SOCIAL PROJECTS OF THE CITY:
EVALUATION OF THE INCLUSIVE EDUCATIONAL NETWORK

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The subject of the study is the process of evaluating the city's inclusive educational network. The aim is to increase the objectivity of decisions made in the process of forming a city network of inclusive educational institutions. An information technology (IT) for evaluating an inclusive educational network has been developed, which is based on the author's own methodology for studying information processes. The structure of IT is presented in the form of a data flow diagram to explain the sequence of processing and generalization of a set of factors in the formation of decisions on the state of an inclusive educational network and the search for ways to improve it. An experiment to study the capabilities of IT has confirmed the effectiveness of its use in assessing the existing network of the city and its districts. It was determined that the level of inclusion of the educational network in Kharkiv is more than 30%, with the largest inclusive network created in the Kholodnohirskyi district and the smallest in the Industrialnyi district. The obtained estimates make it possible to substantiate decisions on the development of the network and the creation of inclusive educational institutions of certain types in the city districts.

Introduction

UN experts (https://news.un.org/) estimate that the number of people with disabilities accounts for about 10% of the world's population, including 240 million children as of the end of 2021. According to the Center for Medical Statistics of the Ministry of Health of Ukraine in 2011, the proportion of children with disabilities aged 0–17 years was 2.1% of the total child population, which increased by 16.9% since 2005 (from 177.6 to 207.6 per 10,000 children aged 0–17 years) [1, 2]. Perhaps that is why, within the framework of the concept of sustainable development, in order to eliminate inequality and ensure attention to each child, the number of studies that examine various aspects of medical and social problems of such children and develop solutions for their adaptation to social life is increasing [1–3]. The experience of economically developed countries shows that the funds spent on the rehabilitation of children with disabilities pay off tenfold. Therefore, the global trend to educate all students in inclusive education systems is recognized as one of the most significant reforms. Creating an inclusive education network is the most pressing issue in the world. Numerous international documents, such as the Salamanca Declaration (supported by UNESCO, 1994), the Convention on the Rights of Persons with Disabilities (supported

by the UN, 2006), emphasize the importance of inclusive education as a way of teaching, raising and developing children, taking into account their needs and capabilities [3 – 5].

The reform of local self-government in Ukraine has given authorities significant powers and functions to make independent decisions on the provision of quality education. Therefore, inclusion issues can be successfully addressed at the local level, but in most cases, officials do not have the appropriate skills and knowledge to exercise the powers granted by law and need clear and understandable tools to help form a network of educational institutions capable of providing equal access to quality education in accordance with state standards. Given the annual increase in the number of children with special educational needs (SEN), the number of educational institutions that meet them is considered insufficient. Therefore, when formulating social projects and steps to improve the social sphere, it is necessary to understand the real picture and thoroughly identify possible areas of change [1, 2, 6].

Formalizing the process of evaluating an inclusive education network

As we enter the third decade of the twenty-first century, a significant number of countries face many sustainable development challenges related to environmental, economic, and social spheres. Their solution directly depends on the renewal and expansion of existing infrastructure systems, which, due to the financial crisis and budget deficit, requires careful justification [7]. Under these conditions, the development of an inclusive educational network is no exception, but given that inclusion can have different meanings in different contexts, it is important to understand that such a network is formed as a result of a complex interaction of historical, socio-cultural, economic and political factors. Taken together, they make it difficult to analyze and evaluate this network and to identify possible areas for its improvement [2, 4].

The process of evaluating the inclusive educational network of a city is an information process associated with data analysis and the formation of certain conclusions. According to the author's research methodology [8], we systematize the information flows of this process and conceptually present it in the form of a theoretical set model:

$$I\_\mathrm{Pr} = \left(V, O, A, \psi, Z, \varphi\right), \tag{1}$$

where $V = \{v_1, v_2, v_3\}$ – the set of input data required for the assessment of an inclusive educational network;

$O = \{o_1, o_2, o_3\}$ – the set of output data of the process;

$A = \{a_1, a_2, a_3\}$ – the set of operations performed during the assessment of an inclusive educational network;

$Z = \{z_1, z_2, z_3\}$ – the set of documents that regulate the process;

ψ, φ – the functions of outputs and updates, respectively.

The set $V = \{v_1, v_2, v_3\}$ of the model (1) combines the following data: on school and preschool children living in the city (input v_1), on educational institutions located in the city (input v_2), and on geospatial data about the city (input v_3). These data are necessary for convenient presentation of the final results of the study.

The set $O = \{o_1, o_2, o_3\}$, as a result of the process, combines o_1 – a database of children with SEN; o_2 – a database of educational institutions suitable for inclusive education; o_3 – assessments of the inclusive education network obtained during the implementation of the process.

The set $V = \{v_1, v_2, v_3\}$ is transformed into a set $O = \{o_1, o_2, o_3\}$ by sequentially implementing the operations of the set $A = \{a_1, a_2, a_3\}$, the elements of which form the evaluation sequence. That is, a_1 – the operation of assessing the demographic situation of the city; a_2 – the operation of assessing the existing inclusive educational network of the city; a_3 – the operation of forming estimates of the inclusive educational network of the city. The rules of this transformation are set by the output function [8, 9]:

$$\psi : A \times V \to O, \tag{2}$$

which clearly defines the output of the process depending on the input elements of the set V and the defined operations of the set A.

The internal content of function (2), in accordance with the rules proposed in [9], is given in Table 1, where each row corresponds to an operation a_i $(i = 1, ..., 3)$ of the set A, and each column corresponds to an input element v_j $(j = 1, ..., 3)$ of the set V. The cell at the intersection of the row and column indicates the

operation a_i to be performed when an element v_j enters the process input, as well as the output element o_l $(l=1,...,3)$ obtained as a result of the operation a_i.

<div align="right">Table 1</div>

<div align="center">**Table view of the output function (2)**</div>

Operations of the set A	Input elements of the set V		
	v_1	v_2	v_3
a_1	$a_1 \mid o_1$	$a_2 \mid o_1$	$a_1 \mid o_1$
a_2	–	$a_2 \mid o_2$	$a_2 \mid o_2$
a_3	–	–	$a_3 \mid o_3$

For example, Table 1 shows that when an element v_3 is received at the input of a process for an operation a_3, the output o_3 is formed as a generalization of the output o_1 obtained as a result of the operation a_1 and the output o_2 as a result of the operation a_2.

Infrastructure policy, urban growth, or sustainable development are areas that are significantly influenced by many interrelated economic, political, and social parameters, and decisions on their implementation require careful planning to set optimization priorities [10]. Therefore, a set of regulatory documents is needed to regulate the internal content of the information flows of model (1) during the transformation of input data into output. Within their powers, local governments form orders for the evaluation of the educational network, determine the parameters of the analysis, establishing a set of requirements taking into account the provisions of current legislation (for example, the Laws of Ukraine "On Education", "On Complete General Secondary Education", building codes DBN B.2.2-3:2018 "Buildings and structures. Educational Institutions", DBN B.2.2.-40-2018 "Inclusiveness of Buildings and Structures. Main Provisions", etc.) [2, 6]. Under the assumptions made, the set $Z = \{z_1, z_2, z_3\}$ combines z_1 – terms of reference for analyzing the existing inclusive educational network of the city, z_2 – requirements for an inclusive educational network, and z_3 – criteria for evaluating an inclusive educational network.

Normalization rules are set by the update function φ [8, 9]:

$$\varphi : V \times Z \to V , \tag{3}$$

which for each element of the set V determines the realization $v_j = \varphi\left(v_j, z_k\right)$ $\forall v_j \in V$, $\forall z_k \in Z$ provided that $j, k = 1,...,3$.

For example, the implementation of function (3) in the operation a_2 allows to form, supplement and expand the template of the database of educational institutions suitable for inclusive education. The implementation of $\varphi(v_2, z_2)$ fulfills the requirement to take into account information about the qualifications of teachers, the material base of the educational institution, the possibility of providing certain psychological and pedagogical and correctional and developmental services, etc. For a_3 realization, implementation of $\varphi(v_3, z_3)$ in the formation of assessments allows to consider possible forms of inclusive education provision in the planning area, to investigate the possibility of observing the principle of territorial accessibility of the educational institution, etc.

Thus, summarizing the identified information flows, operations, and functions of the I_Pr model, while maintaining the formality of presentation and facilitating perception, we present the model in the form of a data flow diagram (Fig. 1).
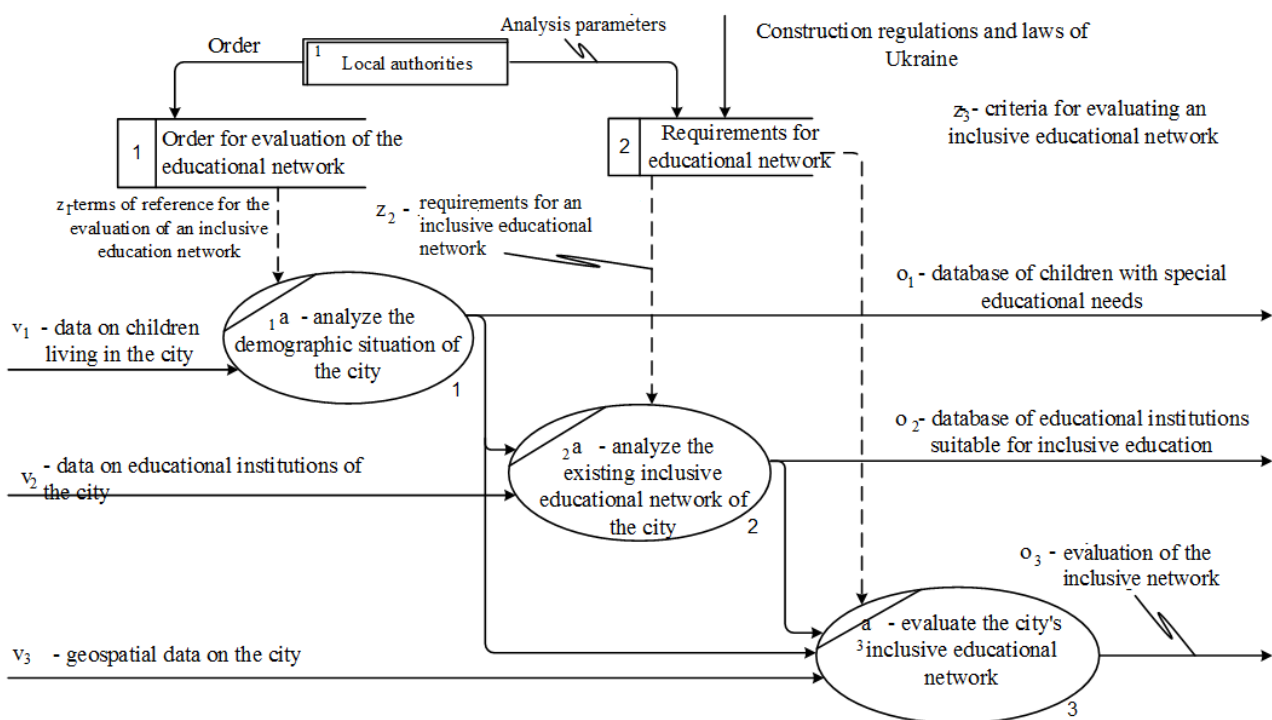

Fig. 1. Data flow diagram for I_Pr in Yourdon notation as a structure of information technology for evaluating an inclusive educational network

The proposed diagram contains all the data of the I_Pr model, their sources, the sequence of processing and transformation in accordance with the functions φ and ψ and defines the structure of information technology (IT) for assessing an inclusive education network. This IT, based on a consistent analysis of demographic and infrastructural factors, can become an effective tool for analyzing the inclusive

education network to understand the real picture and find possible areas for its change, focusing on the actual amount of funding for educational institutions.

Evaluation of the inclusive educational network in Kharkiv

As an example, let's consider the use of the developed IT to evaluate the inclusive educational network of the city of Kharkiv.

It should be noted that some of the input data required for the IT system is subject to the Law of Ukraine "On Personal Data Protection". Therefore, to illustrate the IT, we used open VGI (Volunteered Geographic Information), which is considered an alternative, effective mechanism for obtaining and compiling information, especially in spatial research [11]. In this case, the following sources of information were used:

– statistical data of the Main Department of Statistics of Kharkiv region (http://kh.ukrstat.gov.ua/);

– data on educational institutions from the Kharkiv Oblast Education Management Information System (https://kh.isuo.org/) and educational portals http://vneshkoly.com.ua/ and https://www.education.ua/ ;

– VGI about the study area from GoogleMaps (https://www.google.com/maps/).

ArcGIS Desktop and Excel were used as data processing tools.

Inclusive education as an international practice of education that promotes equal access is based on the existing educational network [2, 4, 12]. With this in mind, Article 7 of the Law of Ukraine "On Complete General Secondary Education" guarantees the right to education regardless of health status, disability, special educational needs, difficult life circumstances, etc. According to this, children with SEN have the full right to receive education in all educational institutions in distance and individual forms, and inclusion involves the education of such children not only in specialized boarding schools, but also in inclusive and special groups (classes) of general education schools (inclusive resource centers). This contributes to their adaptation and socialization regardless of their learning abilities [3, 12, 13]. Therefore, information about general education schools in Kharkiv was added to the database (output o_2) if, according to the conclusions of specialists, a child can receive inclusive education, and this education can be organized at school.

Fig. 2 shows an example of the formation of possible estimates of the inclusive educational network of Kharkiv for operations a_3 by generalizing the outputs o_1 and o_2, as the results of operations and, respectively, and the input v_3 .
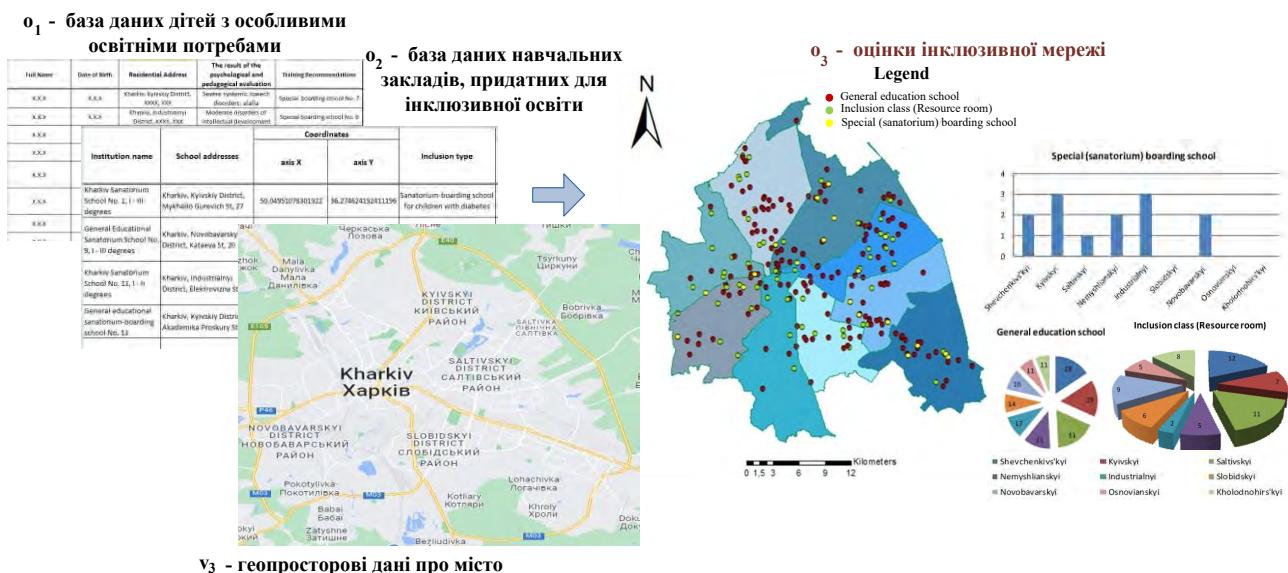
Fig. 2. Formation of o_3 output in the process of using IT-assessment of the inclusive educational network of Kharkiv

The structure of inclusive education in general secondary education institutions of Kharkiv is formed by 65 inclusive classes (resource rooms) and 13 specialized (sanatorium) boarding schools. With this in mind, the level of inclusion of the city's educational network can be calculated using the formula [2]:

$$K_{incl} = \frac{n_{incl}}{N} \times 100\%,\qquad(4)$$

where n_{incl} – number of schools with inclusive education of different types;

N – total number of general secondary education institutions.

According to the formula (4) $K_{incl} = 30,59\%$. This indicates that local governments promote the implementation of inclusive education in the city [2, 6], but a more detailed analysis of the distribution of schools by district (Fig. 3) shows the following.

The highest level of inclusion is in Kholodnohirskyi district (42.1%), which, in our opinion, was made possible by the introduction of inclusive classes (resource rooms), positive attitudes of teachers towards inclusive education and wide involvement of teachers in the education of children with SEN. The lowest level is in the Industriyalnyi district (22.72%), despite the fact that there are 3 specialized (sanatorium) boarding schools in the district. However, the creation of inclusive and special classes on the basis of secondary schools is very slow. It should be noted that in Kharkiv's largest district, Kyivskyi, the inclusion rate is 26.31%. This requires educational activities among teachers to form their positive attitude towards inclusive

education, and the wide involvement of psychologists and correctional and developmental specialists in the education of children with SEN. Attention should also be paid to the development of inclusive classes (resource rooms) at secondary schools, the number of which in the Kyiv district is one of the largest in the city.
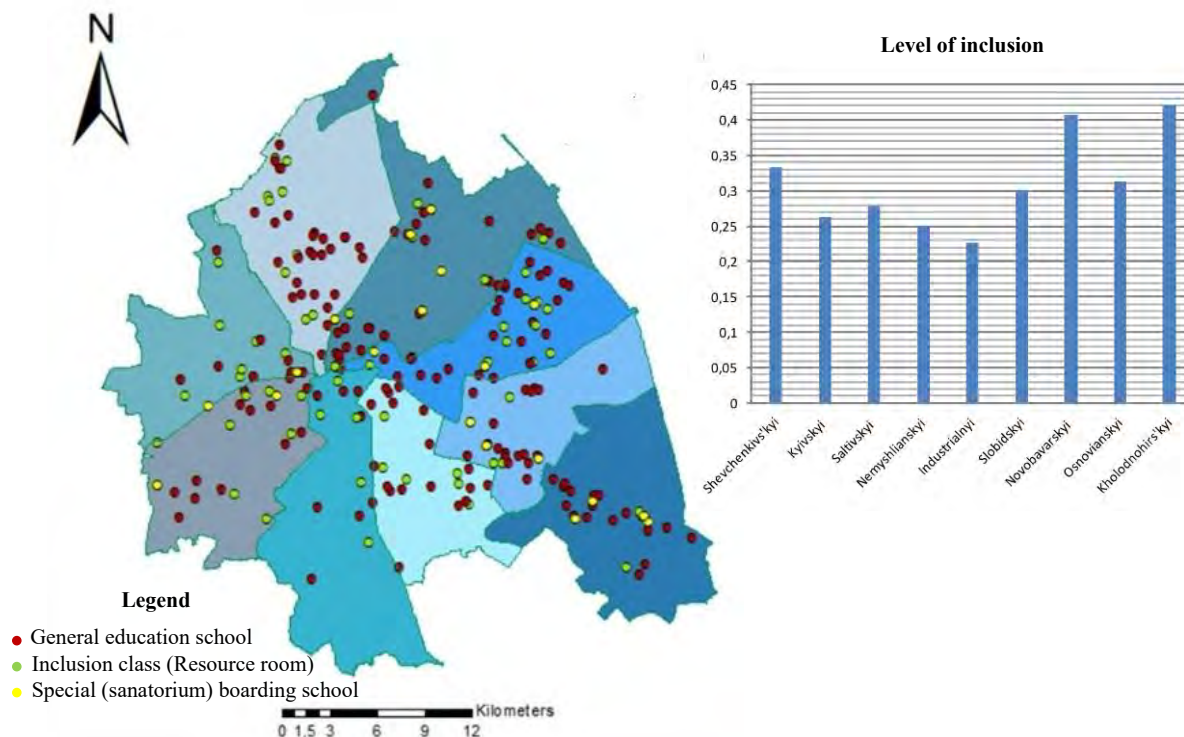

Fig. 3. Evaluation of the level of inclusion in the educational network of Kharkiv districts

It should be noted that teachers' good attitude to inclusive education, their retraining for inclusion, and support from the administration [2, 13, 14] contribute to the fact that the number of inclusive classes in Kharkiv is increasing. A study of their distribution across the city (Fig. 4) shows that the largest number of classes is concentrated in Shevchenkivskyi (12) and Saltivskyi (11) districts, the smallest – in Industrialnyi (2), Nemyshlianskyi (5) and Osnovianskyi (5) districts.

After analyzing the educational network of the most populated Saltivsky district, where more than 250 thousand people live, it is significant (Fig. 5):

– the level of inclusion in the district is 27.9%: inclusive education is provided by a special boarding school No. 3 and 11 inclusive classes based on secondary schools;

– the number of general education schools in Saltivsky district is the largest in Kharkiv, so the number of inclusive classes (resource rooms) can be increased if necessary.
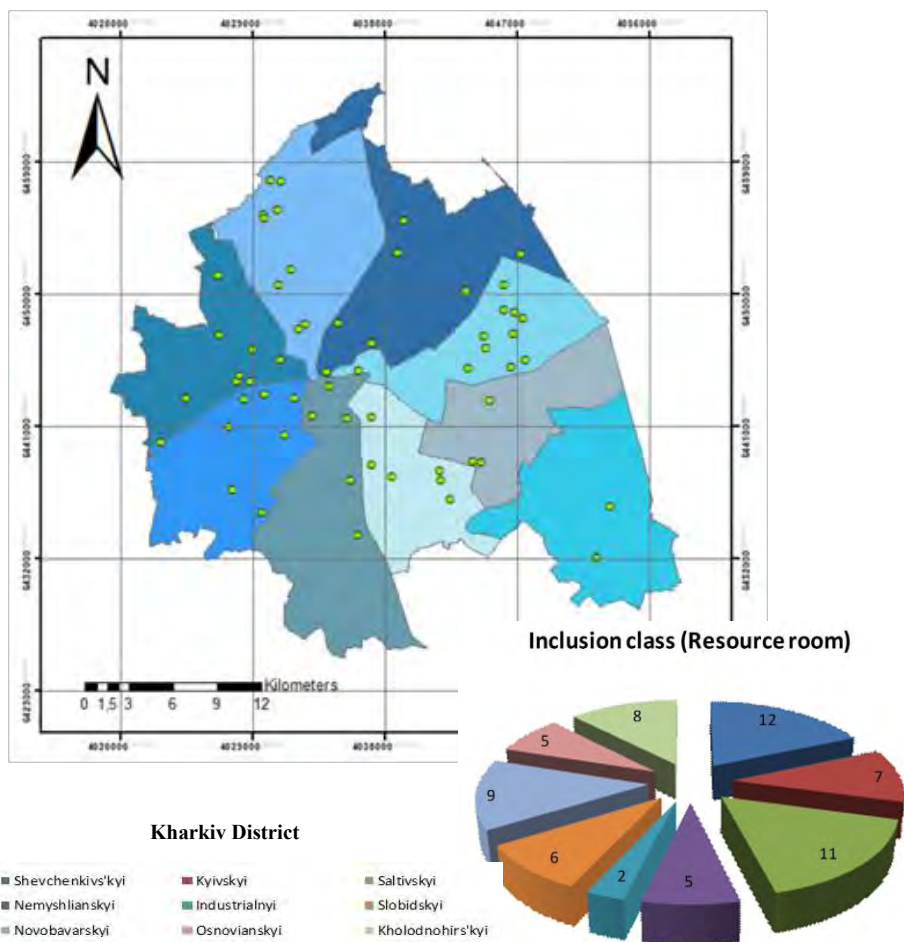
Fig. 4. Distribution of inclusive classes (resource rooms) in Kharkiv districts
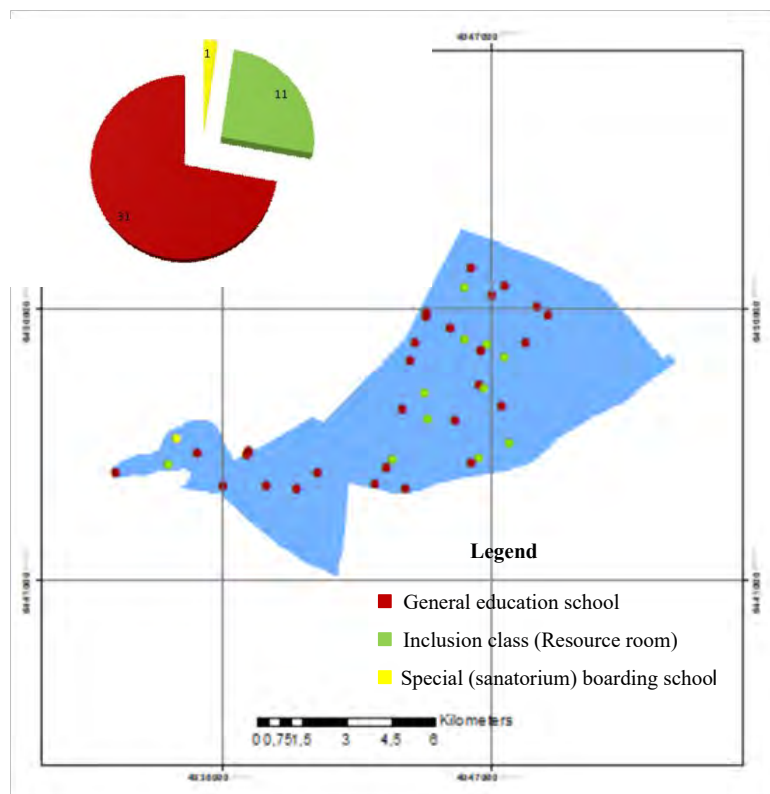

Fig. 5. The structure of the educational network of the Saltivsky district of Kharkiv

The Kharkiv Inclusive Resource Center contributes to the goal of increasing the level of inclusion and ensuring the rights of children with SEN to education. It is also located in Saltivsky district. The center cooperates with educational institutions, provides methodological assistance to teachers on supporting children with SEN, and promotes the organization of inclusive education in groups and classes of educational institutions in Kharkiv [6].

Conclusions

Current research confirms that inclusive education for children with SEN is a global trend [5, 14]. Therefore, social projects that promote equal rights and opportunities in the education of such children are and will be relevant [2, 3, 12].

As part of the local government reform, there is a need to create tools that help increase the objectivity of decisions and thoroughly determine the directions of development of an inclusive educational network [2, 6]. An IT assessment of the city's inclusive educational network has been developed. As a tool for its implementation, the methodology for studying information processes has been further developed by refining the theoretical and multiple model of information flows [8, 9]. Based on regulatory documents, the proposed IT combines demographic and infrastructure data from various sources. It takes into account the logic and dynamics of their interaction, explains the sequence of their processing and presentation to support decision-making in the formation of an inclusive educational network of the city and the search for ways to improve it, taking into account possible options for improvement. The estimates obtained in the study show that IT can be used to process large amounts of data, obtain objective results, and adapt them to real requests for inclusive education in the city.

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