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Theoretical, Methodological, Communication and Information Technologies Approaches to Modeling and Forecasting Personnel Education in Covid-19 Conditions

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Abstract

The article is devoted to solving the problems of predicting the education of Ukrainian staff in the current COVID-2019 conditions in order to improve the efficiency of their work. Theoretical approaches regarding the characteristics of modeling and prediction of education have been studied, systematic and summarized. Factors that significantly complement the theory and methodology of the scientific provisions of the economy have been identified, taking into account the peculiarities of their work in the modern economic environment, structural changes, and new changes. The pros and cons of studying modeling approaches have been identified. The main features of structural change have been studied and it has been established that the modeling and forecasting of staff education has significant features.

Keywords: Educational programs, personnel, planning, training model, COVID-2019.

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Introduction

These days, the problem of the need for a four-level education is particularly acute. As a result, it is necessary to determine the amount of educational institutions that provide appropriate educational levels, the amount of school teachers and university teachers, buildings and technological equipment for the implementation of the educational process, communication tools, working capital, etc. Novadays, higher education institutions are in a fierce competition in attracting applicants.

In this situation, planning and forecasting the need for four-level education, advanced training of specialists and managers is relevant. The solution to this problem can be achieved by modeling, planning and forecasting education in a single state system, taking into account the needs of various industries and type of business.

Therotical Framework

Therefore, the main task of this publication is to build evidence-based modeling in the field of education.

An important point in determining the term of the study is the period from 2017 to 2025, since the number of students in Ukraine in this period of time has significant fluctuations. As a result, colleges and universities are experiencing a significant shortage of pupils and students. Significant current expenses are not always covered by budgetary allocations and

tuition fees by students of commercial forms of study. In this regard, it is advisable to distinguish between strategic planning and forecasting education in the short, medium and long terms. Each of these activities has its own special tasks and uses its specific methods.

Prediction of education processes is designed to the system based of socio-economic and scientific-technical forecasts, evaluate the development of education and the qualification structure in the future, evatuate the likelihood of new processes in this area, open up the possibilities of education, identify various options for satisfying educational needs in society, to determine their impact on personality formation and integrated efficiency, and thereby make it possible to prepare long-term on the basis of all this and medium-term educational policy. At the same time, the forecasts should ensure the maximum information ahead of planning for the long term. The objective of this planning in the field of education is to select the most suitable one from the point of view of the goals of society out of possible development options established as a result of forecasting and to outline the ways for its effective implementation. At this stage, the necessary measures in the field of education are balanced and coordinated with the development needs of other spheres of the state as a whole, as well as the degree of their importance and sequence of their implementation of the strategic objectives is determined.

Planning for the medium and short term in the field of education should guarantee the achievement of the goals and stages defined by the plans, through the rational use of budgetary and own funds in an appropriate period of time.

This article focuses primarily on forecasting and long-term planning of personnel training processes.

Methodology

At the same time, a number of models are considered from the point of view of how they can help in summarizing a huge amount of socio-economic, scientific, technical and pedagogical information that is essential for making long-term decisions, and, consequently, in developing effective ways to improve the level of education and qualifications of personnel — in accordance with the current goals of society (Deineka O.G. 2012). Forecasting and planning for different periods of time in the field of education have the following tasks:

1. On the basis of the study of the directions of socio-economic and scientific-technical development, to determine the long-term needs of the population for education and identify the components that affects the amount of personnel;

2. Resulting from this, to estimate the number of graduates from various educational levels (trainees in higher and special educational institutions, skilled workers, middle-skilled workers), by specialties, educational programs, as well as the possibility of their use;

3. Decoding to the identified needs for education and the number of graduates, to determine the effective structure of education, the level, profile and duration of training personnel at

individual, identify effective ways of training and increase their qualifications in full-time and distance education and find a favorable relationship between them;

4. Proceeding on the basic of the study of the processes of education and the acquisition of qualifications in response, due to social and scientific-technical development needs, to determine the requirements for advanced training of personnel, both in quantitative and temporal terms;

5. To identify the conditions required for the effective return of the qualifications obtained in the national economic reproduction process, also for the full use of trained personnel and the formation of a climate conducive to intensive staff training in the labor process.

Analysis

An important feature of educational planning is its strategic nature. The results of fundamental decisions in the field of education are often directly manifested only after 10-15 years. The time of their indirect influence is even greater: children who have reached school age, for example, in 2022, will work until 2070 orl 2075, and the last students of those teachers who are carrying out their responsible activities at present time, will work until 2083 or 2087.

Planning the education process includes the comparison of the actual and necessary states as the main link in the feedback between compiling the plan and its implementation. The main problem, which, above all, must be solved by long-term planning of personnel training, is determining effective quantitative and qualitative proportions between education and the reproduction process, as well as in the field of education itself. As the main method of its solution, the balance method, tested in other areas of planning, seems to be the most relevant.

Estimates of the long-term needs for skilled labor, balanced with the natural growth of the population, should be compared with existing and projected capacities in the field of education. The meaning of this approach is to reveal positive bottlenecks and find effective ways to train personnel to prevent excessive education costs in advance.

One of the most important problems of long-term planning and forecasting is the correct evaluation of the necessary pace of training of personnel according to their skill levels and professions.

Negligence and the substitution of a sober assessment of reality for just our wishes in this area can result in negative consequences in relation to both the formation of the staff personality and integral efficiency. Thais problem cannot be solved only by summarizing the ideas about the needs for personnel at enterprises, structural units, firms, educational institutions, government bodies and other institutions. This is because at this level, on the one hand, the time range for decision-making process is much longer than that which is necessary for long-term planning, and, on the other hand, training processes are considered mainly of requirements for individual job tasks, and not in broader terms of the distribution of personnel by profession and specialties and their diverse development.

However, the above mentioned does not mean denying the feasibility and necessity of a specific analysis of the requirements, which should be presented to the qualification level of personnel and depend on the achieved level of mechanization and automation of production processes, especially at present time. On the contrary, such an analysis represents an essential basis for strategic planning and should be taken into account when determining the main components of the need for personnel, determined by social development. These components are:

firstly, the need for personnel arising from the development of stuff's needs for education and the necessity to improve their working and living conditions (for example, raising their living standard, cultural needs, health care needs, services, etc.);

Secondly, the need for personnel, resulting from the development of material prerequisites to meet the material and spiritual needs of the staff;

Thirdly, the specific need for personnel, determined by the development of science and technology;

Fourthly, the need for personnel able to manage the state and economy;

Finally, the need for personnel for education itself, satisfying all four previous types of personnel requirements.

The five components of the needs and, at the same time, the areas of use of qualified personnel form the basic structure of the strategic planning model. This model allows put together existing methods for determining the need for personnel in certain areas into the model and at the same time indicates the need to develop a special model and appropriate methods for the analysis of insufficiently researched components. Work on this model is carried out in three stages during which the needs of the areas of the various social process of reproduction for production capacities and the structure of training in the educational system are determined.

At the first stage, the total amount of labor required for a certain sphere is established in order to implement the tasks assigned to it. At the second stage, the need for labor is synthesized for the whole society and balanced with its available resources, i.e., a balance of labor is found.

At the third stage, the future structure of the workforce is assessed by occupation and skill level.

On the basis of general needs of society for qualified personnel which are balanced with potential labor force, and taking into account those who have already received education and are working in the current period, it is possible to determine the need for the replacement and expansion of individual qualification groups of workers. This, in turn, provides initial information to formulate requirements for the development of education.

Determining the need for manpower (in quantitative and qualitative terms) in different areas of production or activities should be done, depending on their specifics, by special methods. It can be illustrated this with the example of material production. The need for material production in the labour force is mainly on the level of achieved productivity and the total amount of the national income. Not all areas of material production contribute fully to the creation of national income, and the overall need for labour is determined by the needs of certain sectors of economy. For industries, transport, construction and agriculture, there is a ratio between their net product of these units and the level of productivity measured by the manufactured net product (services) as per a person, employed in the relevant industry.

Most sectors of the economy are made up of a number of sectors, industries, etc. Therefore, in order to identify the need for labor in certain parts of the Ukrainian economy, it is proposed to divide them into sectors, and sectors into sectors, etc. For each of these, it is necessary to estimate the ratio between the product and labour productivity. The quality of the model depends to a significant extent on the following circumstances.

Firstly, the amound of knowledge about effective links between different social spheres is important. While identifying these links is not part of the model, they are crucial to the rational distribution of total labour across individual areas. This is particularly evident in the balancing of labour when it comes to reassessing the need for labour by area, aligning it with the development of the economic base until it comes balanced. It should be taken into account that other types of balance (jobs and labour), savings and planned investments in education and innovation, material balance, etc.) should be developed along with the balance of the labour force.

Secondly, a preliminary realistic assessment of national income and productivity is important, which is a particularly difficult problem. In addition, it should be borne in mind that the level of productivity depends on a number of factors, including the number and qualifications of the workforce, the estimation of which is, in fact, the purpose of the model. The method we are considering involves a high level of knowledge about the impact of science and technology factors, mechanization and automation, computerization, use to robotsin production processes to raise on productivity and skills structure of the workforce. Thirdly, it is necessary to know the development of the non-production sphere, the impact of which on the need for personnel is investigated relatively little.

The society's need for trained personnel in various ways up to a certain point can be predicted and on the basis of simple models. The following will describe how to identify the dynamics of the need for personnel for the projected period by examining the changes taking place in the composition of skilled workers and professionals, with the help of certain growth rates. The objective of the model used for this purpose (the model of the difference equation) is to show the results of the development of the capacities and training structure the modern Education in Ukraine (full secondary schools, vocational schools, special and higher education institutions).

The model of the difference equation allows to determine optional changes in the availability of skilled workers and specialists; to set the required number of students in four fields of education for each option; to test the target perceptions of the future composition of skilled workers and professional staff in relation to their lack of inconsistencies and coherence with population growth. In building the model, the author's idea were based on an estimate of the increase and decrease in the number of skilled workers and professional staff.

The reasons for the decrease are people's deaths, withdrawal from a particular occupation due to their age or illness, as well as professional development, which (under the model) means moving to a higher qualification level; the model only takes into account the transition of skilled workers to the ranks of staff who have graduated from special educational institutions. The decrease in the number of employees, which occurs for various reasons, is taken into account in the percentage of the decrease. The increase in the number of individual qualifying groups is due to those who have completed: the appropriate level of education: skilled workers; their training in the workplace; specialists who have graduated from special and higher education institutions of different levels respectively. The number of graduates, in turn, depends on the number of students admitted to vocational, special and higher education institutions or institution, the time of admission and the share of graduates. The number of undergraduates in to higher education or universities is determined by the number of applicants, and the latter - by the number of pupils in full secondary schools, by the time of their admission and the number of school leavers. The number of school pupils and those of them who have had work practice is ultimately limited to the number of pupilsin the same year. These capacity ratios of individual levels of education are quite clearly and accurately represented in a system of equations in which individual equations (different equations) take into account the change in the capacity of one stage of education depending on the previous one and on the change in the number of graduates of these stages; the latter is determined by the number of students accepted and the length of the training process. Certain stages of a unified education system create, depending on their distance from the end point of the chosen tape of education, different advance in the training of the relevant personnel: the greater this distance, the greater the advance. Thus, the duration of the training process is of particular importance. Therefore, we consider changes in the number of skilled workers and professional personnel as always depending on the time t, which is divided into units of time. Since these are relatively long periods of time for training personnel and their us age, we take into account, the average length of full secondary school attendance and in-work training's. Thus, as a unit of time t for this model two years have been chosen. Consider the system of equations, which presents the links between the dynamics of the number of trained skilled workers, the number of specialists, the number of specialists retired and enrolled and the number of transitions from one level of education to another. Let's take the following designations:

t-index of the period of time (t-0.1...);

B2, B3, B4- number of qualified workers, staff who graduated from special and higher education institutions, respectively;

m3, t4 - the number of graduates of special and higher education institutions respectively; The difference between the number of graduates from vocational schools and the number of students admitted to special education;

n1, n2, n3, n4 - the number of those accepted into full secondary school, vocational school, special and higher education institutions and universities, respectively;

d(t)—the number of graduates in year who have reached the age of 16 and 17;

a2, a3, a4— the percentage of the decrease in the number of skilled workers and professionals (who have graduated from special and higher education institutions) as a result of deaths, age and illness, respectively;

R- is the ratio of applicants and students of the same year of graduation.

The number of professionals who have graduated from higher education institutions in the period t always consists of some of their remaining part from the period t-1, plusthe number of graduates of higher education institutions in the period t:

$$B4(t)=(1-\alpha_4) \quad B4(t-1)+m4(t) \qquad (1)$$

The number of graduates from higher education during the period is determined by the number of admissions to higher education institutions in the period t-2, taking into account the four-year period of study (Bachelor):

$$m4,(t)=n4(t-2\}. \qquad (2)$$

The number of students in a higher educational institution depends on the number of students in schools in the period t - 1 and on the number of applicants that cannot study in higher educational institutions for different reasons(R > 1). These do not include applicants whose training will begin later because of military service or prior practice. This means that resulting for reason decrease in the number of applicants can be compensated by approximately the same number applicants finishing serving in the army. The corresponding equation has the form:

$$N4(t)=\frac{1}{R} \; a1(t-1). \qquad (3)$$

The number of staff graduating from special educational institutions in the period t is composed of some of them left from the period t-1, and of those graduated from special educational institutions in the period t:

$$B3,(t\} = (1 – a3)\, B_3\,(t- 1) + m3\,(t). \qquad (4)$$

Since the average length of study in a special educational institution is three years, it is necessary, on the basis of the two-year duration of one period assumed in the model, to approximate that half of those who have graduated in the t-period are from those admitted to special educational institutions. In order to make the presentation simpler, we do not consider

here the dropouts due to various reason of students of a certain stage of study during the studying process and possible repetitions of the course (the share of graduates is 1). Further, it is assumed that all those who have completed the last three stages of education begin to work, if there is no retraining, the restrictions can be lifted at any time to improve the information allotment of the model by introducing appropriate ratios (the proportion of graduates, the proportion of those who started their professional activities).

In between t — 1 and t — 2:

$$m_3(t) = \frac{1}{2}\left[n_3(t-1) + n_3(t-2)\right]. \quad (5)$$

The number of students enrolled in vocational school (for the training of skilled workers) depends on the number of school leavers d (i), the number of pupils enrolled in full secondary schools, the members of these age groups a (t) and the number of applicants in the period t, who belong to those accepted to full secondary school during the t-1 period and have not yet begun (and will not soon begin) studies at higher educational institutions. The author considers the last group as those who entered the skilled worker training system. However, we assume that these applicants have not received a vocational certificate.

$$A_2(t) = d(t) + \frac{R-1}{R} a_1(t-1) - a_1(t). \quad (6)$$

The number of skilled workers during the t period increases by the number of graduates from vocational education during this period. It is equal to the number of admissions to the vocational training system in the period t-1 minus (among other things) the number of admissions to special educational institutions during the period t:

$$m2(t)=a2(t-1)-a3(t). \quad (7)$$

The number of skilled workers in the period t is determined by some of them, who remain from the period t-1, and by the number of graduates from professional schools and the number of those who have gone to special educational institutions.

$$B2(t)=(1-a2)-B2(t-1)+m2(t). \quad (8)$$

Thus, the ratios of students enrolled in and graduating to the four degrees of education, as well as changes in the number of skilled workers and professional staff, are represented above in the system of equations. The question can then be asked: how should individual levels of education develop on the basis of simulated links between them, if the number of students is growing with according to a certain pattern? To solve this problem, we use some features of the given system of equations. The equation system (1)-(8) can be divided into three groups: (1)-(3), (4)-(5) and (6) -(8). The first two groups, whose equations describe a change in the number of specialists, are closed systems of equations.

Groups (1)-(3) and (4)-(5) consist of different equations. Assuming that the percentages of staff are constantly in the process of being discharged and being in need for them to grow at a

known time interval, the solution of these equations shows the following: if certain conditions are met in the base period (t q 0), the number of graduates from various types of education and those enrolled in it should increase by the percentage share of growth, as well as the number of the related personnel t after the completion of the relevant stage of Education. This result will reflect reality more correctly if it is possible to synchronize the time periods of uniform staff growth with the expected amount of those who quit, and model a uniform growth as optimal, approaching a really uneven growth rate. Since the optimal or possible rates of growth in the number of specialists who have received higher and special education are largely unclear, we have to evaluate these parameters using the method of variation calculation. Based on the accepted rate of growth in the number of staff, the author brings out the necessary changes in the capacity of the relevant training institutions for its implementation. By sequentially sustaining into the equation (6)-(8) the attained results the change in the number of skilled workers and apprentices in the production system can be found.

Out of the large number of such calculations, made for different growth rates, it is necessary to exclude those whose results seem absurd. The criteria for absurdity are the incredible ratios between the number of skilled workers and the staff of specialists, as well as incredible fluctuations in the arrival of new skilled workers. It is the latter which shows very clearly when the strategy of the growing number of specialists, which is also characterized by a possible influx into industrial training, is disproportionate to the growth of the population of Ukraine. Thus, however, there is no criterion on which to choose the most possible or even optimal one from the remaining number of development options.

The results of the above modeling should serve (as part of the training balance) as the initial data for modeling internal relationships in the education system. This simulation attempts to answer the question of how the established need for skilled personnel can be met with as little money as possible. The education system in this model is presented as a system of interconnected and interdependent processes. In order to ensure an inwardly proportional development of education, it is necessary that training at each stage be carried out in accordance with the needs of the next stage. The development of individual stages and spheres of education should take place in accordance with the tempo of development of the entire education system of Ukraine and, consequently, with the tempo of change in the need for it.

Within the relationship matrix, it is possible to use the transition from one type of education to another and from one stage of education to another one for analyzing the impact of these changing. These transition data is essential as instrumental variables for the planning of education. In accordance with the possible and real transitions of students from one stage of education to another, a transition matrix (D) was drawn up, which includes the absolute number of students. In this matrix, «sir» means the number of transitions between the t and t+1 periods from a class of one level or from an educational institution (i) to classes or institutions R (Sii,Sia)), to a class of the previous level I for re-course (Sii), or entering a job (Sia).

The main diagonal of the matrix shows the number of students undergoing are course of study (Sii), the diagonal located directly above the main diagonal is the transitions to classes of the next level Si $ü$. The team of authors introduces a vector of the quantitative composition of classes S(t)=S$^{(t)}_{1}$,.....$S^{(t)}_{n}$. Its $S^{(t)}_{i}$ component expresses the number of students in classes (representing a certain level of education) by time t. Then, on the basis of the data of the transition matrix (D), it turns out that the number of students in classes of level i by the time t

$S^{(t)t}_{i} = \sum_{R=1}^{m} S_{iR}$ for (i== 1, 2, ... п), and the number of pupils in the R level by the time of t-1.

$S^{t+1}_{R} = \sum_{i=1}^{n} S_{iR}$ при (R=1,2,...,m).

From the D transition matrix, you get a matrix of transitions q, so in general:

$$q_{iR} = \frac{S_{iR}}{S^{(t)}_{i}}$$

For special shares it turns out:

qir=C, if R>i; this means that there is an upper triangular matrix. Only in exceptional cases, which can be neglected here, graduates receive additional qualifications at a higher level (e.g., the staff of professionals who have graduated from higher education, graduate from other special training institutions acquiring the second and third specialty, educational programs).

qiR= qii if R= I, the main diagonal of the matrix is filled; it contains students who take a re-training course, i.e. they will return to the same class next school year; $q_{ii} = \frac{S_{ii}}{S^{t}_{i}}$ the share of those attending the training course.

$q_{iR} = q_{iii}$,if п— 1 = R> i; there are two possibilities here:

a) R = i +1 — this refers to the proportion of transitions to the next class of the same type of school;

b) R = i + z[z = 2, ... n — (i +2]— This represents the share of the transition to a higher-type school system; $q_{ii} = \frac{S_{ii}}{S^{t}_{i}}$ the share of transitions.

4. $q_{iR} = q_{ia}$, if R =п—1, n; this proportion indicates how many students leave the education system (those leaving before and after graduation); $q_{ia} = \frac{S_{ia}}{S^{(t)}_{i}}$ - the share of those who have left.

The sum of shares in one line for all columns is one. On this basis, it is possible to determine the number of students (at these levels) by the time of t+m, if their number is known by the time of t+t-1, if there is data on the number of school-age children and external admissions and if the ratios of the transition dolente matrix remain the same. The external admissions vector is $f^{(t)} = (f_1^{(t)}, f_2^{(t)}, \ldots\ldots f_n^{(t)}$. Its i-component $f_i^{(t)}$, characterizes an increase in the number of students in the i-class due to the expense of external admissions by the time t ($f_2^{(t)}$, is, for example, the number of first year pupils in year (t). The number of class student vector f^{t+1}, by the time of t+ 1 is equal this case to:

$$S^{(t+1)} = S^{(t)}Q + f^{t+1},$$

According to this, the number of students at the level of education is calculated R S_R^{t+1}, i.e.. R. vector component $S^{(t+1)}$, . The calculation is made according to the formula:

$$S_R^{(t+m)} = \sum_{i=1}^{n} q_{iR} S_i^{(t+m-1)} + f_i^{(t+m)}, \quad (R=1,\ldots m).$$

The rule of calculation of the number of the class Students Vector is a recursive formula with the help of which it is possible to calculate the number of students in classes in later years at each level, with no one year falling out:

$$S^{(t+2)} = S^{(t+1)}Q + f^{(t+2)} = S^{(t)}Q^2 + f^{(t+1)}Q + f^{(t+2)}.$$

In general, the formula is:

$$S^{(t+m)} = S^{(t)}Q^m + \sum_{j=1}^{m-1} f^{(t+j)}Q^{(m-j)} + f^{(t+m)}.$$

The purpose of the relationship model calculations is to determine the internal proportionality of a single education system, which ensures that its external proportionality is maintained. They allow for as determine how to meet the need for less personnel. In addition, for each option of meeting the public needs for personnel, it is possible to assess the educational system's need for teachers, training facilities, etc., on the basic of the «teachers-pupils» ratio coefficient.

The scientific novelty and advantages of the model discussed are as follows: first, methodologically, it allows to find out the "movement" of students (pupils and undergraduates) with in the education system; arising from this interdependence becomes clear, and thus objectifying the advance along the chosen path to meet the projected need for educated personnel; secondly, it can be methodically tested with its help different ideas about the development goals of certaine levels of education and the possibility of their implementation, while maintaining its modern structure; thirdly, from theoretical and practical point of view, it allows to show certain changes in the structure of a particular stage

of education and their impact on the state of its entire system. The models used to balance the development of education and the production process, as well as to ensure internal proportionality of the development of the education system in its current form, can help to obtain compatible conditions of proportionality. However, in order to choose the most effective option from the point of view of the purpose of the education system, appropriate criteria are needed. Due to the absence of such criteria, in the author's opinion, there is a decisive "information gap" in the decision-making strategy in the education policy.

Discussion

The most important objection that may be raised against these methods is that the results obtained by their internal logic depend on an increase in the amount of high-skilled labour. In fact, it is assumed that the contribution to the integrated efficiency of the increased level of skills is reflected through an increase in the share of highly skilled labour. As for the quality of training, the effective ratio of skill levels, as well as the efficient use of personnel, they are accepted as given. However, this is an issue that is extremely important for strategic decision-making and for which the appropriate evaluation criteria are not yet available. Besides, in the process of real life, these factors act in a counter-relationship with each other, and neglect of this circumstance has the risk of misdirection of the decision-making process. At a time when there is an urgent need for highly qualified personnel and the question of rapid growth in their numbers is paramount, the distortion of the assessment due to such assumptions is of little importance. But this importance grows with the increasing role of factors of intensive development of education, i.e. the growth of the quality of education, the effective use of personnel who have already been educated, the development of skills of workers of all qualification groups, and so on. .

It is these new qualitative points that have not been taken into account in the methods used to date, which is confirmed by the analysis of the method of determining the contribution of education to the national income of Ukraine, carried out with the help of forecast data until 2030. This analysis shows that, due to the decrease in the importance of extensive factors in the development of education, its contribution over time and has reduced as well as and that intensive factors have not been taken into account in the models. It is also important to emphasize the fact that these methods cannot adequately address the conditions to ensure effective proportional links between education and other areas of reproduction, as well as the relevant relationships in the education system itself.

A possible approach, according to the team of authors, is an analysis to assess costs and revenues of the process of training. This analysis is a method of phasing out the various elements of expenditure and income share for education activities, comparing them with each other and evaluating them in order to select the most conducive to improve an option of integral industry efficiency. At the same time, the team of authors understands «income» as the contribution that various educational activities make to fulfil the goals of society. There are usually three types of options to choose:

Options with commensurate incomes, but with different expenditures. In this case, it is easy to define an option with a favourable cost-to-income ratio using the cost criterion. This relatively rare type of options is often seen as the only one, given in general, which raises the risk of misdirection in decision-making.

Options with the same coats but having different results. These results should be presented in a comparable form and evaluated at appropriate decision-making levels. Options in which costs and revenues are totally different should be assessed separately. But at the appropriate decision-making level, they need to be made a comparable and given a comparative assessment.

It is important to identify and evaluate individual components that should be taken into account in the cost and revenue analysis. These components include costs, i.e. the ratio of one-time and current costs, as well as the costs of live and embodied labour; Quality and results parameters, the duration of the results of educational activities; benefits for to the state in general and a particular industry.

Conclusion

Thus, based on the above theory of the model making, it should be borne in mind that there are opposite interdependences between these components, which should be accurately evaluated when making a decision. For example, a certain level of quality and efficiency can be achieved earlier, but at higher costs. Or, at given costs, skills improvement can only be sooner if the quality and efficiency requirements are hiddenly reduced. It is therefore extremely dangerous to consider only individual components of expenditure and income analysis in assessing educational activities, as they can almost always be achieved at the cost of others. That is why the current simultaneous assessment of education activities, such as spending criteria or projected benefits for the state in general, is necessary to replace with an assessment as part of the analysis of expenditures and revenues. Working out and application of cost and income analysis in the decision-making process is crucially dependent on the state of research into the content of the relationship between education and other areas of the social reproduction process, on the effectiveness of the personnel training, on the development of appropriate economic and mathematical tools and on the effective use of trained personnel, their knowledge and skills, and to the constant improvement of these skills.

Conflict of interest

The authors declare no potential conflict of interest regarding the publication of this work. In addition, the ethical issues including plagiarism, informed consent, misconduct, data fabrication and, or falsification, double publication and, or submission, and redundancy have been completely witnessed by the authors.

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