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Involvement of modern information technologies to support the free choice of academic disciplines by students of higher educational institutions

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Abstract. The work is devoted to the implementation of the procedure of free choice of academic disciplines by students of higher educational institutions and the development of means of support for this choice. The main task, which is solved in the work, is the definition of methods and means of information and technological support for the free choice of academic disciplines by students. The purpose of the work is to make the process of choosing disciplines by students more transparent, convenient and understandable. The provisions on the free choice of academic disciplines of the leading institutions of higher education of Ukraine were used as sources of information. The analysis of these provisions made it possible to highlight the main stages of students' free choice of academic disciplines. On the example of the declared procedure for choosing educational disciplines of Kremenchuk Mykhailo Ostrohradskyi National University, the specified stages were detailed. The following structure was used for detailing: stage description; content of the stage; problems and contradictions that arise at the selected stage; proposals and ways of solving identified problems and contradictions. The results of the analysis of the support system for the free choice of educational disciplines are presented in the form of a decision tree. The developed decision tree contains three ways of developing a support system for the student's free choice of educational disciplines, depending on the level of automation of the process. For each development path of the support system, the final products that must be developed to achieve the selected degree of automation of the process of free choice of educational disciplines are indicated. Also, for each path of the development of such a support system, schemes for the involvement of process subjects, which are understood to mean employees of departments and the university administration, have been drawn up. The student is at the top of this process, he is the final consumer, therefore the whole system is aimed at facilitating the procedure of choosing educational disciplines from the student's point of view. Changes to the format of presenting information in the university-wide catalog of free-choice disciplines are also proposed.

Key words: individual educational trajectory; disciplines of free choice; information support system; information support; decision tree.

Залучення сучасних інформаційних технологій до підтримки вільного вибору навчальних дисциплін студентами вищих навчальних закладів

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Анотація. Робота присвячена впровадженню процедури вільного вибору навчальних дисциплін студентами вищих навчальних закладів та розвитку засобів підтримки здійснення цього вибору. Основна задача, яка розв'язується у роботі, це визначення методів та засобів інформаційної та технологічної підтримки вільного вибору навчальних дисциплін студентами. Мета роботи – зробити процес вибору дисциплін студентами більш прозорим, зручним та зрозумілим. В якості джерел інформації використовувалися положення про вільний вибір навчальних дисциплін провідних закладів вищої освіти України. Аналіз цих положень дозволив виділити основні етапи здійснення вільного вибору навчальних дисциплін студентами. На прикладі задекларованої процедури вибору навчальних дисциплін у Кременчуцькому національному університеті імені Михайла Остроградського була проведена деталізація визначених етапів. Для деталізації використовувалася така структура: опис етапу; зміст етапу; проблеми та суперечності, які виникають на вибраному етапі; пропозиції та шляхи вирішення виявлених проблем та суперечностей. Результати аналізу системи підтримки вільного вибору навчальних

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дисциплін представлені у вигляді дерева рішень. Розроблене дерево рішень містить три шляхи розвитку системи підтримки здійснення вільного вибору навчальних дисциплін студентом, в залежності від рівня автоматизації процесу. Для кожного шляху розвитку системи підтримки вказані кінцеві продукти, які необхідно розробити для досягнення вибраного ступеня автоматизації процесу вільного вибору навчальних дисциплін. Також для кожного шляху розвитку такої системи підтримки складені схеми залучення суб'єктів процесу, під якими розуміються співробітники кафедр та адміністрації університету. Студент знаходиться на вершині цього процесу, він є кінцевим споживачем, тому вся система направлена на полегшення процедури вибору навчальних дисциплін саме з точки зору студента. Також запропоновані зміни до формату представлення інформації у загально-університетському каталозі дисциплін вільного вибору.

Ключові слова: індивідуальна освітня траєкторія; дисципліни вільного вибору; інформаційна система підтримки; інформаційне забезпечення; дерево рішень.

I Introduction

Since 2005, the so-called "Bologna process" was officially introduced in Ukraine [1, 2, 3], which is based on the principles of unified assessment (credit-module system [4, 5]), academic mobility, and student-centered learning. One of the key moments of the new organization of the educational process was the formation of an individual learning trajectory [6, 7]. From a practical point of view, this means that the student must study part of the subjects, and the part he chooses himself. And in the choice student is not limited by the educational program, specialty, or level of study.

According to the legislation [8, 9, 10], elective subjects must make up at least 25% of the total volume of the educational program. The detailed structure of the complex of optional disciplines is not regulated [11]. That is, the issue of the number of credits assigned to one elective discipline, the number of elective disciplines, reporting forms, the procedure for choosing disciplines, and the procedure for forming catalogs of elective disciplines are fully resolved by higher education institutions themselves.

On the one hand, we have a clear confirmation of the autonomy of universities [12, 13], and on the other hand, a completely uncontrolled process in which aspects arise that interfere with the further implementation of full-fledged academic mobility of students.

Also, there were no proposals from state institutions (Ministry of Education, National Agency) regarding technical support for the process of free choice of disciplines. Institutions of higher education gradually evolved: they moved from block selection and departmental catalogs to faculty, institute, and university-wide catalogs [14, 15]. This logically led to an increase in the number of optional disciplines and to an increase in the volume of information that a student must process in order to make his choice. Of course, the workload on employees of departments and educational departments of universities has also increased.

Therefore, an urgent task is the development of elements of information technology supporting the free choice of academic disciplines in a higher education institution.

The purpose of the work is to make the process of choosing disciplines by students more transparent, convenient and understandable.

II Materials and Methods

According to the results of the analysis of the procedure for forming the catalog of "free choice" disciplines, several plans for improving the current system can be identified. Let's try to present it in the form of a decision tree. The starting point for building such a tree will be, surprisingly, the final stage from the student's point of view: that is, making a schedule. Most of the limitations we encountered during the study were related to the university's automated scheduling system. Our institution of higher education, like many Ukrainian higher education institutions, uses the "MKR" system (Methodical Complex Schedule).

The software complex "Automated educational institution management system" is a set of interconnected programs that provide higher education management in a single information space, and includes modules that work in the Windows environment (educational module, dean's office, applicant, methodical department, department personnel, etc.), and a WEB-portal (displaying the schedule of classes, academic performance, study plans, dormitory payment calculations, control of tuition and dormitory payments, student testing, student registration for studying disciplines, etc.). All information is stored in one common database. The main distinguishing features of the complex are the availability of a tool for independent creation of various printed

forms and statistical screen forms, which makes the automated educational institution management system almost independent of developers. The available functionality, as practice and analysis have shown, make it possible to cover virtually all individual features of higher education institutions without software modification of the code. The complex also makes it possible to create and consider individual learning trajectories of students, including through the Internet. The information presented on the site enables:

- review the list of solved tasks and basic functional capabilities;
- get access to the library of printed forms, as well as view examples of generated forms;
- view the list (history) of changes and additions in various modules of the complex, as well as download the latest version of the program (available only to registered users);
- watch video instructions for the operation of various systems and modules (available only to registered users).

According to the data of the developer's website, this system is used in the following higher education institutions with total amount of 49 names: Vinnytsia National Agrarian University; Zhytomyr National Agroecological University; Zaporizhzhia National University; Kyiv National University of Trade and Economics; Luhansk National Agrarian University; Flight Academy of the National Aviation University; Odesa State University of Internal Affairs; Poltava Law College; Sumy National Agrarian University; Uman National University of Horticulture; Kharkiv National Medical University; Central Ukrainian National Technical University.

We pay so much attention to the MKR system because most of the contradictions in the free choice of academic disciplines are related to it. In its current form, the MKR system does not allow:

- create individual student schedules considering the selected disciplines (currently, only the schedule of the academic group is added to the student's individual schedule in the system);
- automatically distribute academic subjects according to the student's individual schedule, so that there are no overlaps, so that you do not have to attend different classes at the same time.

The further development of information technology supporting the free choice of educational disciplines depends on the possibilities of modernization or the lack of this modernization of the load distribution system and the formation of the schedule [16, 17, 18].

We considered various options for the evolution of the automated system for providing the educational process at the Kremenchuk Mykhailo Ostrohradskyi National University, and proposed various types of development of the system for supporting the free choice of educational disciplines. We have identified three possible options:

- development of a programmable subsystem;
- development of a set of consolidated Google tables;
- development of a methodological support system based on the use of Excel tables.

III Results

The following selection procedure is provided at Kremenchuk Mykhailo Ostrohradskyi National University:
Stage 1.

The student goes to the website of KrNU and downloads the general university catalog using the link "List of subjects of free choice". The catalog is an archive with the name "katalog_disc_vibor_2022.rar", when unpacking it, the folder "List of disciplines of free choice" is created. This folder contains separate folders "Second (master's) level of higher education" and "First (bachelor's) level of higher education". The student chooses the desired level of higher education. Next, the selected folder contains subdirectories: "Introduction 2019", "Introduction 2020", etc. It is necessary to select a folder that corresponds to the student's year of enrollment (the year of the OPP in which the student is studying). The selected folder contains the university-wide catalog, which consists of the catalogs of all institutes and faculties that exist in KrNU.

Each directory contains:

- names of disciplines (arranged in alphabetical order);
- number of credits/hours;
- distribution of classroom hours by types of classes (class/pr/lab/sem);
- the number of hours allocated for independent work;
- the abbreviation of the department that offers this discipline for study;

– approximate semester of study of this discipline.

Catalogs are tables created in Microsoft Office.

Stage 2.

According to the above catalogs, a bachelor's student chooses 12 disciplines that he wants to study (a master's student - 5 disciplines). The student submits the list of selected disciplines to the department.

Stage 3.

The department collects lists of all selected disciplines and formulates general proposals for the educational department. The educational department analyzes the number of students who wish to study it for each academic discipline. If there is a sufficient number, the relevant discipline is approved and entered into the workload plan of the department and the general list of selected disciplines of free choice. Disciplines that have not recruited a sufficient number of students are excluded from the general list.

Stage 4.

The decision of the educational department regarding the opening of educational disciplines of free choice is reported to the departments. Departments pass this information on to the student. If the student does not find his chosen academic discipline in this list, he needs to select individual disciplines from the existing list again.

Stage 5.

Having made the final choice, the student comes to the department and writes an application to study subjects of free choice in the name of the director of the institute or the dean.

Stage 6.

The department collects all signed applications and forwards the information to the dean's office. The dean or director of the institute approves the choice made by the students.

Stage 7.

The student writes down the selected disciplines to his individual study plan.

Stage 8.

Let's highlight it separately. Since this stage takes place a month before the start of the autumn semester every year. The educational department brings disciplines to the workload of the department. The head of the department brings discipline to the teacher's workload. The schedule is being formed.

We will analyze the procedure for ensuring and implementing free choice at the university level.

Stage 1. Creation of cathedral catalogs.

Content.

Based on the analysis of the previous disciplines of the previous year and the educational and methodological developments of the department's teachers, a list of disciplines that the department offers for study is formed.

Limitation.

All catalogs are drawn up in a uniform style, according to the requirements of the educational department. Due to the features of the automated schedule formation system, disciplines that can be scheduled in parallel are indicated in the catalog.

Contradictions.

The student's options for choosing a discipline are limited. There are additional difficulties in creating a schedule. If we assume that each discipline is independent, then at the output when forming the schedule, we get an infinite combination of "overlays" and an infinite number of iterations for correcting the schedule. Also, the formation of the schedule causes additional difficulties if the student has chosen disciplines from another educational program or another educational level.

The essence of this contradiction stems from the fact that in the system the timetable is formed in relation to academic groups.

And also because of the administration's attempt to make the schedule concise, that is, so that the couples go consecutively, without breaks.

Solutions.

1. Formation of pairs of disciplines in catalogs. This method is quite unsuccessful, it is used now, and overlays with disciplines of other OPs are still found.

2. Departure from the traditional formation of the timetable based on the academic group. Instead, make a link to an established schedule with disciplines. The disadvantage of this method is that the student may have

gaps in his schedule during the day. On the other hand, the academic discipline will always be read at the same time in the same classroom. This opens up opportunities for creating specialized offices, developing visual aids, etc.

3. Mixed approach. At the same time, working time during the day is divided into three groups, for example:

- a) 2-3 pairs – mandatory disciplines,
- b) 4-5 pairs – disciplines of free choice of the first subgroup,
- c) 6-7 pairs – disciplines of free choice of the second subgroup.

As we can see, in this case, all disciplines of free choice should be divided into two subgroups. In the same way, you can use not 4-5 and 6-7 pairs, but separate days for the disciplines of the first subgroup, separate days for the second subgroup.

Offer.

In order to lay the methodological foundations for the implementation of any of the three proposed ways of eliminating contradictions, it is first necessary to change the form of reporting. Currently, the general university catalog provides the following information for each discipline: name, type of control, number of credits/hours, classroom hours, independent work, department, oriented semester.

Table 1. Current format for submitting information to the cathedral catalog

Title	Type of control	Number of credits/hours	Auditory hours	Independent work	Department	Oriented semester

In our opinion, duplicate information should be removed from the table - the type of current control, independent work in hours - because these data are the same for everyone.

Further, in our opinion, information about the direction, specialty, teacher should be added to the table. Then the table will look like this.

Table 2. Offered format for submitting information to the cathedral catalog

Code, the name of the direction	Code, the name of the specialty	The name of the educational component	Full name of the teacher	Department	Oriented semester	Distribution of hours

It is also necessary to change the format of information submission files.

We offer several approaches:

1. Submission of data in the form of an excel file with manual data consolidation to the person responsible for creating the catalog.
2. Submission through Google spreadsheets with automated data consolidation
3. Creation of a subsystem in a separate software application for data entry by representatives of departments. Verification of entered data should be configured in the system and a corresponding database should be developed.

These methods are arranged in order of increasing complexity of implementation and reliability.

It should be noted that the method with the excel-file is the simplest and does not require additional changes in the procedure of creating the general university catalog. At the same time, the involvement of process subjects does not change.

For the 2nd method, the engagement scheme will change a little (Fig. 2).

The main interaction takes place through the Google Sheets system. A group should also be provided for the communication of responsible persons (actual executors) for the prompt resolution of issues.

The heads of the department and educational HEs perform a controlling function.

If detailed rules for data verification are developed for the 3rd method, then this function can be transferred to the system (Fig. 3). Then the interaction scheme will be even simpler.

Only the introduction of excel-files is realistic for implementation during the current academic year.

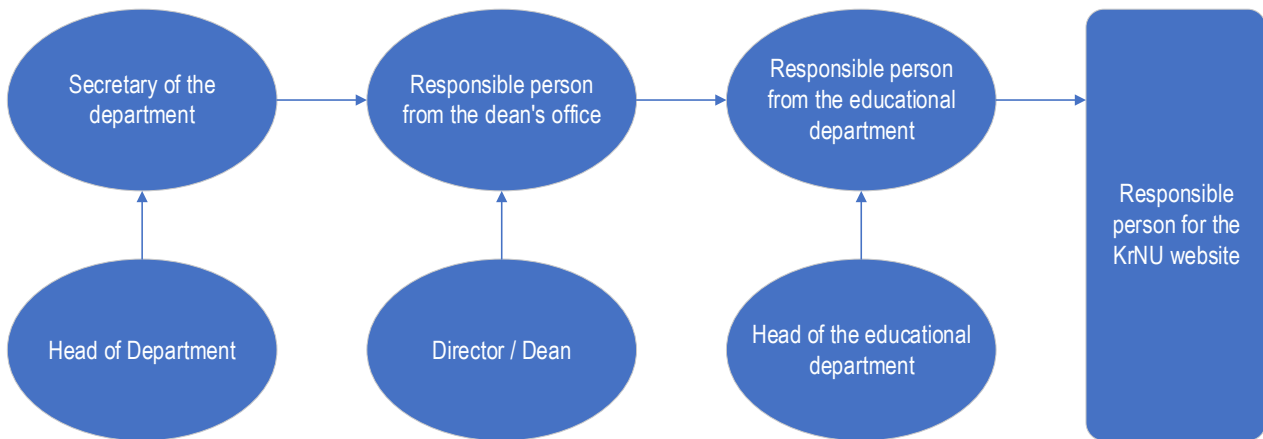


Fig. 1. Diagram of the involvement of subjects in the formation of the catalog by the First method

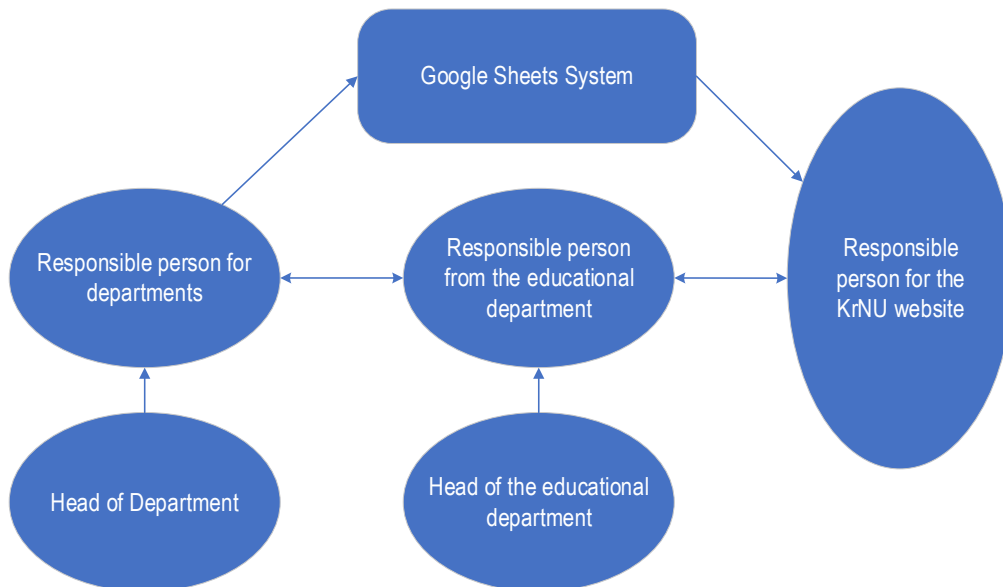


Fig. 2. Diagram of the involvement of subjects in the formation of the catalog by the Second method

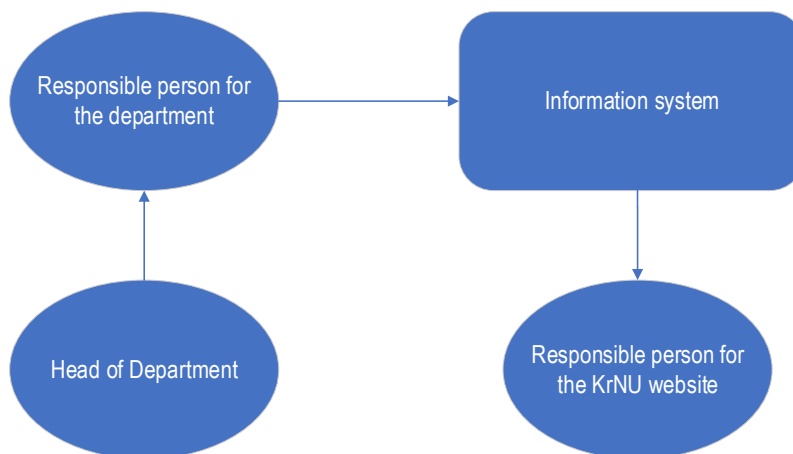


Fig. 3. Diagram of the involvement of subjects in the formation of the catalog by the Third method

Stage 2. Formation of the general university catalog

Content.

All-institutional catalogs are formed based on the data submitted by the departments. Then, on their basis, a general university catalog is formed.

Limitation.

Unlike the cathedral catalogs, the general university catalogs do not indicate disciplines that can be read in parallel. The catalog is compiled without sorting, which makes it very difficult to perceive information.

Contradiction.

Each department offers about 20 disciplines, as a result, the catalog grows to incredible sizes. The absence of any sorting at all makes it impossible to perceive information. In addition, in fact, the university-wide catalog is an archive that contains the files of the institute-wide catalogs.

It is implied that the student will download this archive, download the files of the general institutional catalogs, read them and select disciplines.

The table shows data on the number of disciplines.

Table 3. Quantitative data from catalogs

Institute	Number of disciplines
IMITPN	177
JULIT	104
FEU	105
FPGISN	180
In Total	566

Solutions.

Solution Method 1.

In the presence of excel catalogs prepared by the departments according to a single model, it is possible without any problems to compile a single catalog for the university in the form of a smart table with the possibility of automatic filtering and sorting of data. This approach will already facilitate the student's work with the data.

Solution Method 2.

Using Google Sheets. A java script can be added to the general Google table, which will automatically consolidate data from Google tables filled with departments. At the same time, the automatic data update function is immediately provided. If in the process the department found some errors in its table and corrected them, the data in the general table is updated automatically. You can also use scripts to organize automatic filtering. For example, on the first window, students will see a list of areas of training (branches). Here he can choose the fields that interest him. Then the offered specialties are automatically filtered in the next window. Further, according to the selected specialties, the student can choose the disciplines he wants to study.

Solution Method 3.

Using the software application. The logic of the 2nd method can be implemented in it. In addition, it is possible to organize the selection by semesters and with restrictions regarding disciplines that are taught in parallel. The possibility of using Google forms, but with elements of a programmable interface, should be discussed separately.

Offer.

The most realistic in terms of implementation time is the use of Google tables, but it is not possible to organize multi-user access for them. Because when a student starts going through the selection process, their filters are applied to the entire database. This can be solved only by using a separate Google sheet for a single user. Therefore, from a practical point of view, the best options are programmable Google forms or a software application.

That is why our decision tree takes the form shown in the figure 4.

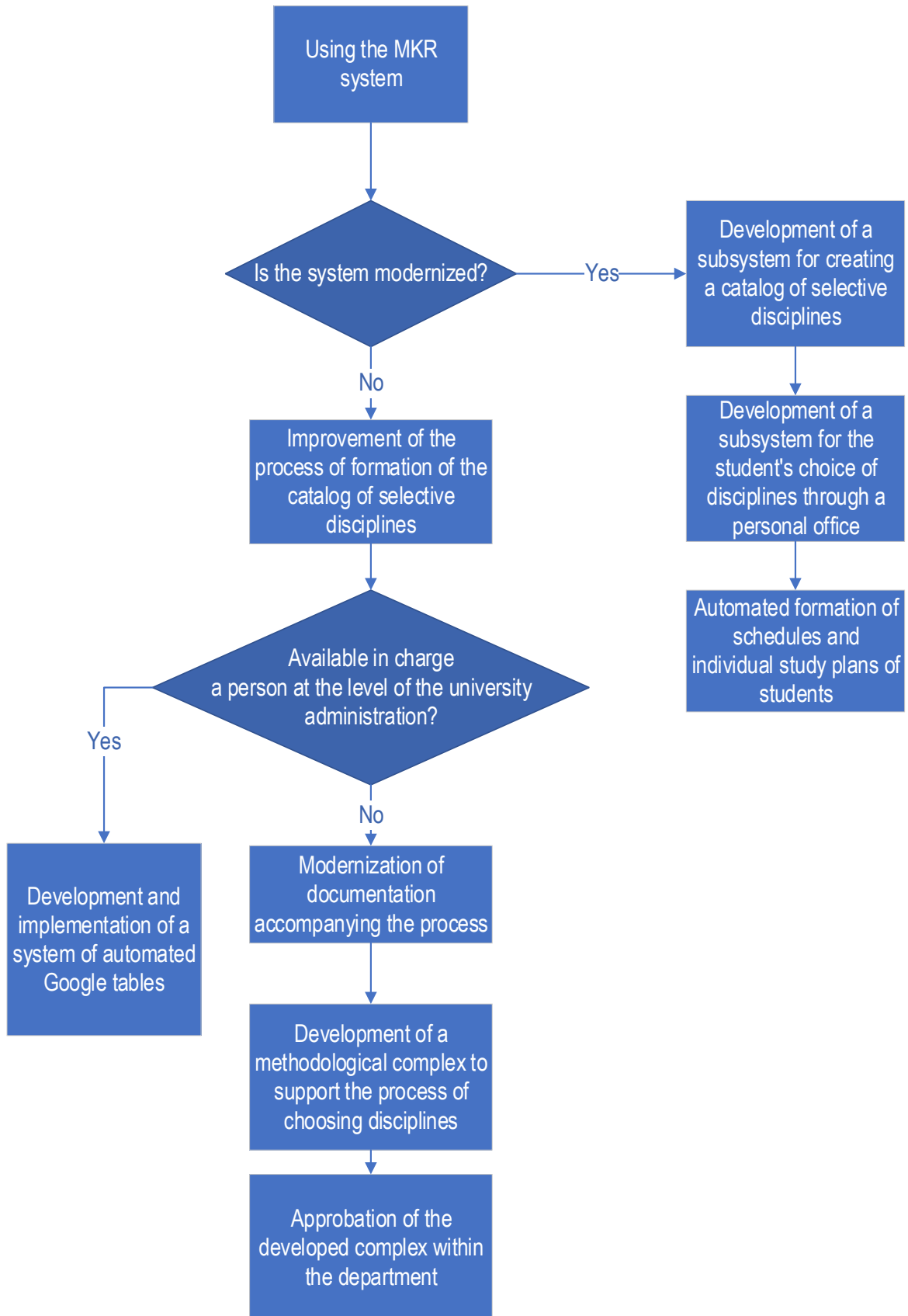


Fig. 4. Decision tree for possible modernizations of the support system for free choice of educational disciplines

IV Discussion

As a result of the analysis of the implementation of the Bologna process in Ukraine, it can be said that:

- all institutions of higher education comply with the legislative requirements regarding the implementation of the individual educational trajectory of students of higher education;
- on the websites of all institutions, relevant provisions on the free choice of academic disciplines are presented, which allows you to get an idea of the principles of implementing the procedure of free choice of academic disciplines common to all institutions of higher education.

A separate analysis of the content, accessibility to the student, and clarity of the information presented in the provisions on the free choice of academic disciplines was carried out.

- it should be noted that the procedure for choosing academic disciplines from the student's point of view is not completely clearly and transparently described in some provisions;
- in some provisions, the volume of optional disciplines is not specified, both in general and for each discipline separately;
- in some provisions, it is not specified how many academic disciplines a student can choose each semester;
- it should also be noted the almost complete absence of infographics to explain the procedure of free choice of academic disciplines.

An analysis of the provisions on free choice of a number of leading institutions of higher education in Ukraine indicates a low level of automation of this process.

According to [19, 20] the introduction of automation to the process of choosing disciplines will lead to an improvement in the quality of education in the educational institution.

V Conclusion

In general, the following conclusions can be drawn based on the results of the work:

1. The general principles of the organization of support systems for the free choice of educational disciplines are highlighted.
2. Analyzed features of the organization of free choice at our university.
3. Extraneous factors affecting the procedure of free choice of academic disciplines are identified.
4. Developed proposals for modernization of the existing system.

References

1. Benyakh, V. V. (2007). The Bologna Process in Ukraine: Thesis. URL: <http://dspace.uccu.org.ua/handle/123456789/681> (access date: 29.09.2022). [in Ukrainian]
2. Zhuravel, H. P. (2012). The Bologna Process and Ukraine. *International Scientific Bulletin*, 4 (23), p. 1., 285-292. [in Ukrainian]
3. Miroshnichenko, M. (2008). Integration of Ukraine in the Bologna process: problems and prospects. *Actual problems of international relations. European studies*, 82, p. 1., 85-89. [in Ukrainian]
4. Golovan, M. S. (2012). The European credit-transfer system as an innovative technology of training organization: Theses. URL: <http://essuir.sumdu.edu.ua/handle/123456789/63713> (date of access: 08.10.2022). [in Ukrainian]
5. Yevtukh, M. (2020). National framework of qualifications and the European transfer credit-accumulation system. *Formation of modern scientific thought*. DOI: <https://doi.org/10.36074/31.01.2020.12> [in Ukrainian]
6. Korostianets, T. (2020). Individual educational trajectory of a student: analysis of interpretations of the concept. *Humanities science*, 4(30), 73-79. DOI: <https://doi.org/10.24919/2308-4863.4/30.212557> [in Ukrainian]
7. Zhuravlyov, Yu. (2017). Individual learning trajectory. *New collegium*, 3(89), 22-26. [in Ukrainian]
8. The Law of Ukraine "On Conducting a Pedagogical Experiment on the Credit-Modular System of Organization of the Educational Process". URL: <https://zakon.rada.gov.ua/rada/show/v0048290-04#Text> (access date 29.09.2022). [in Ukrainian]
9. The Law of Ukraine "On conducting a scientific and practical seminar on the implementation of a credit-module system for the organization of the educational process". URL: <https://zakon.rada.gov.ua/rada/show/v0481290-04#Text> (access date 06.10.2022). [in Ukrainian]
10. The Law of Ukraine "On Higher Education". URL: <https://zakon.rada.gov.ua/laws/show/1556-18#Text> (access date 08.10.2022). [in Ukrainian]
11. Korol, A. (2016). Higher education of Ukraine: stages of development. *Scientific Bulletin of Mykolaiv V.O. Sukhomlynskyi National University. Pedagogical sciences*, 1(52), 93-97. [in Ukrainian]

12. Naidyonov, I. (2004). The Bologna process: cultural paradigms. *Digest of pedagogical ideas and technologies "School - Park"*, 3/4, 25-29. [in Ukrainian]
13. Cherevichnyi, G. S. (2007). Higher education of Ukraine: innovations, problems, prospects. *Science and science*, 1, 107-112. [in Ukrainian]
14. Syusko, M. M. (2013). Higher educational institution in a unified educational space: place, role, tasks. *International Scientific Bulletin*, 7 (26), 315-322. [in Ukrainian]
15. Klimenko, V. (2011). University – faculty – department – student. *High school*, 5/6, 91-98. [in Ukrainian]
16. Lutsyki, M. A. (2022). Modern institution of higher education as a research and innovation center. *Scientific works of National Aviation University. Series: Law Journal "Air and Space Law"*, 1(62), 200-209. DOI: <https://doi.org/10.18372/2307-9061.62.16501> [in Ukrainian]
17. Yo, S. H. (2021). Student's individual educational path: the essence and key aspects of organization. *Collection of research papers pedagogical sciences*, 95, 56-62.
18. Virolainen, O. (2019). Organization of the model of the freedom of choice of individual educational trajectory in the conditions of implementation of remote technology. *Young scientist*, 11(75). DOI: <https://doi.org/10.32839/2304-5809/2019-11-75-44>
19. Marushkevich, A. (2020). Ensuring the quality of education in modern higher education institutions: actual ideas? *Bulletin of Taras Shevchenko Kyiv National University. Pedagogy*, 2(12), 31-34. [in Ukrainian]
20. Vorobyova, O. (2020). Education quality assurance system: Ukrainian experience. *Humanities science*, 1(29), 259-264. DOI: <https://doi.org/10.24919/2308-4863.1/29.209322> [in Ukrainian]



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