

THE ESTIMATION OF VOCATIONAL EDUCATION SYSTEM POTENTIAL FOR OUTRUN DEVELOPMENT OF FAR EAST AS A PRIORITY TERRITORY OF RUSSIA

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Abstract

The article presents the results of the study that researches vocational education system potential of Far East as a priority territory of Russia. The system of vocational education is obliged to respond promptly to current and future requests for changing labour market, technological changes, and to train due number of demanded specialists with sufficient level of professional skills. The purpose of the study is to overcome the limitations and increase the efficiency of the education system functioning from the perspective of aligning the output of the education system with the needs of the economies of the Far East. The research methodologies as well as results are presented.

Keywords: vocational education system, education system functioning, education system output forecasting, personnel needs, macroeconomic methodology.

1 INTRODUCTION

The development of Far East territories is Russia's national priority, focused on global competitiveness in the countries of the Asia-Pacific region. Over the next 10 years in the Far East, more than 800 investment projects are planned and over 110,000 new high-tech jobs will be created.

The system of vocational education is obliged to respond promptly to current and future requests for changing labor market, technological changes, and to train due number of demanded specialists with sufficient level of professional skills. The purpose of the study was to overcome the limitations and increase the efficiency of the education system functioning from the perspective of aligning the output of the education system with the needs of the economies of the Far East. The research methodology uses a quantitative and qualitative approach to forecasting and is based on a comparative analysis of the results of the macroeconomic methodology for forecasting the demand for regional economies in personnel and the methodology for the education system output forecasting.

2 METHODOLOGY

2.1 Research concept

The methodology for assessing the potential of the vocational education system is based on systematic and macroeconomic approaches to the modeling of socio-economic processes. From the point of view of the research goal, vocational education system graduates are considered as one of the main resources that provides qualified personnel for the development of the economy of the Russian Far East regions. The vocational education system output is carried out in the annual measurement. From the position of management theory, the regions' economy needs an annual influx of human resources, which is an external impact on the socio-economic system. This need for resources must be met in time to ensure that the economy functions smoothly. The role of the compensating mechanism for this plays the vocational education system.

At the heart of the presented approach to management is the principle that the educational services market is considered secondary to the labor market, which itself is secondary to the production of goods and services market [1], [2].

Thus, the main function of the vocational education system is to train and produce on the labor market the personnel demanded by the economy, which is not always the case. One of the reasons for this is the inertia of the vocational education system, which works on the principle of "from achieved",

reproducing from year to year personnel for those specialties that are in demand, mainly from the population, but not from employers.

In order for the education system to produce personnel that will be in demand by the economy, it must start to prepare not those specialists who are needed in the labor market at the present time, but those who will become needed after graduation in 3-4 years. For this, it is necessary to have information about the future needs of the labor market, that is, to be able to forecast the needs for qualified personnel. Thus, a compensating management of the feedforward type is organized, which allows you to prepare the necessary specialists in advance for the required time.

To solve this problem, the team of the PetrSU Budget monitoring center has developed a macroeconomic methodology for forecasting the needs of the regions' economy in skilled personnel [3].

2.2 Macroeconomic methodology for forecasting the staffing needs

The basis of the macroeconomic methodology for forecasting the staffing needs is a unified approach for all regions of the Russian Federation based on forecast estimates of the economy growth rates, labor productivity and investment by types of economic activity and the necessary number of labor resources to achieve the planned indicators [4], [5].

The concept of demand forecasting is based on a systematic approach from general to specific, in the process of which there is a consistent decomposition of forecast trends of the type "aggregate staffing requirement" → "additional staffing requirement" → "detailing the additional staffing requirement". The basic calculation index is the annual additional demand for the economy in the personnel, which includes replenishment of the natural-age retirement of workers; change in the number of employees in connection with the change in the volume of production and labor productivity; as well as with the increase in the number of employees in the implementation of investment projects [6].

To calculate the annual additional demand for the economy in skilled personnel, the total staffing needs or average annual number of employees is structured according to the levels of education and types of economic activities, taking into account the share of annual staff renewal. At the last stage, the annual additional need for qualified personnel is detailed on educational specialties or professions in the economy [7].

2.3 Forecasting of vocational education system output

On the other hand, in addition to forecasting the needs of the economy in the personnel, it is necessary to understand how much demanded personnel education system will be able to train in the long term. For this, a forecast of the education system output is necessary, provided that the current trends in reception and the forecast background are preserved. Such a forecast was also developed by a team of authors from the PetrSU Budget monitoring center [8].

It is based on a mathematical model in the form of a system of linear non-stationary difference equations with discretization in time. The basic idea underlying the created model is the consideration of the movement of the students' number within vocational education institutions not only by years, but also by courses. At the same time, the j number of students of the course of the i year is determined taking into account the number of $j-1$ year students, and the i output of the year - through the contingent of senior $i-1$ years students. This allowed estimating the graduates number of the 11th grades entering the current year who have not arrived in the last three years, as well as students who can take part in the admission again from the lower courses of the education institutions of the vocational and higher education.

To describe the distribution flows by methods, a model similar to the transport model of a substance is applied to the education system institutions. The flows of incoming persons are recorded in the form of balance equations on the basis of the law of conservation of their numbers. Such a model has the property of additivity and allows describing the collective behavior of the incoming with sufficient accuracy.

2.4 Analysis of correspondence between education system output and regional economy needs

Based on the comparison of the forecast of the vocational education specialists output and the forecast of the economy needs in specialists with different levels of vocational education, balance

sheets of supply and demand are compiled. It should be noted that although the coverage of the annual personnel needs of the economy is carried out mainly by the educational organizations graduates, but part of the coverage is due to the retraining of the unemployed, interregional and foreign labor migration.

Comparative analysis of the two forecasts gives an opportunity to understand how much the output from the vocational education system corresponds to the personnel needs of the economy of the regions of the Far East.

The balance tables show the numerical value of the imbalance in the given educational specialty in the form of the difference between the need for personnel and the output for this specialty. In the case of staff shortages, a decision is made to increase the admission in the relevant educational specialty, with the case of an excess of staff - a decision to reduce admission.

On the basis of these tables, recommendations are made on the formation of control figures of admission for specialists' training. These recommendations are drawn up taking into account the so-called "capacity" or potential of vocational education institutions. This means such factors as the maximum capacity (in people per year) to be trained in the chosen specialty, taking into account the availability of educational licenses for training, the adequacy of the number of faculty, premises, infrastructure and so on.

2.5 The model of personnel training for the forward-looking development of Far East regions

The foregoing provisions can be formalized in the form of a structural and functional model of training personnel to ensure the advanced development of the regions, which is shown in Fig.1 below.

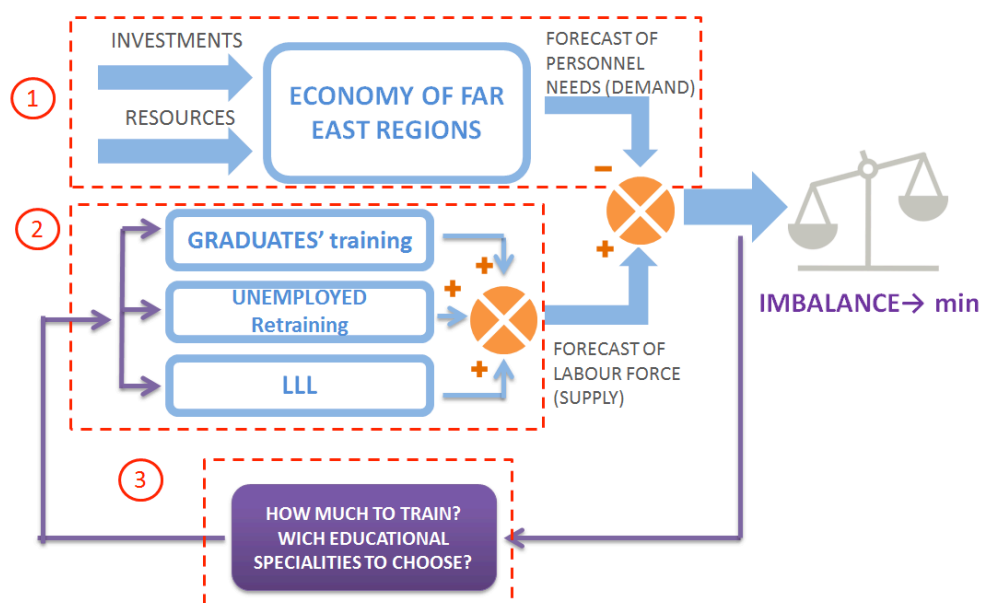


Fig.1. Structural-functional model of personnel training for the of Far East regions economy

The work of the training model can be interpreted as follows:

- 1 In the upper part of the figure in block 1, a forecast of the economy's demand for personnel is calculated in advance. It forms the future demand for the selected year of the forecast period.
- 2 In the middle part of the figure, a forecast of the labor resources is estimated in advance, it forms the labor market proposal for the selected year of the forecast period.
- 3 The difference between two estimates is calculated, and on the basis of the resulting imbalance, recommendations are worked out: how many and in which specialties it is necessary to train graduates in advance, so that the imbalance value is reduced to a minimum by the selected year. At the same time, the potential of the education system to implement the necessary training is assessed and taken into account. On the basis of these recommendations,

managerial decisions are made to formulate control figures of admission to the relevant vocational education organizations.

Thus, the methodology of researching the potential of the vocational education system uses a quantitative and qualitative approach to forecasting and is based on a comparative analysis of the results of the macroeconomic methodology for forecasting the regional economies needs in personnel and the results of forecasting the output of the education system.

3 RESULTS

Based on the developed forecasting methodology quantitative estimates of the additional staffing requirements and the number of graduates for 9 regions of the Far East for the period 2018-2025 were obtained.

3.1 The Integral Forecast of the Staffing Need of the Russia Far East

The forecast of the additional personnel needs is formed for three components:

- "for replacement" – due to natural-age retirement of personnel (pension, disability, mortality);
- "for growth" - an additional need due to the growth and expansion of the existing industries capacities;
- "for development" - new jobs created when implementing investment projects on the territory of regions and territories of Far East advanced development.

As Fig.2 shows, the integral value of the additional staffing need is 103.8 thousand people for 2018, of which 77.6 thousand are "for replacement", 10.1 thousand "for growth" and 16 thousand "for development". The greatest importance of the staffing need component is the "replacement" of already existing jobs, which can be fully replenished by the education system. The "development" component is formed based on an analysis of the investment projects list in the regions of the Far Eastern Federal District for the period 2018-2020. It is replenished both at the expense of the graduates of the education system and by attracting labour migrants from other regions of Russia and other countries (mainly from China).

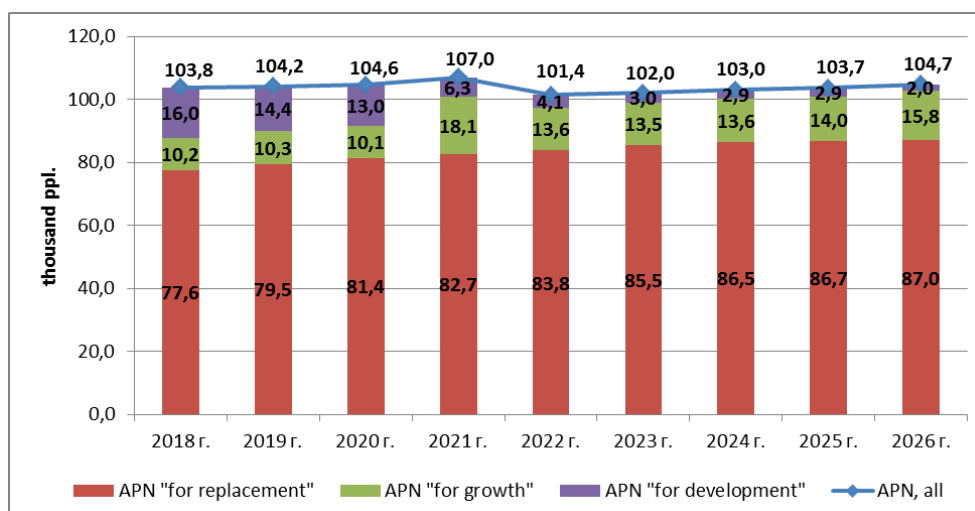


Figure 2 - Forecast of additional staffing needs for the Far East in section of three components

It is important to understand how much the education system should train by education levels in order to ensure the personnel needs of the regional economy. As shown in Fig.3, the indicator of the additional personnel needs is structured according to the levels of vocational education (higher and secondary vocational education), and also with no professional education. It is important to note that the overall structure for the integrated staffing needs is shown, while for the "development" component, as the results of interviews with the initiators of investment projects [Agency for Human Capital Development] show, the structure is different. It shows reducing the share of workers without

vocational education, and increasing the share in workers with secondary vocational education up to 70%.

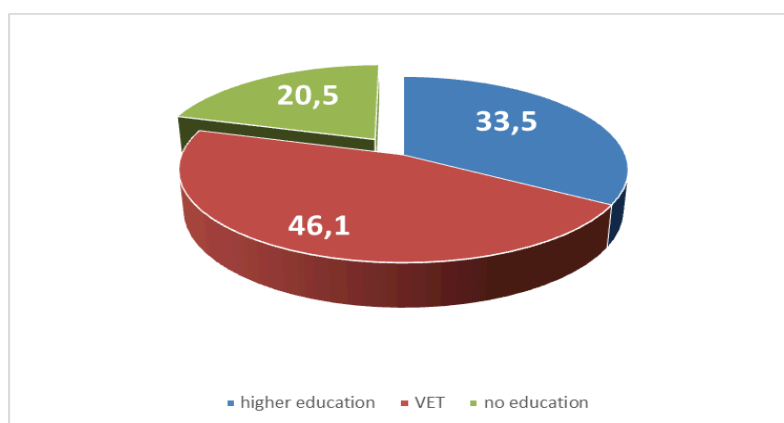


Figure 3 - Structure of the additional staffing needs of the Far East in terms of education levels, 2018

3.2 Forecast of staffing needs for 9 regions of the Russia Far East

The results of demand forecasting for 9 Russia Far East regions are presented in Table 1.

The biggest figures of the staffing needs are in the three regions that are leaders in socio-economic development of the Far East. They are Primorsky Krai, the Republic of Sakha (Yakutia), and the Khabarovsk Krai.

The regions with the lowest numbers are regions that are lagging behind in development but have the potential and are planning rapid development in the long term: the Chukotka Territory, the Jewish Autonomous Region, the Magadan Region.

The component "for development" in all regions has biggest number for 2018, then every year the value of this component is significantly reduced until 2025. This is due to the lack of basic data on jobs created for the long term. Initiators of investment projects confidently make forecasting estimates of the created jobs only for short and medium term prospects for projects that are already being implemented. For the long term projects that are at the stage of harmonization, it is difficult to make estimates.

Table 1. Forecast of additional staffing needs for the Far East regions.

Regions of Russia	2018		2022		2025	
	APN, all	of which «for development»	APN, all	of which «for development»	APN, all	of which «for development»
Amur Region	8 870	745	10 710	745	11 410	745
Jewish Autonomous District	3 525	1 580	3 115	0	3 370	0
Primorsky Krai	30 910	3 750	30 660		1260	30 170
Chukotsky Autonomous District	445	15	1 020	180	970	180
Sakhalin Oblast	8 690	1020	9 690	0	10 800	0
Kamchatka Krai	5 280	330	5 450	100	5 600	70
Magadan Region	2510	0	3 585	0	3 905	0
Khabarovsk Krai	20 620	1000	19 990	305	18 750	210
The Republic of Sakha (Yakutia)	22 960	7 760	17 190	1 480	18 730	1 480
<i>Additional personnel need (APN) for Russia Far East</i>	<i>103 810</i>	<i>16 012</i>	<i>101 410</i>	<i>4 070</i>	<i>103 710</i>	<i>2 940</i>
Additional personnel need by levels of education						
APN for higher education, Russia Far East	33 540	5 280	32 720	1 270	34 220	970
APN for VET, Russia Far East	46 060	7 141	45 170	1 810	46 255	1 310

3.3 Sources of staffing needs of the Russia Far East regions

The following categories are the sources of coverage of the region's staffing needs.

Local workforce:

- 1 Graduates of state and corporate universities, colleges, vocational schools, which are trained and employed after graduating inside the regions of the Far East.
- 2 Graduates of universities, colleges, vocational schools that were trained in the territory of other regions of Russia (outside the Far East), and after graduating they are employed for permanent employment in the territories of the Far Eastern Federal District.
- 3 Retrained and unemployed citizens passed professional training who are employed after training on the received specialty.
- 4 Assistance and organization of temporary employment of citizens, etc.

External workforce (attracted):

- 5 Interregional labour migrants (including working on a rotational basis)
- 6 Foreign labour force
- 7 Compatriots from abroad

This definition of the sources of labour resources shows the main significant categories. But not all these categories can be estimated numerically for the following reasons: there are no data (in the state statistics of Russia, and also on the results of departmental observations (this refers to categories 4 and 7). Methodologically, when compared with the additional staffing needs, it is necessary to compare the data not in absolute values, but their growth for 1 year. But there is no data on the growth of migrants (the number of arriving at work annually) in the Russian statistics, therefore, categories 5 and 6 cannot be estimated.

Table 2 gives an estimate of the sources of labor resources according to the available data.

As the table shows for the Russia Far East regions, the following features are typical:

- graduates of local educational organizations cover the need for cadres by 40% -50%, while the graduates' employment rate is 67% for higher education and 57% for vocational education.
- there is a large influx of university graduates to work from Moscow, St. Petersburg, Irkutsk region, Novosibirsk region, Kursk region and other regions outside Russia Far East regions (from 3% to 92% of the demand coverage)
- the percentage of coverage at the expense of graduates and retrained unemployed for 7 regions of the Far East is less than 70%, only for two regions (Chukotsky Autonomous District, Amur region) there is coverage.
- interregional migrants and foreign labour cannot be estimated in additional values, therefore they are presented as a separate unit as additional sources contained in the number of employed in absolute terms.

For the system of secondary vocational education in all regions, the coverage of the staffing needs by the graduates is ensured only by 30-40%, which indicates that the VET system does not cope with the training of personnel for the social and economic development of the regions of the Far East. If labour migrants are assessed, they mainly work in places requiring secondary vocational education and "close" the existing gap in training and demand for personnel.

3.4 What occupations and specialties are needed in the regions Russia Far East?

To assess what specialties and professions have lack of training specialists the following data were analysed:

- Federal Labour and Employment Service data on the number of vacancies for employers and citizens' applications to labour services and employment in the regions of the Far East in 2017
- Ministry for Development of Russian Far East data on the results of interviews with employers implementing investment projects on the creation of new workplaces in the territories of the Far East regions and the territories of advanced development of the Far Eastern regions.

Based on the analysis, 3 ratings were compiled, which are given below.

1 Rating of TOP-20 in-demand occupation for the Far East (determined by comparing the data of Federal Labour and Employment Service on the number of vacancies for employers and appeals of citizens to the labour and employment services in 2017)

- | | |
|---|--|
| 1. Mason | 11. Locksmith on the assembly of metal structures |
| 2. Fruit and vegetable grower | 12. Sharpener woodworking tools |
| 3. The fixture | 13. Locksmith on the manufacture and repair of pipelines |
| 4. Concrete Worker | 14. The pediatrician |
| 5. Finisher of reinforced concrete products | 15. The farmer |
| 6. Plasters | 16. Molder of products of building ceramics |
| 7. The technician on adjustment and tests | 17. Welder-operator |
| 8. The rice grower | 18. Product and Process Quality Controller |
| 9. Woodworking equipment commissioner | 19. Diamond Marker |
| 10. Facing tiler | 20. The cook |

Table 2. Sources of coverage for the personnel needs in the Far East regions in 2016

	Russia Far East		Primorsky Krai		Khabarovsk Krai		The Republic of Sakha (Yakutia)		Amur Region		Sakhalin Oblast		Kamchatka Krai		Magadan Region		Jewish Autonomous District		Chukotsky Autonomous District	
	ppl.	Share of APN	ppl	Share of APN	ppl	Share of APN	ppl	Share of APN	ppl	Share of APN	ppl.	Share of APN	ppl	Share of APN	ppl.	Share of APN	ppl	Share of APN	ppl	Share of APN
Additional personnel need (APN)	79600		23800		17390		16050		7040		6450		4300		2430		1850		290	
Sources of coverage																				
Education system output in Far East (with employment inside Far East 67%)	44170	55%	13307	56%	12143	70%	6613	41%	5526	78%	2602	40%	1912	44%	967	40%	972	53%	128	44%
Education system output outside Far East, employed in Far East	8341	10%	815	3%	1637	9%	1857	12%	1129	16%	1518	24%	800	19%	308	13%	42	2%	268	92%
Unemployed with vocational education who applied to the Employment Services and have been retrained in the specialty	3185	4%	837	4%	411	2%	707	4%	742	11%	120	2%	201	5%	93	4%	47	3%	26	9%
Russian labor migrants (as part of the employed population)	39984	50%	4045	17%	8926	51%	13681	85%	4583	65%	5134	80%	3190	74%	1944	80%	0	0%	1833	632%
Foreign labor migrants (as part of the employed population)	64400	81%	17455	73%	14101	81%	5410	34%	4657	66%	10187	158%	5196	121%	4507	185%	2766	150%	125	43%
TOTAL	160080	201%	36459	153%	37218	214%	28268	176%	16637	236%	19561	303%	11299	263%	7819	322%	3827	207%	2380	821%

2 TOP-15 educational specialties with higher education, for which new jobs are created in the regions of the Far Eastern Federal District during the implementation of investment projects in 2018-2025, indicating the proportion of all jobs created with higher education by occupation

- | | |
|---|--|
| 1 Tourism 18.40% | 9 Technological machinery and equipment 2.64% |
| 2 Management of 7.52% | 10 Technology of transport processes 2.49% |
| 3 Construction of unique buildings and structures 6.53% | 11 Industrial fishing 2.41% |
| 4 Machine building 6.05% | 12 Veterinary and sanitary examination 2.28% |
| 5 Construction 5.88% | 13 Hospitality 2.02% |
| 6 Mining 4.58% | 14 Computer Science and Computer Engineering 2.00% |
| 7 Economy 3.42% | 15 Electricity and electrical engineering 1.90% |
| 8 Navigation 3.03% | |

3 TOP-15 educational specialties with secondary vocational education, for which new jobs are created in the regions of the Far Eastern Federal District during the implementation of investment projects in 2018-2025, indicating the proportion of all jobs created with higher education by occupation

- | | |
|---|---|
| 1. Operational activities in logistics 3.93% | 8. Auto mechanic 2.39% |
| 2. The machinist in open-cast mining 3.55% | 9. Master of Civil Works 2.30% |
| 3. Master of finishing construction works 3,24% | 10. Mining worker in underground works 2.11% |
| 4. Welder (electrowelding and gas welding) 2.92% | 11. Logging technology 1.99% |
| 5. The road and construction machine operator 2.73% | 12. The manufacturer of ferro-concrete products 1,83% |
| 6. Manufacturer of reinforcing nets and frames 2.64% | 13. Shipbuilding and ship repairman of non-metallic vessels 1.75% |
| 7. Technical operation of lifting, transportation, construction, road machinery and equipment (by industry) 2.40% | 14. Master of carpentry, carpentry and parquet work 1,74% |
| | 15. Mineral beneficiary 1.73% |

Comparison of the three ratings shows that the occupations of rating 1 and educational specialties of secondary vocational education for investment projects of rating 3 are similar and overlap.

In the rating 1 of deficit occupations of today did not include occupations with higher education, which are massively provided and there is only a small number of narrowly specialized specialists with a higher education (mining engineer, construction engineers, forestry engineer). These "narrow" occupations are included in the rating 2 too. When implementing investment projects in the development of tourism and industrial production in all regions of Russia Far Eastern, experts in the field of tourism, as well as engineers and specialists in the industrial and transport spheres will be important.

4 CONCLUSIONS

The following tasks were implemented during the research:

- an assessment of the demand for personnel in 9 regions of the Far East for the medium and long term,
- a comparison of the received personnel needs data and the education system output was made in providing these personnel needs by education levels and educational specialties,
- the development of recommendations in the form of a admission quotas for the education system (how many specialists for which education specialty it is necessary to train in which region). One of the main results obtained was the developed of personnel training model to ensure the advanced development of the Far East regions.

The received forecasts of the education system activity allowed to evaluate:

- how much training in universities and colleges in the regions of the Far East provides staffing needs by quantity of vocational education;
- What education specialties and occupations are lacking in training,
- What are the limitations in the vocational education system of the Far East for ensuring the advanced development of the macro region;
- Other sources of demand coverage, including labor foreign and internal migration, and retraining of the adult population were defined.

Based on the results received organizational solutions for managing the admission flows for the education system were formulated in the form of methodological recommendations for determining instruments to remove restrictions and the efficiency of vocational education and training of personnel for key sectors of the economy of each subject of the Far East.

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