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SCHOOL CHOICE AND THEIR SPATIAL DISTRIBUTION WITHIN RURAL AND URBAN AREAS IN UKRAINE

The problem of spatial distribution of schools for ensuring regional development is investigated. The range of factors influencing schools distribution, as productive forces of a region, is analyzed. The social inappropriateness to introduce the cost approach to spatial distribution of schools redesign across the region is proved on the example of Stakhanov city in the Lugansk region.
Keywords: *productive forces; regional economy; regional development; schools; optimization.*

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ВИБІР ШКІЛ ТА ЇХ ПРОСТОРОВЕ РОЗМІЩЕННЯ У СІЛЬСЬКІЙ ТА МІСЬКІЙ МІСЦЕВОСТЯХ В УКРАЇНІ

У статті досліджено проблему просторового розміщення шкіл у контексті регіонального розвитку. Проаналізовано чинники розміщення шкіл як продуктивних сил регіону. Обґрунтовано соціальну неприйнятність витратного підходу до редизайну системи розміщення шкіл на прикладі міста Стаханов Луганської області.
Ключові слова: *продуктивні сили; регіональна економіка; регіональний розвиток; загальноосвітні школи; оптимізація.*
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ВЫБОР ШКОЛ И ИХ ПРОСТРАНСТВЕННОЕ РАЗМЕЩЕНИЕ В СЕЛЬСКОЙ И ГОРОДСКОЙ МЕСТНОСТИ В УКРАИНЕ

В статье исследована проблема пространственного размещения школ в контексте регионального развития. Проанализированы факторы размещения школ как продуктивных сил региона. Обоснована социальная неприемлемость затратного подхода к редизайну системы размещения школ на примере города Стаханов Луганской области.
Ключевые слова: *продуктивные силы; региональная экономика; региональное развитие; общеобразовательные школы; оптимизация.*

Problem statement. The proclaimed independence in Ukraine, which opened the new way towards market economy, has brought wide changes into education. This transformation created a mixed educational environment where private schools compete with public institutions and urban schools dominate over rural and township ones. Consequently, children's and their parents' attitude to any school became more freely to express in terms of family's choice of school. In the past the Soviet government heavily donated rural and township schools, as well as agricultural and industrial enterprises, and today the amount of public finance flowing into such schools and enterprises is considerably limited. Underperforming rural schools are no longer attractive to children and their parents choosing urban education. We will examine briefly the nature of choice in favor of town schools to describe Ukrainian specifics and provide rationale for the factors mostly impacting that choice.

The importance of the study is proved by its underlying another challenge met by Ukrainian government. This challenge is in the process of closing some rural schools and allocating resources to others. In fact, it can be referred to as redesign of spatial

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location of rural and urban schools on the map of certain Ukrainian districts. In this article, we discuss the inconsistency of any decisions related to changing spatial location of rural schools and, thus, confirm its complexity.

The optimization of spatial distribution of rural schools even if dictated by children's school choice cannot be driven only by current economic expediency without taking into account major social trends in education. Instead, regional policy in the field of development of rural schools and optimization of their location may be improved by considering learning opportunities (Sekete, 2000), which can be created by the government through spatial redesign of rural schools in consistency with social trends. We suppose that more factors are to be taken into account than simple school productivity when changing spatial distribution of schools. In addition, we assume that strategies to increase productivity are also to be developed.

Therefore, the problem statement can be reduced to the following. The current situation with rural schools in Ukraine forced Ukrainian government to take decisions on closing some of the schools. This solution was determined by considerable outflows of pupils from rural schools to towns. Consequently, since rural schools in Ukraine are publicly financed, it caused a huge misbalance between government expenses for such schools and demand for their services.

To improve rural schools' productivity, the government recently has decided to make a conservation of low demanded rural schools and offered children whose school is prepared to be closed to join a school in a neighboring district, for example. The social and economic dilemma between social responsibility and economic expediency arose in the field of artificial spatial distribution of rural schools. In this article, we will investigate the main approach selected by the government on the school network optimization, as well as offer some strategies to optimize spatial distribution of rural schools in Ukraine by taking into consideration current social and educational trends.

Latest research and publications analysis. The literature analysis allowed us come to two main insights on spatial distribution of rural schools. They are as follows.

Variety of problems caused by the misbalance between the amount of money spent on maintaining rural school facilities and a number of pupils attending these schools can be divided into two main groups. The first group includes the challenges arising due to the fact that rural schools are operating below their capacity and, thus, they need to be closed. The second group embraces the opposite case when rural schools cannot meet growing demand for their services and, thus, more schools need to be built. Both situations are focused on spatial distribution of schools across rural districts. Therefore, in literature we can find the authors arguing the introduction of new schools, as well as the researchers standing for closing the so-called "three-student" schools.

The second statement can be referred as the totality of problems arisen from spatial distribution of rural schools independently on the type of economy. Both developing countries and highly developed economies face challenges of either closing unprofitable schools or building the new ones. So, the problem of optimum placement of productive forces including rural school facilities is evidently global. However, closing unprofitable rural schools, as well as probable building of new schools, do not always guarantee that the planned effect will be achieved. Very often

social negative externality caused by closed school is much higher than the economic effect yielded through this cost cut (Brauner-Otto, 2012).

Indonesian Mojokerto is struggling from growing population and, thus, growing demand for schools (Priadi, 2009). Due to the lack of schools in this city, the primary schools network there requires effective expansion, which is quite challengeable at budgetary cuts. While examining Zaria region in Kaduna State, J. Inobeme and K. Ayanwole (2009) argued that uneven distribution of publicly funded education facilities, as well as their inadequacy and inefficiency, encourage the proliferation of privately funded secondary schools and has serious consequences on educational services provided and therefore, the quality of education and its standards. The unexpected geographical distribution of population, exacerbated by the recent spread of urban growth in Chilean Concepcion Metropolitan Area, has promoted a clear spatial inequity in the provision of quality educational facilities (Fuentel et al., 2013). There is a problem of absence of schools in Nigeria. Thus, a new optimal network of distributed schools across the country must be developed with the demographic factor being taken into account.

The optimization of educational productive forces is very topical for Bangladesh where this problem is not given proper attention. A.M. Khan points out to the need for public and political decisions aimed at effective distributing schools across regions (2010). They attempted to assess spatial variation in educational attainment and educational facilities at regional levels in Bangladesh.

Recent declaration of the US government about free school choice encouraged S. Gosh (2013) to investigate partnership relations between schools located in neighboring districts so that one can make predictions about future prospects of any school.

The study by D.L. Konstantinovskiy, V.S. Vahshtain and D.Y. Kurakina (2013) focuses on the objective indicators describing teaching staff, conditions of facilities, and financial of such institutions. These indicators are offered to be the key to the decision of closing rural schools.

In the works by O.S. Vasina (2011), schools are offered to be clustered by the following criteria:

1. Technical equipment.
2. A number of teachers in computer sciences.
3. A number of courses in computer sciences.

The purpose of the article. To address the issue of optimal spatial distribution of rural schools reflecting the governmental decisions to close or continue financing of selected schools in Ukraine, we outlined that the purpose of the article is to ground the conceptual framework for spatial distribution of rural schools in Ukraine in the context of current social and educational trends. This conceptual framework may be paid attention by Ukrainian central and local governmental bodies when taking decisions on the redesign of rural school map.

To achieve the purpose of the article, we concentrated on the following tasks:

- Providing historic information on spatial distribution of rural schools in Ukraine.
- Performing the cause-effect analysis of the outlined problem to find out the relevant factors.

- Describing the relationship between school choice and spatial distribution of rural schools.

- Offering hypothetic strategies on spatial distribution of rural schools performed by Ukrainian government.

- Analyzing the cost approach to spatial distribution of secondary schools across Stakhanov city of the Lugansk region according to the declared Ukrainian policy for school network optimization.

Key research findings. For better understanding the core essence of the problem related to the spatial distribution of secondary schools in Ukraine, we need to provide historic background of this process. The current system of school-level education has been shaped since 1919 after the Soviet decree on enhancing people's education (Soviet Decree, 1919). This milestone of Ukrainian history opened the era of mass schools building across the country. By 1960, Ukraine had about 200.000 schools. The main principle of schools distribution was referred to as each rural settlement must have a school even though it is the smallest one. It was the policy of the country. This historical brief provides an insight into the fundamental pillar of spatial distribution of schools across the country. There was no need in economic efficiency but there was a need in social responsibility. Educational system of Ukraine was shaped centrally rather than due to market forces. Therefore, spatial distribution of schools was managed and controlled centrally by the government making important decisions on the school network design.

Despite being centrally designed, rural schools are facing now tough competition and strong influence of market forces. Because of underused capacities, some schools are planned to be closed. The cause-effect analysis of factors influencing school popularity among students revealed the following.

Among the factors of spatial distribution of educational facilities across certain areas are online education, globalization, the concept of educational establishment as a center for life learning, productivity and profitability, industrial growth within the area, socialization ratio reflecting the process or speed of transition from collectivism to individualism, which is important when analyzing the online and face-to-face educational model, the level of educational migration, population density, services diversification taken by a school, closeness to plants that are usually located far from the city center due to environmental problems. The latter could radically change the philosophy of spatial distribution of educational establishments across the countryside since it reflects the concept of early professional orientation and close relations with enterprises. It mirrors the concept of useless transmitting knowledge to students and the paradigm of the useful gaining practical skills through improvement of production processes and quality of life. Therefore, spatial distribution of educational facilities in the country must be done given these relevant factors.

The relationship between school choice and spatial distribution of rural schools can be described evolutionarily with the objective to better understand the prospective trends in changes of rural schools network (Table 1).

By taking into consideration all mentioned above, we can conclude that Ukrainian governmental bodies responsible for the national education system need to develop a long-term strategy on spatial distribution of secondary schools across rural and urban areas. In addition, this new strategy should correspond to the strategy of

human development. In this research, we suggest considering the current strategy reflecting the cost approach, the strategy oriented to online education and the strategy oriented towards closer relationship between educational system and real business.

Table 1. **Evolutionary relationship between school choice and spatial distribution of rural schools,** *developed by the authors*

	Outflow of students from rural schools. Students make choice in favor of urban schools	**Inflow of students to rural schools. Students make choice in favor of rural schools**
The rural area is highly saturated with secondary schools. The rural school network is strongly distributed across the territory	1980–2000 The deterioration of agricultural technology and growing automation led to rural slowdown and depression	1950–1970 The growth of agriculture industry led to growing rural settlements and high birth rate
The rural area is poorly saturated with secondary schools. The rural school network is strongly distributed across the territory	2000–2014 Depressed rural areas	2015 – A boom in innovations and environmentally perfect location of big plants may lead to rural areas recovery

According to the strategy mirroring the online education approach to spatial distribution of schools across the region, the government should form the so-called educational hubs delivering online educational services.

According to the strategy based on closer relationship between education and real business, the government should locate schools near big plants occupying rural territories.

The simplest approach to selection of schools required to be closed is to employ the optimization technique which uses the criterion of minimal total expenses spent by local government to maintain the existing school network.

The total expenses spent by local governments from the local budget consist of the integrated cost plans provided by each school independently. In turn, a school's cost plan comprises all costs needed for involving resources into the process of educational provision. One of the crucial points is that each school has different cost amount and, consequently, shows a different cost plan. However, this cost amount depends not only on student numbers studying at schools because not all costs are relevant to their numbers. The cost amount is mainly influenced by such factors as school space, the local or centralized system of heating, with either gas or coal, the temperature of air during the heating period etc. Considering costs on heating, water supply and electrical power we find that they are not relevant to the students' number and, therefore, they are fixed. Conversely, cost of food provision for each student, wages and extra payments to teachers vary dramatically. Herewith, we need to pay attention to the fact that the abovementioned factors directly impact school's productivity.

Therefore, we can conclude that previously declared state policy of regional development and growth strongly contradicts to the actual principles taken for distribution of financial resources across secondary schools. This conclusion is drawn on the basis of examining current school network in Stakhanov city. The state policy of regional development and growing economic performance pursues the objective of

providing equal living standards across the territory. In Ukraine, this objective is achieved through equal distribution of budgetary funds across the territory and similarity in providing basic services to people. Thus, since educational services are basic and predominantly provided by the state (most secondary schools are publicly owned), then the cost amount per a pupil must be similar for all pupils across all regions. In fact, we can observe the following situation. Nominally, there are normative expenses per pupil calculated by the government. This indicator distinguishes only geographical disparity and varies through urban or rural territories. Mainly, this normative is the same for all Ukrainian schools. However, if one calculates the total costs of a certain school to pupil numbers studying there, then the cost amount per pupil will be different for Ukrainian schools due to the factors above. In this case, trying to adhere to the main goal of governmental policy, which is to reduce budgetary costs and spend less money on maintaining schools, we should close those schools having the highest cost amount per student.

The described approach can be referred to as cost approach to schools distribution across Ukrainian regions. To find whether the cost approach is relevant and provides reasonable results, we applied it to the secondary school network in Stakhanov, Lugansk region.

The algebraic form for the outlined objective of optimizing secondary school network is represented by the following purpose function (F):

$$F = \sum_{i=1}^{n} x_i a_i \to \min, \quad (1)$$

where x_i – the students' numbers in i school (persons); a_i – amount of costs per student at i school (currency equivalent).

After returning the result by the purpose function, we will find the optimal student numbers for each school, costs of providing educational services for which will be the lowest. Thus, the reduction in budgetary expenses will be met. Predictably, the purpose function will show zero optimal number of students for some schools. These schools need to be closed according to the cost approach to spatial distribution of secondary schools across the city.

The approximate range of costs included into the purpose function is given in Table 2. It contains the empirical data on schools in Stakhanov for checking the reliability of the cost approach to optimization of spatial distribution of the school network.

For creating the reliable model to optimize the school network according to the criterion of minimal expenses on their maintenance, we need to introduce additional limitations for a more relevant model.

These limitations serve as a fixed framework for further calculations. Without them, we could find that all secondary schools across the region had to be closed except one school having the lowest costs of providing educational services per student.

Therefore, the first limitation is the consistency between actual student numbers and school's capacity. Understandably, the actual number of students cannot exceed school's capacity defined by its building passport.

The second limitation is following from the logic statement that all pupils currently studying at all schools of the city must be distributed across newly found

Table 2. **Some indicators describing the performance of schools located in Stakhanov, Lugansk region, Ukraine,** *developed by the authors*

School number	Total annual expenses, UAH	Annual expenses per pupil, UAH	School's capacity (students)	Currently studying students	Expenses on staff salary	Expenses on equipment	Expenses on food provision	Expenses on water supply	Expenses on electric power	Expenses on gas/coal	Expenses on garbage removal	Other expenses
#1	716,400	4,841	420	148	625,478	1,159	17,525	2,637	12,563	16,671	8,813	31,555
#2	912,400	4,110	510	222	796,602	1,476	22,320	3,358	16,000	21,232	11,224	40,188
#3	2,020,400	3,413	840	592	1,763,979	3,268	49,425	7,436	35,430	47,016	24,854	88,991
#7	1,559,400	3,813	840	409	1,361,487	2,523	38,148	5,739	27,346	36,288	19,183	68,686
#8	1,834,700	3,556	920	516	1,601,848	2,968	44,882	6,752	32,174	42,694	22,570	80,812
#9	2,911,200	3,260	1,020	893	2,541,723	4,709	71,217	10,714	51,051	67,745	35,812	128,228
#10	1,309,900	4,352	1,210	301	1,143,653	2,119	32,044	4,821	22,971	30,482	16,114	57,696
#11	1,740,500	3,447	1,200	505	1,519,603	2,816	42,578	6,406	30,522	40,502	21,411	76,663
#12	696,400	4,904	600	142	510,912	3,116	17,952	1,956	10,536	68,250	3,838	79,840
#13	797,400	6,874	1,020	116	607,256	3,054	17,696	3,016	31,520	91,601	1,867	41,390
#14	489,600	6,800	270	72	427,462	792	11,977	1,802	8,586	11,393	6,023	21,565
#15	1,581,000	3,593	920	440	1,380,346	2,558	38,676	5,819	27,725	36,791	19,449	69,637
#16	490,700	7,667	540	64	390,350	996	10,472	932	4,080	65,196	3,208	15,466
#18	1,531,700	2,596	920	590	1,337,303	2,478	37,470	5,637	26,860	35,643	18,842	67,466
#25	542,800	6,031	420	90	473,910	878	13,278	1,998	9,519	12,631	6,677	23,908
#26	1,656,200	3,870	1,020	428	1,446,002	2,679	40,516	6,095	29,043	38,541	20,374	72,950
#28	1,131,200	3,661	600	309	987,633	1,830	27,672	4,163	19,837	26,324	13,916	49,825
#29	1,563,700	4,192	920	373	1,365,242	2,530	38,253	5,755	27,421	36,388	19,236	68,875
#32	1,241,900	4,516	1,020	275	1,084,283	2,009	30,381	4,571	21,778	28,900	15,277	54,701

schools needed to be open. It is unacceptable that more or fewer students are covered with the optimization model than they are now. Thus, the whole number of students at all schools left open after optimization should be equal to the total students studying at schools at the moment of optimization.

The third limitation is boiled down to the fact that student number at each school left open after optimization must be a whole number since, in case of the opposite, results returned by the model will not have logical sense.

These limitations are as follows:

$$\sum_{i=1}^{n} x_{if} \le \sum_{i=1}^{n} x_{ip}; \quad (2)$$

$$\sum_{i=1}^{n} x_{d} = \sum_{i=1}^{n} x_{if}; \quad (3)$$

$$\sum_{i=1}^{n} x_{d} \in Z, \quad (4)$$

where x_{if} – the total students currently studying at schools of the region; x_{ip} – the total capacity of schools across the region; x_{d} – distributed students returned by the optimization model; Z – integer number.

By taking into account all the limitations offered for increasing the reliability of the optimization model applied for the secondary school network in a region with the purpose of considerable cost reduction, equations (1)–(4) can be used for calculating the optimal number of students having to study at each school. The model was checked on the example of Stakhanov city. To calculate the optimal numbers of students, we took into account all schools located in Stakhanov (Figure 1a) and governed by the Education department of the city council. The main economic disparity of these schools is that all of them have different cost amount per student. Some schools have capacity to teach more than 1000 students; however, their capacity is used only half. Consequently, such schools have high costs per student for providing educational services. Conversely, other schools have low capacity but are totally full with students. However, these schools also have high costs per a student due to deteriorated equipment and other fixed assets (systems of heating, water supply and electricity), as well as due to high costs of energy resources.

According to the previously considered cost approach to the optimal distribution of secondary schools across the territory, the main criterion of the equations (1)–(4) is the cost of providing educational services to students. Therefore, after all necessary calculations for current school network in Stakhanov, we defined schools reasonable to be closed and those required to be opened. In addition, students of closed schools should be redistributed across the schools left open (Figure 1b).

The Fugure 1b shows that schools required to be closed according to the model of school network optimization (1)–(4) are located in the same area. Some of them are neighboring institutions. Herewith, these schools are located in the city center with the most concentration of citizens and huge transport hub. We suppose that their closure is not logical and may evoke citizens' frustration. From another point of view, one can be an opponent to this suggestion since often widely known schools and university colleges are located far from the city center and occupy rural territories.

However, such campuses are for relatively permanent residence and studies. Ukrainian schools do not meet all requirements to become a place for students', mostly living at home.

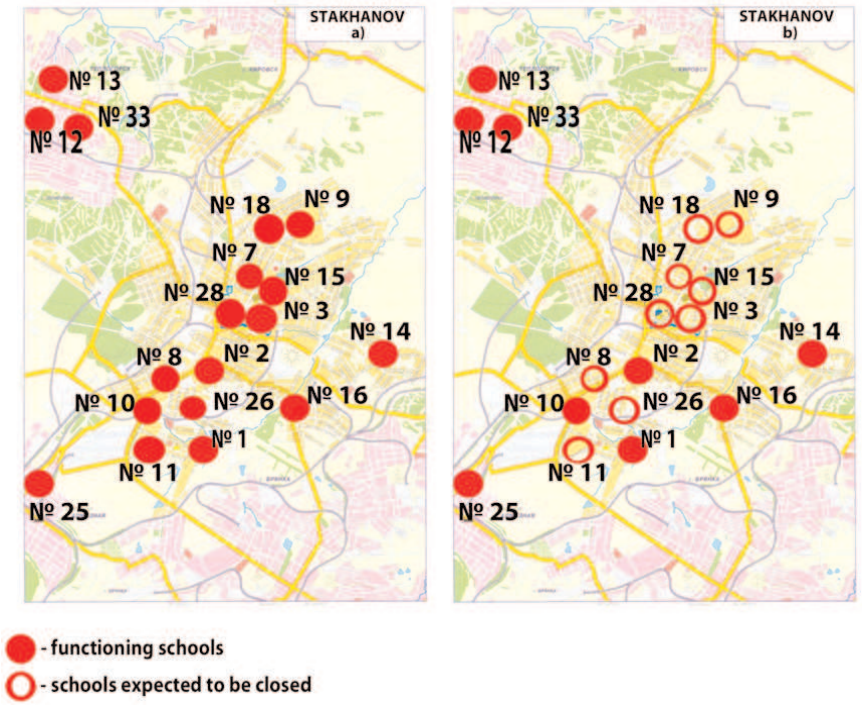

Figure 1. **School network in Stakhanov, Lugansk region, Ukraine: a) before employing the cost approach to its design and b) after using the equations (1)–(4),** *developed by the authors*

Schools to be closed according to the performed calculations under the cost approach (Figure 1b) are the best in terms of pedagogical staff and teaching techniques. They are the most authoritative and oldest in the city. They are the base of the city education and show strong teaching traditions. In case of their closing, the city will occupy lower positions in educational rankings of Ukraine.

By analyzing the results obtained due to the model (1)–(4) developed for the school network optimization according to the cost approach, we can conclude that this model provides us with incorrect and vague outcomes. For the purpose of saving financial resources of the local government, productive forces of the secondary school network are distributed across the territory in the way that schools providing high quality services and, though, demonstrate high prices are required to be abandoned despite high demand from students and their parents. If the factor of cost amount for providing educational services per student is either not taken into consideration or rather corrected by other factors reflecting the quality of educational services, then decisions on closing schools located in peripheral territories are not accurately proved and voluntaristic. The case is how to calculate the marginal value of the number of students studying at the school, which signals about the necessary closure of the

school. Some rural schools require less financial resources from local budgets because they have fewer students than some urban schools having many students up to their capacity level.

Therefore, we can conclude that the cost approach to the optimization of secondary schools network in the region described with the equations (1)–(4) is not accurate. It does not allow us take into account during managing spatial distribution of productive forces in the region such social factors as optimization quality of educational services, closeness to places of children residence and suitable transport infrastructure. Then we face the problem of not having optimal spatial distribution of secondary schools across the region with the objective of saving budgetary expenses. Obviously, this problem requires another approach.

Conclusion. The following points of the research need to be highlighted:

1. There is a problem of ineffective network of rural schools providing financial burden on budgetary funds in Ukraine. Some schools are working under their capacity and, thus, have too low productivity to continue performing. Managerial decisions on school network redesign require rationales.

2. Historically, rural network of schools is formed centrally by government and without free market mechanisms. Therefore, there was no need in economic efficiency consideration but there was a need in social responsibility. Spatial distribution of schools was managed and controlled centrally by the government making important decisions on the design of school network.

3. Among factors of spatial distribution of educational facilities across certain area are online education, globalization, productivity and profitability, industrial growth within the area, socialization reflecting the process or speed of transition from collectivism to individualism, which is important when analyzing online and face-to-face educational models, educational migration, population density, services diversification, closeness to plants that are usually located far from the city center due to environmental problems.

4. The evolutionary relationship between school choice and spatial distribution of rural schools showed 4 stages in the development of rural schools. We suggest that the next stage would reflect the growing popularity of rural schools among students in case of taking into consideration the current global trends.

5. Considering the current strategy of spatial distribution of rural schools reflecting the cost approach we offer the strategy oriented at online education and the strategy oriented towards closer relationship between educational system and real business.

6. Applying the cost approach to spatial distribution of secondary schools across Stakhanov city of Lugansk region according to the declared Ukrainian policy for school network optimization revealed its inappropriateness.

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