The object of this study is the processes to form teams for educational projects. The issue addressed is the distribution of lecturers based on educational components, taking into account the complex set of functional requirements for the executors of specific educational projects. To successfully implement educational projects, it is proposed to build a reserve of personnel and form effective teams of performers who have the necessary competencies and experience in implementing international projects. A method for determining the individual competencies of executors of educational projects at institutions of higher education has been formalized. It is proposed to evaluate lecturers on the basis of their effectiveness in teaching educational components, which is measured by testing the level of assimilation of program results by students. As a result, a matrix of competences was constructed, containing the evaluations of performers, which helps the management of the institution to make decisions about the extension or termination of contracts with lecturers, as well as possible bonuses. A method for analyzing the matrix of competencies for the formation of an educational project team is to identify lecturers who have the necessary competencies to provide educational components. As a result of applying the method, a project team is formed, which is able to provide all the necessary competencies, taking into account the qualification requirements. The method helps determine the shortage of qualified personnel and the need for their development. The method was verified using an example of an educational project in Kazakhstan to form a team of lecturers that meets the qualification requirements of the educational program. The results show that even a minimum team of three people can provide all 16 competencies at an appropriate level, and the involvement of additional performers expands the possibilities of flexible distribution of responsibilities between them

Keywords: educational project, competency method, matrix of competencies, multi-university cooperation, qualification requirements

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DEVISING A METHOD FOR BUILDING AN EDUCATIONAL PROJECT TEAM BASED ON THE ANALYSIS OF COMPETENCY MATRIX

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1. Introduction

Over the past decade, improving the mechanisms for multi-university communication has become increasingly important in the national educational and research communities. This is connected with the opening of new programs for educational and scientific exchanges, educational events, new educational programs in various relevant fields of knowledge. In order to intensify the improvement of the quality of education, educational initiatives are implemented, including those of an international nature, international educational projects are created and implemented. These projects are aimed at sharing experience and implementing interactive learning methods, improving the efficiency of

knowledge acquisition and program results, etc. To ensure the success of such initiatives and the effective implementation of educational projects, the involvement of highly qualified performers whose competencies meet the needs of a specific educational project is required [1].

The most significant difficulty that arises on the way to the implementation of educational projects is the shortage of highly qualified human resources, that is, executors of educational projects. This is due to a significant outflow of university employees with scientific degrees and relevant qualifications abroad. In particular, in Ukraine, this outflow increased with the beginning of a full-scale war. Another difficulty is the need to internationalize educational programs through the involvement of foreign students in training. This task is also related to the search for qualified employees who have not only a sufficient level of competence but also experience in the implementation of international projects and programs and an appropriate level of English.

Therefore, under such conditions, in particular given the turbulence in the external environment, the involvement of performers for the effective implementation of educational projects should be carried out on a permanent basis. Reserves of potential project executors or scientific and pedagogical workers should be built, which can be involved in these projects in the case of unforeseen circumstances. The difficulty of establishing a connection between the functional duties provided for by the educational project and the level of competence of its potential executors is complicated by the shortage of scientific and pedagogical workers. In addition, an important task today is to devise conceptual foundations for the openness of future research, in particular in the field of education [2]. This is manifested, among other things, through the involvement of competent specialists from various fields in these studies and advancement of innovations. Therefore, in order to solve the problem related to devising methods for managing human resources within an educational project, it is relevant to develop methods for forming its effective team. In particular, methods that would take into account the set of competencies of performers and a complex set of functional requirements for performers of specific educational projects.

2. Literature review and problem statement

The tasks of human resource management and the formation of a team of project executors are relevant on the one hand in terms of the creation of new startups, organizations, and the revitalization of the innovation market. On the other hand, it is relevant under conditions of extreme activities (military conflict, pandemic, economic crisis, etc.). The market is constantly transforming, so it is important that the functional tasks of the projects and the competence of human resources correspond to this transformation. In particular, it is stated in work [1] that the effective operation of organizations and technological innovations within them directly depend on high requirements for the selection of human resources. The evolution of human resources management methods is connected with the development of information technologies. In [3], it is stated that the construction of automated management systems makes it possible to maintain a proper management climate, recruit personnel, and establish systems of control and motivation of employees. In study [4] it is described that owing to the use of information technologies for human resources management systems, tasks can be solved more strategically, efficiently, and flexibly in a client-oriented manner. An overview of human resource management technologies is given in [5]. In this case, it is argued that the development of this direction is important under conditions of uncertainty and risk, when the use of human resource management methods with predictable consequences is difficult. In work [6] it is indicated that the use of personnel management methods makes it possible to automate routine tasks, such as salary processing, administration, and transactional actions; accordingly, personnel specialists can freely focus on more strategic issues, such as increasing the productivity of the organization.

The main concept in forming a team for projects, including educational ones, is an attempt to evaluate potential project participants before the project is implemented. Works [2, 7] present the concept of evaluating potential project participants. It is claimed that such an assessment allows for a mathematically justified choice of project executors and increases the effectiveness of projects. In papers [6, 7], emphasis is on the features of the construction of the project team, but it is not indicated how the competencies of potential executors can affect the effectiveness of the project. It is believed that the competence approach to the formation of an educational project team is decisive for the effectiveness of educational programs and the effectiveness of the provision of educational services by the relevant institutions of higher education.

Another feature in the implementation of educational projects under turbulent conditions is the involvement of project executors remotely. In particular, work [8] describes the approach for forming such project teams, which are distributed territorially in different countries. In addition, maintaining a high level of diversity of their participants is important when forming project teams. In [9], it is indicated that for devising new ideas in projects it is important to support the diversity of their executors. A similar concept is also described in [10], which shows the influence of the diversity of project executors on the development and effectiveness of the project. However, studies [9, 10] do not detail how diversity is correlated with the level of competence of performers.

Competency methods play a key role in managing human resources and building project teams. In work [11], a review of competence approaches, which are used for the effective operation of organizations, was carried out. The results of study [11] show that further competency studies should consider different groups of workers and industries and expand the set of competencies. In this case, the fact that the list of competencies possessed by the project executor may change was not separately investigated. This is a consequence of rapid technological changes and increased demand for self-improvement and self-learning. Work [12] examines processes and methods for competence development in a specific field of knowledge, and also indicates the importance of employee competence development for modern practices in any organization. However, the work does not examine the principles of forming competency requirements for the team of a new project or projects. This especially applies to educational projects related to the creation and implementation of new relevant educational programs taking into account new technologies, elements of internationalization, etc.

The development of digital competences in training systems is a related topic for the task of forming the organization's personnel. After all, many companies offer their own training systems with the subsequent selection of trainees for vacant positions. In work [13] the concept of formation of digital

competences in education systems is described. In this case, it should be noted that effective assimilation of the appropriate level of competences is possible under the condition of high-quality construction of the educational space. Work [14] describes the process of formation of the educational space using an example of training computer game developers. In this case, an integral component of the space is the competence of lecturers of the relevant educational components who ensure the quality of the program learning results. The construction of educational project teams based on a competence method should take into account the peculiarities in the formation of competences themselves. The general concept for building a methodical competence formation system is described in [15]. However, the work does not show the connection between the formation of methodological competence among students and the construction of educational project teams. Formation of management personnel to increase the effectiveness of project team management is described in [16]. In this case, special emphasis is on the automation of this process. In particular, work [17] describes the process of assessing the level of assimilation of program results under dynamic conditions, which can also be used to form the composition of executors of educational projects. After all, the quality of assimilation of program learning outcomes of educational components by students is related to the qualification and level of competence of lecturers of these components.

Research into the area of forming the composition of project executors, in particular educational projects, using a competence approach, is mostly aimed at the local selection of the project manager, or filling vacant positions. Work [18] describes the model of competences of the project manager for the informatization of education, which has its own unique interdisciplinary features. Paper [19] describes the game task of assigning personnel to work on projects based on the ontological approach. However, such tasks are difficult to automate and require computing resources. When devising new educational projects, it is very important to quickly build a team, taking into account the limitations of available human resources and functional requirements for performers. This is a problem that needs to be solved.

The task of assigning executors to the project as a discrete combinatorial task was described in [20, 21], which, in particular, has application under conditions of turbulence in the external environment. That is, work [20] proposes an algorithm that combines binary programming with scenario planning and applies the optimism coefficient, which describes the attitude of the project manager to risk. The application of the general assignment problem to tasks in the field of education was reported in [22]. In [23], the specified task was described in application to the management of educational projects that take into account the development of educational programs. In work [23], the strategic importance of individual knowledge in less represented fields is taken into account. It aims to improve the overall quality of education in multidisciplinary programs.

Based on our review, one may conclude that the problem of research that needs to be solved is the distribution of lecturers based on educational components that are part of educational projects. In this case, a complex set of functional requirements for the executors of these projects must be taken into account. The majority of studies on the construction of educational project teams do not take into account the competence criteria of selection or consider them indirectly. In the case of forming a team of educational projects, taking into account the competencies of the performers is extremely important. Firstly, due to the complexity of the functional requirements for performers in such projects, and secondly, due to the fact that the irrational choice of performers for the team of educational projects can affect the effectiveness of the higher education institution.

3. The aim and objectives of the study

The purpose of our work is to devise a team selection method for the implementation of an educational project based on analyzing the matrix of competencies. This will make it possible to increase the efficiency and effectiveness of project implementation and, accordingly, to improve the efficiency of higher education institutions at which these projects are implemented.

To achieve the goal, it is necessary to complete the following tasks:

– to formalize the individual competences of performers, corresponding to the functional parameters of the tasks within the limits of a specific educational project;

– to describe a method for analyzing the matrix of competences and its application for the construction of an educational project team;

– to verify the method for selecting team members for the educational project using the competency matrix on a model example.

4. The study materials and methods

An educational project is a project that is devised and implemented at institutions of higher education and whose main purpose is training, retraining, and improving the qualifications of students at educational courses or programs. Accordingly, the educational project was considered as an educational program or a set of programs that include various educational components, each of which makes it possible to learn program results and for each of which one or more performers or scientific and pedagogical workers can be responsible. An important component of the effective implementation of such projects is taking into account changes in the competencies of their executors, that is, the list of competencies is not static.

The object of our study is the processes associated with the formation of a team for educational projects, in particular those that involve the introduction of educational programs into the educational process. The formation of the team is proposed to be carried out on the basis of analysis of the matrix of competencies. The research hypothesis assumes that based on a competency matrix analysis method, it is possible to optimize the distribution of lecturers by educational components, taking into account their professional skills and qualification levels. This will improve the quality of the educational process at the institution of higher education, increase the effectiveness of educational projects, and also determine the need for additional personnel or retraining of lecturers.

The work is based on the descriptions of the English-language educational programs at the Department of Computing and Data Science, Astana IT University, "6B06101 "Computer Science", "6B06103-Big Data Analysis", "6B06107 Mathematical & Computational Science". The staffing of this department and other departments that provide these

programs was analyzed. Information about personnel is personal, so the details of this part of the study are not disclosed. Along with this, the analyzed information and the described method are used to introduce a new master's level educational program. This is important under conditions of shortage of human resources with the required level of competence.

In the considered project to launch the educational process, according to one of the educational programs presented above, 16 educational competencies reflected in the educational program were selected. The team was built on the basis of 10 full-time employees of the department. Based on the analysis of previous activities of these lecturers, a matrix of competencies of the performers of these educational components was constructed (Table 1).

Table 1

Matrix of performers' competencies

F / R	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	4	0	0	0	3	0	0	0	0	5	0	5	3	0	0	2
2	3	0	2	5	4	2	0	2	5	2	1	0	0	0	4	3
3	0	5	4	5	0	1	4	2	3	1	0	0	0	3	0	0
4	0	5	0	1	0	2	0	0	0	4	4	0	0	0	2	0
5	3	0	0	3	0	3	2	0	1	0	5	0	1	2	1	4
6	0	0	0	5	0	5	0	1	0	0	1	0	0	2	0	0
7	4	3	0	3	5	0	0	0	0	0	2	1	3	0	0	0
8	0	1	3	0	0	2	0	0	5	0	2	0	3	0	0	0
9	3	3	0	1	0	4	5	0	2	0	2	0	3	0	3	2
10	0	0	1	0	5	0	0	0	3	5	4	0	4	0	0	0

According to the method for analyzing the matrix of competences and its application to the formation of the team for an educational project, the matrix of correspondence K is defined (Table 2).

Table 2

Matrix of compatibility of performers

F / R	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	1	0	0	0	1	0	0	0	0	1	0	1	1	0	0	1
2	1	0	1	1	1	1	0	1	1	1	1	0	0	0	1	1
3	0	1	1	1	0	1	1	1	1	1	0	0	0	1	0	0
4	0	1	0	1	0	1	0	0	0	1	1	0	0	0	1	0
5	1	0	0	1	0	1	1	0	1	0	1	0	1	1	1	1
6	0	0	0	1	0	1	0	1	0	0	1	0	0	1	0	0
7	1	1	0	1	1	0	0	0	0	0	1	1	1	0	0	0
8	0	1	1	0	0	1	0	0	1	0	1	0	1	0	0	0
9	1	1	0	1	1	1	1	0	1	0	1	0	1	0	1	1
10	0	0	1	0	0	0	0	0	1	1	1	0	1	0	0	0

Appointing lecturers based on their competencies makes it possible to select lecturers who best meet the needs of a specific group of students. Owing to a more efficient distribution of lecturers, it is possible to optimize the use of university resources.

The evaluation of the competence of lecturers is carried out on the basis of clearly defined criteria, which minimizes the influence of subjective factors on the evaluation process. Owing to this evaluation, after each certification, the lecturer receives updated evaluations of competence indicators and can be involved in new educational projects or excluded from the educational process (Table 3).

Table 3

Comparison of conventional methods og personnel selection for the implementation of educational projects with the method based on indicators of competence

Criterion	Conventional methods	Competence assessment method
Focus	Seniority, scientific degrees, experience	Student learning results (attestation results, test results, knowledge slices)
Source of information	Colleagues, administration	Students, objective data (survey results, questionnaires)
Stimulation of development	Limited	High
Objectivity	Low	High

The appointment of lecturers for the implementation of educational projects based on indicators of competence is a more effective approach that makes it possible to improve the quality of education and ensure a more objective assessment of the work of lecturers. For the successful implementation of this approach, it is necessary to devise clear criteria for assessing competence, in particular, to emphasize the educational components within a specific educational program in which they should be involved; ensure the transparency of the lecturer evaluation process by students and create conditions for the continuous professional development of lecturers.

5. Results of investigating the formation of an educational project team

5. 1. Formalization of individual competence parameters of performers corresponding to functional characteristics

At institutions of higher education, a large number of educational and research projects are as a rule carried out simultaneously. For all these projects, it is necessary to implement the involvement of executors, in particular scientists and experts in specific fields of knowledge and lecturers. The effectiveness of the functioning of this institution depends on the quality distribution of executors for implementing the tasks of these projects, taking into account the human resources available at the institution of higher education.

Institutions of higher education are denoted by U_i, $i=\overline{1,m}$. Let educational projects mean the preparation of educational and educational-scientific degree holders in a specific field of knowledge. For example, it can be a project to train PhD candidates in computer science, etc. The methodology for formalizing the competences of the executors of research projects will be based not only on the relevant qualifications reflected in a specific educational program as educational components but also take into account, first of all, scientific productivity. For educational projects in the presented formalization, it was taken as a basis not to take into account the level of knowledge of the executors of these projects or the lecturers of the relevant educational components but the level of assimilation of the program results by the students of these educational components taught by these lecturers – participants in the educational project.

Assuming:

$$R^i = \left(R_1^i, R_2^i, \ldots, R_v^i\right), i = \overline{1,m}, \quad (1)$$

R^i – project executors for a higher education institution U_i, R_k^i – executor of the educational project, i.e., a scientific and pedagogical employee at a higher education institution U_i, $i = \overline{1,m}$, $k = \overline{1,v}$. Each executor R_k^i will be matched with a tuple of assessments of the productivity or quality of his/her teaching of educational components in a specific educational project. The grades are obtained as the average values of grades based on the results of independent testing of the level of assimilation of the program results of educational components taught by the performer as a scientific and pedagogical worker. That is, each R_k^i corresponds to a tuple of t_k elements, where t_k is the number of educational components taught by the performer R_k^i, $i = \overline{1,m}$, $k = \overline{1,v}$:

$$\left\langle K_1^{k,i}, K_2^{k,i}, \ldots K_{t_k}^{k,i} \right\rangle, \quad (2)$$

$K_j^{k,i} \in [0,100]$ – numerical evaluation of the performer R_k^i, $j = \overline{1,t_k}$.

These numerical evaluations of the performer can be his/her professional competence in terms of teaching the educational components of the program, which is determined by independent testing of the trainees. It is clear that this is only one of the components of competence; however, in educational projects, the purpose of which is the training of students, the result is the assimilation of relevant program results by students; therefore, this component was chosen as the basis for calculating the assessment of competence.

Assuming $\left\langle Y_1^i, Y_2^i, \ldots Y_y^i \right\rangle$ are all the educational components that are taught at the institution of higher education U_i, then it is possible to build a matrix of competencies of all performers or lecturers of these educational components, which will consist of average evaluations of competencies:

$$\Delta_i = \begin{pmatrix} K_1^{1,i} & K_2^{1,i} & \cdots & K_y^{1,i} \\ K_1^{2,i} & K_2^{2,i} & \cdots & K_y^{2,i} \\ \vdots & \vdots & \ddots & \vdots \\ K_1^{v,i} & K_2^{v,i} & \cdots & K_y^{v,i} \end{pmatrix}, \quad (3)$$

where $K_j^{k,i}$ is the assessment of the competence of performer k from university U_i for educational component j, if $K_j^{k,i} = 0$, the lecturer does not teach this educational component.

If:

$$\tilde{K}^{k,i} = \frac{1}{t_k} \sum_{j, K_j^{k,i} \neq 0} K_j^{k,i}, \quad (4)$$

where $\tilde{K}^{k,i}$ is the average value of competency ratings for lecturer k.

If we set a certain quality threshold N, then one can determine the following recommendation for the head of the HR department at a higher education institution:

1. If $\tilde{K}^{k,i} > N$, the lecturer continues to work at a higher education institution.

2. If $\tilde{K}^{k,i} < N$, the lecturer is considered as a candidate for contract termination or contract non-renewal.

3. If N is close to 100, then one can consider the option of rewarding the lecturer for excellent work (Table 4).

Table 4

Interpretation of values of competence assessments $\tilde{K}^{k,i}$

No.	$\tilde{K}^{k,i}$	Interpretation
1	(0, 35]	Termination or non-renewal of the contract
2	[35, 59]	The contract may not be renewed
3	[60, 74]	It is possible to extend the contract
4	[75, 89]	Contract extension
5	[90, 100]	Contract extension, bonuses

The organization of HR department work involves the following steps (Fig. 1):

1. Evaluation of the qualifications of those lecturers at the institution of higher education who can be involved in teaching.

2. Involvement of lecturers in teaching educational components.

3. Formation of groups of listeners for specific projects.

4. Intermediate and final testing of trainees to assess the level of assimilation of program results that correspond to the project.

5. Averaging test results and their comparison with the competence of lecturers. Averaging the values of lecturers' competence assessments.

6. If the average values of competencies exceed the threshold, the lecturer continues to work. If the average values of competencies are less than the threshold value, then a decision is made to terminate the contract with the lecturer or take other action.

That is, on the basis of the described interpretation of the values of competence assessments, it is possible to select the executors of educational projects who meet the functional parameters of the tasks within the framework of the educational project. The next task is a detailed analysis of the matrix of competencies and characteristics of potential performers in order to solve the problem of their selection as a member of the team of educational projects.

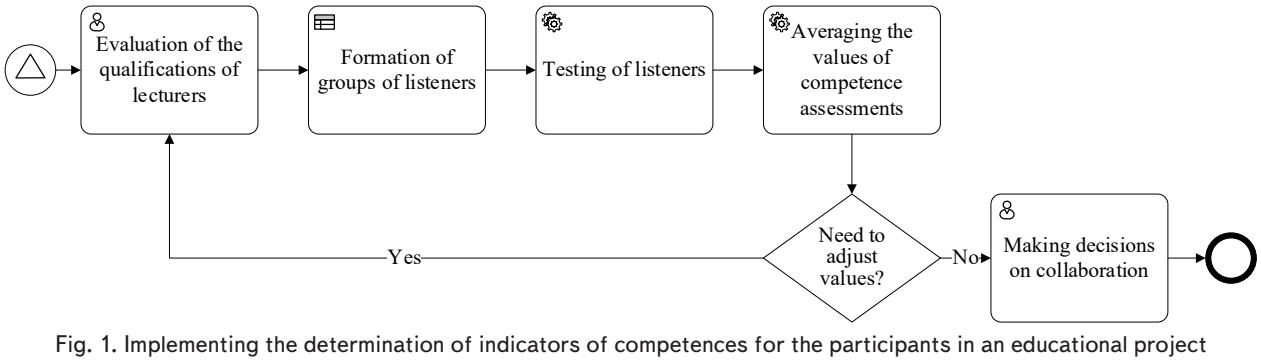

Fig. 1. Implementing the determination of indicators of competences for the participants in an educational project

5. 2. Method for analyzing the matrix of competences and its application to form the team of an educational project

Educational projects usually contain the tasks of teaching certain educational components, which are necessary to ensure the acquisition of certain competences. To teach the relevant educational component, the lecturer must possess all the competencies that the relevant educational component provides at a high level. Accordingly, it is necessary to design competencies in detail before forming an educational project team, which will represent the sequence of implementation of project tasks in accordance with the defined educational components [24].

Each of the lecturers, who can be involved in conducting classes involving individual educational components, as a member of the project team, possesses a set of competencies in accordance with individual characteristics. These competencies correspond to the needs of providing educational components implemented during the implementation of the project.

To simplify the model, it is assumed that each educational component ensures the acquisition of one competence by learners. It is also considered that the educational project is implemented only by one university U_i. Then, as was indicated in chapter 5. 1:

– $R=\left\{R_1^i, R_2^i, ..., R_v^i\right\}$ – number of lecturers who can be involved in the implementation of an educational project, v – their number;

– $F=\left\{f_1^i, f_2^i, ..., f_y^i\right\}$ – a set of competencies in the project that must be provided for, where y is the total number of competencies.

For each lecturer, the matrix of compliance with competencies Δ is established (Table 5). If the lecturer R_k^i has competence f_l^i, then $\delta_{kl}=1$, otherwise $\delta_{kl}=0$.

The matrix of competences of performers Δ indicates the individual characteristics of each potential participant in an educational project. In order to determine a specific lecturer who will provide educational components, a set of options for distribution representations between the performers involved in the implementation of the project are formed, which are described by matrix H (Table 6). If the lecturer R_k^i within the educational project provides educational component Y_l^i, then $h_{kl}=1$, otherwise $h_{ij}=0$.

Table 5

Compliance matrix of performers' competencies

R \ F	f_1^i	f_2^i	...	f_l^i	...	f_y^i
R_1^i	δ_1^1	δ_2^1	...	δ_l^1	...	δ_y^1
R_2^i	δ_1^2	δ_2^2	...	δ_l^2	...	δ_y^2
...	...	...	...	...	...	...
R_k^i	δ_1^k	δ_2^k	...	δ_l^k	...	δ_y^k
...	...	...	...	...	...	...
R_v^i	δ_1^v	δ_2^v	...	δ_l^v	...	δ_y^v

Table 6

Assignment matrix

R \ F	f_1^i	f_2^i	...	f_l^i	...	f_y^i
R_1^i	h_{11}	h_{12}	...	h_{1l}	...	h_{1y}
R_2^i	h_{21}	h_{22}	...	h_{2l}	...	h_{2y}
...	...	...	...	...	...	...
R_k^i	h_{k1}	h_{k2}	...	h_{kl}	...	h_{ky}
...	...	...	...	...	...	...
R_v^i	h_{v1}	h_{v2}	...	h_{vl}	...	h_{vy}

The result of involving lecturers for the team in an educational project is achieved with the help of the set $P=\{p_1, ..., p_v\}$, where:

$$p'_k=\sum_{l=1}^{y} p_{kl},\ k=\overline{1,v}. \quad (5)$$

At $p_k>0$, $k=\overline{1,v}$, it is possible to involve the lecturer R_k^i, as a member of the team for implementing an educational project, and the indicator p_i is responsible for the number of educational components that the lecturer R_k^i can provide. The total number of lecturers included in the project team as executors is determined from the formula:

$$b=\sum_{k=1}^{y} sign\left(p'_k\right). \quad (6)$$

Owing to the analysis of indicators of the competence of educators, it is possible not only to select participants for specific educational projects but also to determine the extension of contracts, revise employment contracts, involve in retraining or internships. Project managers (these can be heads of departments, deans, guarantors of educational programs) during selection may identify critical areas and limited resources that prevent the quality implementation of educational projects or their scaling, as there is a need to attract performers with special qualification parameters or search for new labor resources with appropriate qualifications.

5. 3. Verifying the method to form an educational project team based on the analysis of competence matrix

To verify the method for forming a team for an educational project based on the analysis of the competency matrix, we shall consider its application using an example of forming a team for an educational project at Astana IT University (Republic of Kazakhstan). The purpose of the educational project was to launch the educational process for educational programs at the master's level. Descriptions of educational programs of the department of computing and data science of Astana IT University were analyzed: "6B06101 "Computer Science", "6B06103-Big Data Analysis", "6B06107 Mathematical & Computational Science". The task was to build a team of lecturers for these educational programs. In this case, each of the lecturers, who can be involved in conducting classes on individual educational components, as a member of the project team, possesses a set of individual competencies. These competencies are compared with the needs of providing educational components implemented during the implementation of the project.

On the basis of the matrices of performers' competences and the compatibility of performers (Tables 1, 2), rules were established for determining performers who can provide the competence $F(R, l)$ with all possible employees $j=1, ..., y$:

$$F(R,1)=\left(\delta_1^1 \vee \delta_2^1 \vee \delta_5^1 \vee \delta_7^1 \vee \delta_9^1\right);$$

$$F(R,2)=\left(\delta_3^2 \vee \delta_4^2 \vee \delta_7^2 \vee \delta_8^2 \vee \delta_9^2\right);$$

$$F(R,3)=\left(\delta_2^3 \vee \delta_3^3 \vee \delta_8^3 \vee \delta_{10}^3\right);$$

$$F(R,4)=\left(\delta_2^4 \vee \delta_3^4 \vee \delta_4^4 \vee \delta_5^4 \vee \delta_6^4 \vee \delta_7^4 \vee \delta_9^4\right);$$

$$F(R,5)=\left(\delta_1^5 \vee \delta_2^5 \vee \delta_7^5 \vee \delta_9^5\right);$$

$$F(R,6)=\left(\delta_2^6\vee\delta_3^6\vee\delta_4^6\vee\delta_5^6\vee\delta_6^6\vee\delta_8^6\vee\delta_9^6\right);$$

$$F(R,7)=\left(\delta_3^7\vee\delta_5^7\vee\delta_9^7\right);$$

$$F(R,8)=\left(\delta_2^8\vee\delta_3^8\vee\delta_6^8\right);$$

$$F(R,9)=\left(\delta_2^9\vee\delta_3^9\vee\delta_5^9\vee\delta_8^9\vee\delta_9^9\vee\delta_{10}^9\right);$$

$$F(R,10)=\left(\delta_1^{10}\vee\delta_2^{10}\vee\delta_3^{10}\vee\delta_4^{10}\vee\delta_{10}^{10}\right);$$

$$F(R,11)=\left(\delta_2^{11}\vee\delta_4^{11}\vee\delta_5^{11}\vee\delta_6^{11}\vee\delta_7^{11}\vee\delta_8^{11}\vee\delta_9^{11}\vee\delta_{10}^{11}\right);$$

$$F(R,12)=\left(\delta_1^{12}\vee\delta_7^{12}\right);$$

$$F(R,13)=\left(\delta_1^{13}\vee\delta_5^{13}\vee\delta_7^{13}\vee\delta_8^{13}\vee\delta_9^{13}\vee\delta_{10}^{13}\right);$$

$$F(R,14)=\left(\delta_3^{14}\vee\delta_5^{14}\vee\delta_6^{14}\right);$$

$$F(R,15)=\left(\delta_2^{15}\vee\delta_4^{15}\vee\delta_5^{15}\vee\delta_9^{15}\right);$$

$$F(R,16)=\left(\delta_1^{16}\vee\delta_2^{16}\vee\delta_5^{16}\vee\delta_9^{16}\right).$$

Having analyzed the sets of indicators of personnel competence in accordance with the educational components implemented in an educational project, one may conclude that competences 7, 8, and 12 reveal the most limited number of employees who can provide them. In this case, competency 11 has the largest number of alternative performers, which provides more opportunities to construct different sets of performers. Therefore, each of the presented lecturers can provide a certain list of competencies at the appropriate level.

The value of characteristics of each of the 10 lecturers is graphically represented in accordance with the 16 competencies defined in the project (Fig. 2).

For certain educational projects, the level of qualification of the performer may be limited not only by his/her availability but also by a certain numerical value. For example, to attract an executor to provide educational services for the third level of education, it should be much higher than for providing education of the first educational level – a bachelor's degree. The imposition of such restrictions determines the minimum value of the qualification level in accordance with a specific project (Fig. 3). Accordingly, when imposing a certain minimum level of competence admission, only those performers who have reached the threshold value are taken into account.

When selecting performers for an educational project, it is necessary to group the competencies possessed by several lecturers. A mandatory condition for building a team for project implementation is the presence of at least one executor who provides each educational component presented in the project. For the implementation of each educational project, it is necessary to immediately determine the parameters of the limitations of the minimum value of the educational component to allow the performer to be involved in this work. A restriction was imposed that to ensure competences 3 and 4 require a characteristic value of at least 2; for competencies 7 and 9 – at least 3; and for competencies 1.5 and 12 – at least 4. Such restrictions determine that certain educational components of the project require special qualifications of the executor. Separately, one can impose certain conditions on the entire project in general (for example, the level of English language proficiency).

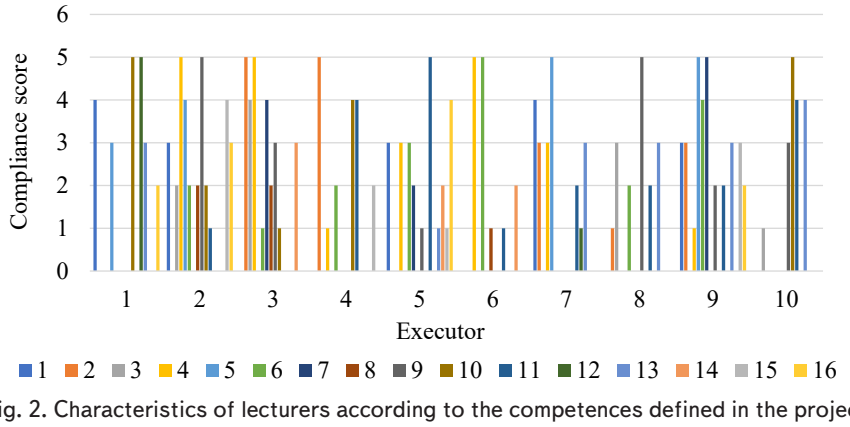

Fig. 2. Characteristics of lecturers according to the competences defined in the project

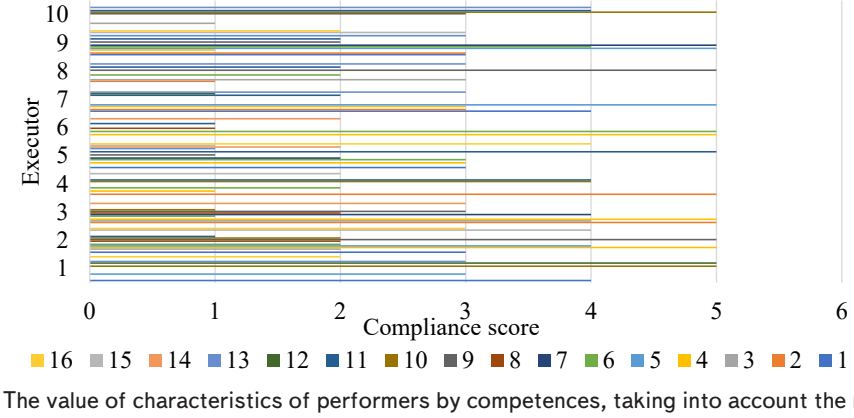

Fig. 3. The value of characteristics of performers by competences, taking into account the minimum permissible level of qualification

Sets of possible representations of educational project teams were generated, when the educational component can be provided by those lecturers who possess a certain level of value of the characteristic. However, multiple executors with appropriate levels of competence may be alternative solutions for appointing executors. That is, teams will be formed from the minimum number to the involvement of all available lecturers for the implementation of the project with the mandatory condition that all educational components of the project are provided by executors with the necessary qualifications.

According to the above requirements, employee 1 must participate in the project since only his/her qualifications meet the set limits for competence 12. In this case, employee 1 cannot provide competence 5 in the project since his/her qualification level does not meet the established requirements.

Option 1:

$$F(R,1)\times F(R,2)\times F(R,3)=$$
$$=\left(\delta_1^1\vee\delta_{10}^1\vee\delta_{12}^1\vee\delta_{13}^1\vee\delta_{16}^1\right)\times$$
$$\times\left(\delta_3^2\vee\delta_4^2\vee\delta_5^2\vee\delta_6^2\vee\delta_8^2\vee\delta_9^2\vee\delta_{10}^2\vee\delta_{11}^2\vee\delta_{15}^2\vee\delta_{16}^2\right)\times$$
$$\times\left(\delta_2^3\vee\delta_3^3\vee\delta_4^3\vee\delta_6^3\vee\delta_7^3\vee\delta_8^3\vee\delta_9^3\vee\delta_{10}^3\vee\delta_{14}^3\right)=$$
$$=\delta_1^1\vee\delta_2^3\vee\delta_3^{2|3}\vee\delta_4^{2|3}\vee\delta_5^2\vee\delta_6^{2|3}\vee\delta_7^3\vee\delta_8^{2|3}\vee\delta_9^{2|3}\vee$$
$$\vee\delta_{10}^{2|3}\vee\delta_{11}^2\vee\delta_{12}^1\vee\delta_{13}^1\vee\delta_{14}^3\vee\delta_{15}^2\vee\delta_{16}^{1|2}. \quad (7)$$

In accordance with this option, three employees (1, 2, 3) are enough to ensure the educational process, which will fully ensure the implementation of all educational components in accordance with the imposed restrictions; competences 3, 4, 6, 8, 9, 10, and 16 may require alternative performers.

Option 2:

$$F(R,1)\times F(R,3)\times F(R,9)=$$
$$=\left(\delta_1^1\vee\delta_{10}^1\vee\delta_{12}^1\vee\delta_{13}^1\vee\delta_{16}^1\right)\times$$
$$\times\left(\delta_2^3\vee\delta_3^3\vee\delta_4^3\vee\delta_6^3\vee\delta_7^3\vee\delta_8^3\vee\delta_9^3\vee\delta_{10}^3\vee\delta_{14}^3\right)\times$$
$$\times\left(\delta_2^9\vee\delta_5^9\vee\delta_6^9\vee\delta_4^9\vee\delta_{11}^9\vee\delta_{13}^9\vee\delta_{15}^9\vee\delta_{16}^9\right)=$$
$$=\delta_1^1\vee\delta_2^{3|9}\vee\delta_3^3\vee\delta_4^3\vee\delta_5^9\vee\delta_6^{3|9}\vee\delta_7^{3|9}\vee\delta_8^3\vee$$
$$\vee\delta_9^{3|9}\vee\delta_{10}^3\vee\delta_{11}^9\vee\delta_{12}^1\vee\delta_{13}^{1|9}\vee\delta_{14}^3\vee\delta_{15}^9\vee\delta_{16}^{1|9}. \quad (8)$$

In accordance with this option, three employees (1, 3, 9) are enough to ensure the educational process, which will fully ensure the implementation of all educational components in accordance with the imposed restrictions, while competences 2, 6, 7, 9, 13 and 16 may have alternative performers.

According to the available labor resources, guided by the competence indicators, it is possible to make a set of options for the representations of the project teams, taking into account the imposed requirements for functional limitations and the competence indicators of all employees.

The maximum option for the project team is the involvement of all available employees. Such a representation takes the form:

Option *n*:

$$F(R,1)\times F(R,2)\times F(R,3)\times F(R,4)\times F(R,5)\times$$
$$\times F(R,6)\times F(R,7)\times F(R,8)\times$$
$$\times F(R,9)\times F(R,10)\times F(R,11)\times F(R,12)\times$$
$$\times F(R,13)\times F(R,14)\times F(R,15)\times F(R,16)=$$
$$=\left(\delta_1^1\vee\delta_{10}^1\vee\delta_{12}^1\vee\delta_{13}^1\vee\delta_{16}^1\right)\times$$
$$\times\left(\delta_3^2\vee\delta_4^2\vee\delta_5^2\vee\delta_6^2\vee\delta_8^2\vee\delta_9^2\vee\delta_{10}^2\vee\delta_{11}^2\vee\delta_{15}^2\vee\delta_{16}^2\right)\times$$
$$\times\left(\delta_2^3\vee\delta_3^3\vee\delta_4^3\vee\delta_6^3\vee\delta_7^3\vee\delta_8^3\vee\delta_9^3\vee\delta_{10}^3\vee\delta_{14}^3\right)\times$$
$$\times\left(\delta_6^4\vee\delta_{10}^4\vee\delta_{11}^4\vee\delta_{15}^4\right)\times\begin{pmatrix}\delta_4^5\vee\delta_6^5\vee\delta_{11}^5\vee\delta_{13}^5\vee\\ \vee\delta_{14}^5\vee\delta_{15}^5\vee\delta_{16}^5\end{pmatrix}\times$$
$$\times\left(\delta_4^6\vee\delta_6^6\vee\delta_8^6\vee\delta_{11}^6\vee\delta_{14}^6\right)\times$$
$$\times\begin{pmatrix}\delta_1^7\vee\delta_2^7\vee\delta_4^7\vee\\ \vee\delta_5^7\vee\delta_{11}^7\vee\delta_{13}^7\end{pmatrix}\times\left(\delta_2^8\vee\delta_3^8\vee\delta_6^8\vee\delta_{11}^8\vee\delta_{13}^8\right)\times$$
$$\times\begin{pmatrix}\delta_2^9\vee\delta_5^9\vee\delta_6^9\vee\delta_4^9\vee\\ \vee\delta_{11}^9\vee\delta_{13}^9\vee\delta_{15}^9\vee\delta_{16}^9\end{pmatrix}\times\left(\delta_{10}^{10}\vee\delta_{11}^{10}\vee\delta_{13}^{10}\right)=$$
$$=\delta_1^{1|7}\vee\delta_2^{3|7|8|9}\vee\delta_3^{2|3|8}\vee\delta_4^{2|3|5|6|7}\vee\delta_5^{2|7|9}\vee$$
$$\vee\delta_6^{2|3|4|5|6|8|9}\vee\delta_7^{3|9}\vee\delta_8^{2|3|6}\vee\delta_9^{2|3|8}\vee$$
$$\vee\delta_{10}^{2|3|4|10}\vee\delta_{11}^{2|4|5|6|7|8|9|10}\vee\delta_{12}^1\vee$$
$$\vee\delta_{13}^{1|5|7|8|9|10}\vee\delta_{14}^{3|5|6}\vee\delta_{15}^{2|4|5|9}\vee\delta_{16}^{1|2|5|9}. \quad (9)$$

When constructing possible sets of project team members for the considered educational project, sets from 3 to 10 performers were built. Hence, it was determined that in order to provide all educational programs, the minimum number of the project team should be 3 people, who fully cover all 16 competencies at the qualification level that meets the requirements for the educational program. After all, with such a selection, the conditions have been met that all project team members can provide high-quality educational services according to those educational components, imposed parameters and characteristics that correspond to their competences. This selection visualizes that the team has at least one member who has the necessary competencies to implement each task. When the number of performers on the project increases, it becomes possible to vary the execution of the task between different performers, which makes it possible to vary the tasks of a certain qualification between different performers involved in the project. The teaching of educational components in accordance with the specified characteristics can be distributed among those participants of the educational project who have the appropriate level of qualification. If one educational component can be provided by several members of the project team, then the number of options for determining the likely executor increases.

In accordance with this division, at Astana IT University, based on the analyzed educational program, the distribution of employees was carried out in accordance with the determined indicators of competences. First of all, the appointment of unique executors for the implementation of the project (teaching of a specific discipline), which closes the relevant educational component, was carried out. The next

educational components are alternately distributed among the project participants (all 10 members of the department) in accordance with the parameters of their competence, in such a way that each member of the project (lecturer at the department) is equally involved in the educational process, but at the same time as efficiently as possible provides the acquirers with relevant knowledge according to a specific educational competence defined by the educational program.

6. Discussion of the verification of a method to build an educational project team based on the analysis of competence matrix

The results of our study are based on the quality of collecting data on the competence of lecturers. Assessment of lecturers' competences based on the assimilation of program results by students does not always make it possible to objectively determine the level of professional training of each lecturer. This approach does not give an accurate idea of the correspondence of lecturers' skills to the requirements of educational components.

The use of the formalization of individual competence parameters of performers (1) to (4) and the method for analyzing the matrix of competences (5), (6) helps effectively distribute lecturers. In this case, avoiding situations where one person performs too many tasks or does not have enough competencies to teach certain educational components of the educational project. This improves the overall efficiency of the educational process.

The results of method application may also reflect the presence of a shortage of specialists with certain competencies, which affects the complexity of building project teams and may require additional measures for training or finding new employees.

Modern methods for selecting executors (educators) for the implementation of projects, in particular the teaching of disciplines, or participation in other educational projects are based mainly on the subjective evaluations of the management [25]. The leading universities in Ukraine and Republic of Kazakhstan in their practice take into account the survey of applicants to determine the lecturer's rating but these assessments do not significantly affect the choice of performers to provide educational services [26, 27]. Appointment of lecturers on the basis of competence indicators, which are formed by the results of student surveys and analysis of their educational achievements, is a promising approach that has a number of advantages over conventional methods. In particular, focusing on learning outcomes makes it possible to evaluate the lecturer's competence directly based on student success rates (how well the learning material has been mastered). It is the learning results that are a more objective indicator of the lecturer's effectiveness than the subjective evaluations of colleagues or the administration. Taking into account the opinion of students through a survey makes it possible to get valuable feedback that can be used to improve the educational process and rate the lecturer [28]. After receiving feedback, lecturers will be able to identify their strengths and weaknesses and devise a plan for professional development – individual indicators of competence. Lecturers will be more motivated to self-development if they understand that their work is evaluated by the results of student learning.

The proposed method makes it possible not only to effectively build teams but also to determine critical places in staffing. It helps university leaders to make decisions about the need for staff training or changes in personnel policy. This is shown by the model example with the condition of the problem defined in Tables 5, 6, as well as solutions derived from formulas (7) to (9).

Based on our method, the distribution of executors was performed for implementing the educational process within the framework of teaching educational components. According to the results of our experiment, higher success rates of applicants and higher results of student surveys regarding the quality of providing educational services were obtained in comparison with previous periods. Also, such results were obtained in comparison with other educational projects, where the performance indicators of the performers were not taken into account during the distribution of performers. Taking into account the internal system for evaluating the quality of the provision of educational services at Astana IT University [29], the growth of a number of indicators was noted. In particular, the average score of students increased by 0.17 points, the percentage of graduates who got a job in their specialty by 2 %, the number of scientific publications by lecturers – 7 %, the number of students who took part in Olympiads increased by 9 %, student satisfaction with the quality of teaching (according to 5-point scale) – 0.2 points. This indicates a positive trend of increasing the level of provision of educational services – the implementation of educational projects, owing to the implementation of the method for analyzing the competence of project executors.

Research results could be used by managers and HR departments at higher education institutions to increase the efficiency of labor resources management, in particular, when building teams of lecturers for educational projects. Using the proposed method for competency matrix analysis, it is possible to optimize the allocation of lecturers for educational components, taking into account their professional skills and qualification levels. This will improve the quality of the educational process, increase the effectiveness of educational projects, and also determine the need for additional staff or lecturer training. Also, these results may prove useful for educational program developers and university administrators involved in the management of educational projects, to ensure the appropriate level of teaching, in accordance with the requirements of competencies, and for planning the development of teaching staff.

However, the study has certain shortcomings. In particular, a small number of potential performers were involved during the verification of the method to form a team of performers for an educational project. A limitation of our study is that it implied the involvement of full-time employees whose competencies have already been well defined as part of the project executors. If it is necessary to attract new employees, the construction of their competence matrices is a separate task for research. In the future, it is possible to automate the process of evaluating potential participants of project executors for the distribution of executors according to different work packages of projects, etc.

7. Conclusions

1. The formalization of individual competencies of the performers, corresponding to the functional parameters of tasks within the framework of an educational project, was carried out. Formalization of lecturers' competencies is

a necessary condition for effective management of personnel resources in educational projects. The use of lecturers' productivity indicators based on students' assimilation of program results makes it possible to objectively assess their competence. This helps optimize personnel decisions regarding the extension or termination of contracts with lecturers, as well as identify opportunities for their bonuses.

2. Based on our analysis of the matrix of competences, a method was devised that makes it possible to build optimal teams for educational projects based on the correspondence of the competences of lecturers to specific educational components. This helps ensure the appropriate level of teaching and achievement of educational goals. The method also helps identify gaps in lecturers' competencies and determine the need for professional development or the search for new specialists.

3. The method for building an educational project team was verified using an example of an educational project at Astana IT University (Republic of Kazakhstan). The results confirm the effectiveness of the method under actual conditions. An increase in the quality of the provision of educational services was noted according to 5 indicators that are decisive in educational projects. The formation of a team from the minimum number of lecturers (three people), who are able to provide all the necessary competencies, shows that the method allows for a flexible distribution of personnel resources. This promotes efficient use of available resources and helps determine which competencies require additional performers or upskilling.

Conflicts of interest

The authors declare that they have no conflicts of interest in relation to the current study, including financial, personal, authorship, or any other, that could affect the study, as well as the results reported in this paper.

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Data availability

All data are available, either in numerical or graphical form, in the main text of the manuscript.

Use of artificial intelligence

The authors confirm that they did not use artificial intelligence technologies when creating the current work.

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