \sum\limits_{j=1}^{M_i} V_{ij} \le V_{\min l}, \\ 1 + \dfrac{\sum\limits_{j=1}^{M_i} V_{ij} - V_{\min l}}{600} & \text{if } \sum\limits_{j=1}^{M_i} V_{ij} > V_{\min l}, \end{cases} \tag{3}$$

where $V_{\min l}$ – the academic load minimum volume per 1 rate of scientific and pedagogical staff per year, depending on the occupied position, according to the regulatory documents, in hours; $l = \overline{1{,}12}$. An example of the dependence of the minimum volume of hours of the academic load from the occupied position is given in Table 1.

Table 1. Minimum volume of hours of academic load dependence from the occupied position

l	Position	Minimum hours
1	Professor	450
2	Docent	500
3	Senior Lecturer	570
4	Teacher, assistant	600
5	Head of the department, professor	400
6	Head of the department, associate professor	450
7	Deputy Head of the graduate department (-10% of the academic load of the position)	0,9 $V_{\min}$
8	Rector	150
9	First pro-rector	150
10	Pro-rector	300
11	Head of structural divisions and departments	300
12	Part-time employer	600

3) Other requirements, for example, allowed number of lecture subjects for a teacher, number of students for the graduation work guidance per a teacher, the ability to teach subjects in a foreign language.

When distributing the academic load it is important to consider the competence of the teacher in satisfying the requirements in accordance with the current licensing conditions for the initiation and conduct of educational activities, which are approved at the state level by the profile ministry. Professional competence is defined as the volume of competences in the field of professional activity. In a narrower sense, professional competence is interpreted as a range of issues in which the person possesses knowledge, experience, the combination of which reflects professional qualification [7]. In the developed automated system for planning an academic load, the competence of a teacher in a specific type of academic load is determined according to an integral criterion consisting of the following 20 accepted indicators: the results of scientific activity in accordance with clauses 1-18 of licensing conditions, the compliance of base education and academic degree

with the type of academic load. To determine the integral criterion for each teacher in all disciplines, a competence matrix $\mathbf{K}^i$ must be composed in form as

$$\mathbf{K}^i = \begin{bmatrix} k_{11} & k_{12} & \dots & k_{1p} \\ k_{21} & k_{22} & \dots & k_{2p} \\ \dots & \dots & \dots & \dots \\ k_{q1} & k_{q2} & \dots & k_{qp} \end{bmatrix}, \quad (4)$$

where the elements k of the matrix $\mathbf{K}^i$ are equal to 1 or 0, depending on the presence or absence of scientific activity results, as well as compliance or non-compliance of bases education and academic degree with the type of academic load; $p = 20$ – the number of accepted indicators; q – the number of types of academic load in the total volume for distribution.

Then the integral criterion for each discipline and each teacher can be written as

$$\mathbf{G}^i = \begin{bmatrix} g_1^i & g_2^i & \dots & g_q^i \end{bmatrix}^{\mathrm{T}} = \begin{bmatrix} \frac{1}{p}\sum_{r=1}^{p} k_{1r} & \frac{1}{p}\sum_{r=1}^{p} k_{2r} & \dots & \frac{1}{p}\sum_{r=1}^{p} k_{qr} \end{bmatrix}^{\mathrm{T}}. \quad 5)$$

The data obtained as a result of the calculation of the criteria according to (5) are recorded in Table 2.

Table 2. Summary table of integral indicators

	Teacher 1	Teacher 2	…	Teacher i	...	Teacher N
Discipline 1	g_1^1	g_1^2	…	g_1^i	...	g_1^N
Discipline 2	g_2^1	g_2^2	…	g_2^i	...	g_2^N
…	…	…	…	…	...	…
Discipline q	g_q^1	g_q^2	…	g_q^i	...	g_q^N

The distribution of academic load (disciplines, etc.) is made according to the following algorithm:

1) For each discipline $m = \overline{1,q}$ from table 2, a teacher i is identified who has the maximum integral indicator $\max g_m^i$; the discipline is distributed in the academic load to the identified teacher.

2) If the maximum integral indicator has several teachers, then the discipline is distributed to the teacher to whom it was distributed in the last academic year.

3) If it is impossible to make an unequivocal choice in step 2 (for example, the discipline was not distributed to any of the teachers last year, or the discipline is distributed for the first time), then among the teachers identified in step 1, the choice is made by the decision maker (DM) – usually, this is the head of the department.

Based on the proposed method, the structure of the decision support system (DSS) is developed, shown in Fig. 1.

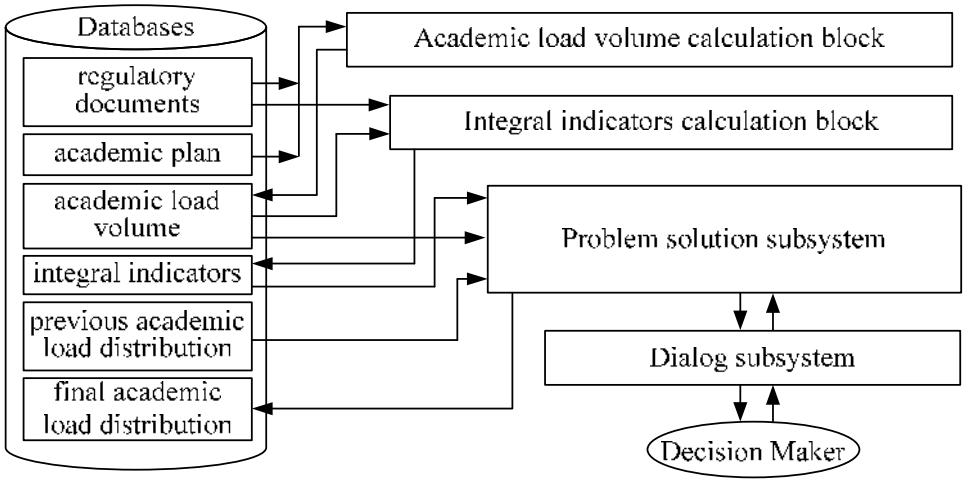


Fig. 1 – DSS structure

Visual FoxPro 9 SP2 was chosen as a tool for the DSS developing. The project includes databases (Fig. 2), screen forms of the dialogue subsystem (Fig. 3, 4), printed forms of documents (Fig. 5, 6), program code that implements the DSS calculation blocks and the problem solution subsystem.

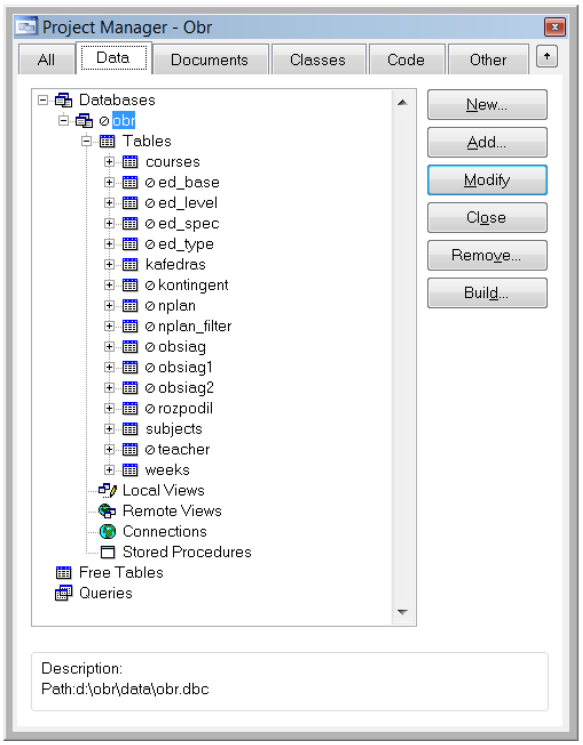


Fig. 2 – Database of the DSS project

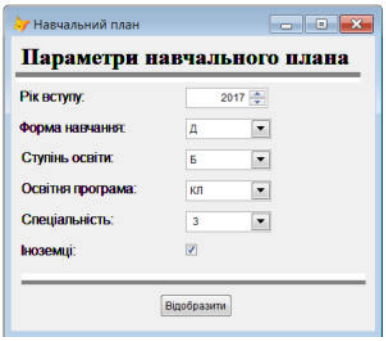


Fig. 3 – Example of the DSS screen forms – academic load request

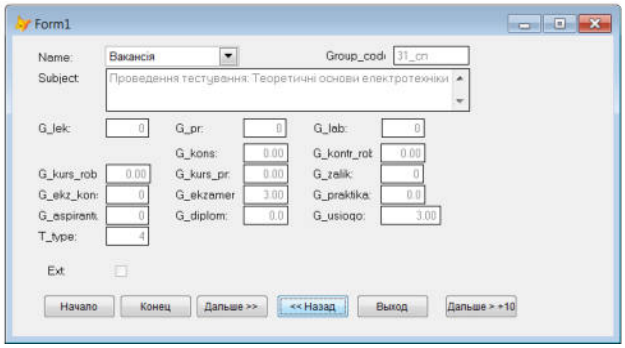


Fig. 4 – Example of the DSS screen forms – the process of distribution of academic load

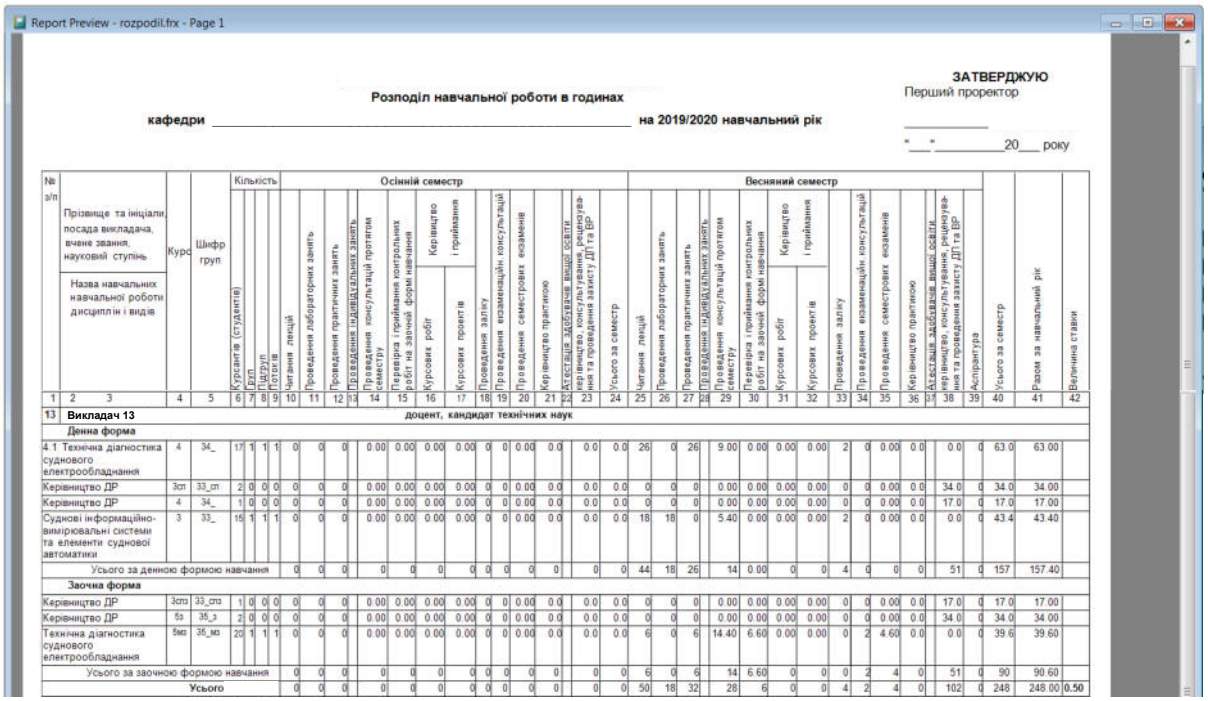
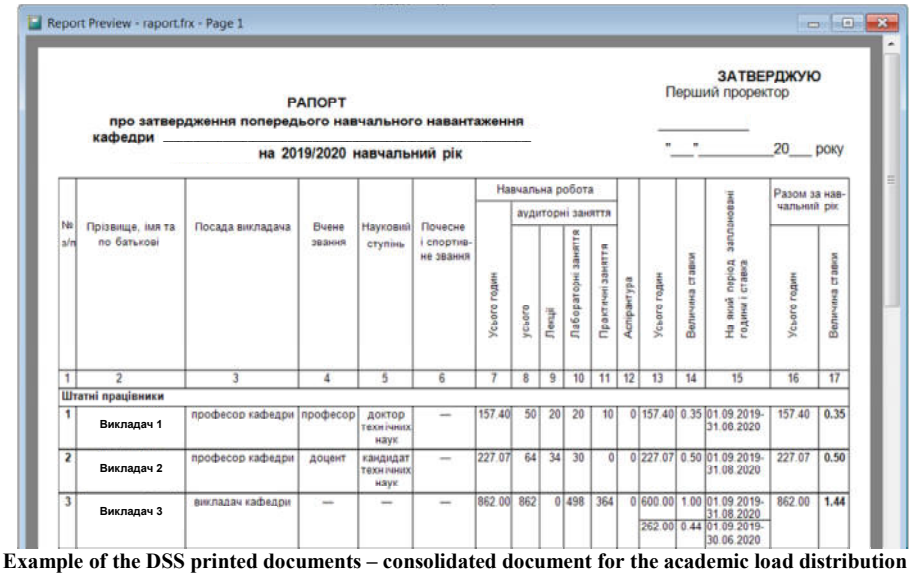


Fig. 5 – Example of the DSS printed documents – the final academic load distribution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ЗАТВЕРДЖУЮ
Перший проректор
_____
"___"_____20___ року

РАПОРТ
про затвердження попередього навчального навантаження
кафедри _____
на 2019/2020 навчальний рік

№ з/п	Прізвище, ім'я та по батькові	Посада викладача	Вчене звання	Науковий ступінь	Почесне і спортивне звання	Навчальна робота									Разом за навчальний рік	
						Усього годин	аудиторні заняття				Аспірантура	Усього годин	Величина ставки	На який період заплановані години і ставка	Усього годин	Величина ставки
							усього	Лекції	Лабораторні заняття	Практичні заняття						
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Штатні працівники																
1	Викладач 1	професор кафедри	професор	доктор технічних наук	—	157.40	50	20	20	10	0	157.40	0.35	01.09.2019-31.06.2020	157.40	0.35
2	Викладач 2	професор кафедри	доцент	кандидат технічних наук	—	227.07	64	34	30	0	0	227.07	0.50	01.09.2019-31.08.2020	227.07	0.50
3	Викладач 3	викладач кафедри	—	—	—	862.00	862	0	498	364	0	600.00	1.00	01.09.2019-31.08.2020	862.00	1.44
												262.00	0.44	01.09.2019-30.06.2020		

Fig. 5 – Example of the DSS printed documents – consolidated document for the academic load distribution approval

At the end, the user receives all the necessary documents for the planning of academic process in higher education institutions in Ukraine.

Conclusions

The developed automated system of the educational process management in institutions of higher education using the DSS allows to prepare curriculum and working curriculum, calculate the academic load volume and to make decisions on its distribution among teachers of the department. The advantage of the proposed system is that it is implemented on free software, as well as greatly eases the process of planning the academic load, eliminates possible errors caused by the human factor, provides the opportunity to take into account the competence of teachers, stimulates them for professional activity. This system can be supplemented by modules for solving other tasks, such as drawing up a schedule, taking into account the load of the auditorium fund, personnel accounting of teachers, etc.

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