Mapping and visualisation of activities in special education

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Abstract

The paper deals with geographical identification of territorial distribution of activities within special education in the Czech Republic. It response to the research questions: What are territorial differences in content and volume of special education at national level? Are there any regional disparities? The research was designed to collect territorial arguments about legislation, infrastructure, activities and visions for governmental and management decisions in policy of special education in the Czech Republic. The authors applied several scientific methods – a standardized form for recording of particular contact the teacher with child in Special Education Centre, database design, spatial analysis, map and atlas compiling. The study confirms a significant increase of disability in higher age and dominant role of the family in the care for a person with disability. It brings the principal arguments in the form of relevant document – the Atlas of Special Education Centre in the Czech Republic. Its thematic maps give an overview concerning the distribution of special needs centres, ie some regions have no centre that specialise in all disabilities, the ratio of specialists in centres etc. The research confirmed the dominant role of regions as special needs centres authorities. Based on a unique survey the study quantified special needs centres activity regarding their stance to proposals to dominant means of special pedagogical support – teacher’s assistant.

Key words: special education; atlas, map; disability; spatial distribution.

1. Introduction

In the Czech pre-school, primary and secondary education, the educational services are provided to approximately 1,656,000 children (312,000 in kindergarten, 788,000 in primary schools and 556,000 in secondary schools) (EACA, 2011). Almost 103,000 children of these are children with special educational needs (including disability, health deprivation and social disadvantage). In particular, children with physical disabilities and physical handicaps use the services of Special Educational Centres (SECs), one of two types of school...
counselling facilities in the country. The main SECs’ task is defining (diagnosis and counselling) special educational needs for children, pupils and students on grounds of disability at kindergartners, primary and secondary schools in the whole country. In a broader context, the SEC clients are also students’ parents, guardians (legal representatives), teachers and schools in which pupils are educated.

The SECs’ activities affect the success of training tens of thousands of children. In many studies (for example Michalík, 2011) the high dependence of families caring for children with disabilities in institutions, advisory and consulting field were confirmed. Questions of optimization of network devices, as well as the availability of services for the target group are widely discussed in the Czech Republic. However, the discussion is so far without processing adequate measurements and analyses by means of special education and also by spatial (territorial) approaches. Therefore, a unique project within a system of measuring the availability of counselling and diagnosis of SECs in the Czech Republic for public authorities (Ministry of Education, regional authorities, etc.) was conducted. That system resulted in a unique set of data and cartographic output. Geoinformation technologies, mainly geographic information system (GIS) tools, were applied for the spatial information integration of all investigated activities and for the advanced calculations in order to detect all the arguments for the network optimization and the SEC activities (Voženílek, 2002, 2009).

One of the main project objectives is to create a unique data set of cartographical outputs which express the availability of consulting and diagnostic SECs’ advisory in the Czech Republic. The GIS tools were used to manage spatial localization of all investigated activities and to suggest all possible changes for their optimisation.

2. Objectives

The objectives of the research were targeted into three topics that concerned to SECs and follow directly at each other – to map the principal aspects of special education system the Czech Republic (mainly infrastructure of SECs, its organisational and professional activities and transport accessibility of SECs), to analyze collected data in order to receive unique information for decision making in the Czech special education system and finally to visualise them in maps and thematic atlas. All information was related to 2011.

3. Mapping

The Czech SECs are part of the pedagogical-psychological counselling system to children, youth and their parents, teachers and other educators. The SECs’ activities include the systematic special education, psychological, diagnostic and advisory work with children of the target group. Primarily it is for pupils with special educational needs by reason of mental disability, physical, visual, auditory, speech disorders, autism spectrum disorders and the combination of the so-called basic disability. Providing appropriate special educational support is an essential prerequisite for the successful education of this group of students (Michalík, 2012).

The SEC network in the Czech Republic covers the needs of students with disabilities at an insufficient level (particularly in terms of accessibility).

The research was based on an objective assessment of the availability of appropriate services of the special educational centres in terms of their spatial locations within the territory of the Czech Republic, to assess the volume, type and selected aspects of their activities. This objective is fulfilled through cartographical visualization of information of investigated themes. The basis for the preparation of the ASPEC maps was on two datasets describing:

- the infrastructure of the SECs’ network,
- the volume and type of the SECs’ services to their clients.
The SECs’ infrastructure was mapped in sense of SEC specialisation, staffing, facilities and other characteristics, whose complete list is given in Table 1. There are totally 105 SECs in the Czech Republic (without detached units). Information about the SECs’ infrastructure have been identified in collaboration with the staff of regional offices and the Ministry of Education, part of which was provided by the Institute for Information on Education.

Table 1. The overview of the mapped characteristics of the SECs’ infrastructure

<table>
<thead>
<tr>
<th>mapped characteristics</th>
<th>possible attribute</th>
</tr>
</thead>
<tbody>
<tr>
<td>SEC address</td>
<td>region, city, street, postcode</td>
</tr>
<tr>
<td>SEC founder</td>
<td>Ministry of Education, regional authority, municipal authority, private founder</td>
</tr>
<tr>
<td>Year of SEC establishing</td>
<td>mental, physical, visual, auditory, speech disorders, autism spectrum disorders and combined</td>
</tr>
<tr>
<td>SEC specialisation (disability)</td>
<td>asked whether the SEC has a specialist for mental, physical, visual, auditory, speech disorder or autism spectrum disorders</td>
</tr>
<tr>
<td>SEC staff</td>
<td>Total number of employed</td>
</tr>
<tr>
<td>SEC staff structure</td>
<td>Number of special educators, psychologists and social experts</td>
</tr>
<tr>
<td>Specialisation of special educators</td>
<td>description of standardized instruments for measurement of selected areas, such as intellect, family climate, school climate, pathopsychological phenomena, ADHD / ADD, school readiness and others</td>
</tr>
</tbody>
</table>

Relatively comprehensive pilot survey to verify the structure of survey data on services was designed and brought well structured SEC data collection for further investigation. Pilot data collection which was attended by SEC of two regions was conducted from September to December 2010. The basic element, that was verified (and subsequently used during the actual data collection) in the pilot testing, was the record of each "SEC educator’s contact with the client." Therefore, each SEC staff recorded selected range of information about each service provided by the client. To ensure anonymity necessary (it was a procedure with the data bound to a disability, so-called sensitive personal data under the Act) personal information such as name, exact date of birth and address of residence were not recorded.

Data containing information on gender and age of client, type and severity of his disability, and other (for details see Table 2) were monitored. Record geolocation was made by postcode of residence of the client and the place where the SEC educator contacted the client.

Table 2. Collected data on the volume and type of services provided to clients by own exploration of SECs

<table>
<thead>
<tr>
<th>mapped characteristic</th>
<th>possible attribute</th>
</tr>
</thead>
<tbody>
<tr>
<td>date of contact</td>
<td>number of week in year</td>
</tr>
<tr>
<td>gender of client</td>
<td>girl, boy, group of client (gender is not recorded)</td>
</tr>
<tr>
<td>age of client</td>
<td>categories 0-2, 3-5, 6-11, 12-14, 15-19, 20-26 years</td>
</tr>
<tr>
<td>school grading of client</td>
<td>attended grade in school</td>
</tr>
<tr>
<td>residence of client</td>
<td>postcode and municipality name</td>
</tr>
<tr>
<td>place of contact</td>
<td>SEC, client’s home, social welfare institution + postcode and municipality name</td>
</tr>
<tr>
<td>form of transport</td>
<td>bean which transported the client, or employee - car, city transport, walk</td>
</tr>
</tbody>
</table>
accompany of client themselves, a family member, teacher, someone else
depth of client’s disability none, light, moderate, severe
kind of disability client mental, physical, visual, auditory, speech disorders, autism spectrum disorders and combined
kind of contact examination, education, reeducation, screening, etc.
who initiated the contact client itself, SEC, court, doctor, etc.

The SEC educators used the paper form (Fig. 1 left) to notice all required information about the meeting with a client (or immediately after). Once a week, all paper forms were recorded through a web form project (Fig. 1 right). Two-stage data collection (first fill out the paper form and then copy it into the web form) was designed from two reasons. The SEC staff usually does not use a computer during contact with the client and in many cases (diagnosis, screening) the typing of records could act inappropriately and disturbing. The data was stored in spatial database for further analysing in GIS.

After optimization of survey information in the pilot survey the web-based environment for data input system was adapted to be easy for the SEC staff.

From January to December 2011, collecting information and field offices in 86 SECs in all regions of the Czech Republic (excluding Prague) was organised in the main survey. Also data on contacts of SEC focused exclusively on children and students with mental disabilities were not collected due to wide network of this type SEC (de facto in each district). In contrast, the SECs focused on other disability are established in only one region (rarely some regions are without any centre). For the entire period of data collection (except for pilot collection), over 76 000 records of client service provided by the SEC were captured.
4. Analyses

Data for analyses were obtained in two ways: by providing their own research and government organizations, the Institute for Information on Education and the Czech Statistical Office. The Atlas has processed information from the investigation that took place during the years 2010-2012.

Spatial analyses of the activities of the SECs provide a basis for decision-making activities founding institutions, justification of optimization of the network and subsequent SECs’ services. Therefore, the authors performed various spatial analyses, for example location accessibility by network analysis, and identified regions with insufficient percentage of special education. All results from spatial analysis inform about the SECs’ activities and can also serve clients with special needs and their families to find a specific place of care.

4.1 Analyses of the SECs’ infrastructure

Special educational centres in the Czech Republic are established for six kinds of "basic" disability and for combined disability. Half of the centres are set up for single disability, half of centres for two or more (up to 6) kinds of disability. Historically, the municipalities set up the centres with one specialisation, while later they gained more specialisations on other disabilities to cover SECs availability in the region. Poor accessibility of the SECs in the south of the capital Prague is related to the low number of centres in the southwest, south and southeast regions.

While the distribution of the SECs for mental disability is relatively uniform and sufficiently dense throughout the national territory, distribution of centres with other specialisation shows large territorial differences (Fig. 2). In western part of the country, most centres are concentrated in the centre (20 centres), while in other large cities there are only a few centres and then there are only cities with a single centre. Very rare distribution of SECs in western part of the Czech Republic in areas outside major cities reaches the extreme in the southwest of the country, where there are only five cities with the SECs. In contrast, in the east of the country there are nine cities with more than one centre, while a total distribution of the centres is regular.
Special educators are indispensable for quality activities of the SECs. In general, at least one special educator with the appropriate specialisation works in any SEC, which is focused on particular disabilities. The largest number of special educators is focused on mental disability, which corresponds to the high number of SECs of this kind, and speech impairment as a result of a large number of clients of these centres. Special educators focused on more kinds of disability are very rare. Likewise, the centres with special educators for more disabilities than those targeted are the exception. Still, there is the number of centres declaring specialisation on particular disability, even though they do not have special educators with appropriate specialisation.

4.2 Analyses of organizational activities of the SECs

The SEC clients in the category of children, pupils and students are represented in the structure by sex in various centres more or less equally – boys two thirds and one third of girls. This corresponds to the ratio of the number of beneficiaries aged 0-19 years on care – 60% boys, 40% girls for 2010 indicated by the government. Only a few centres show extreme values. They are mostly the centre focused on children with autism spectrum disorders. Only two SECs serve more girls than boys. Compared to population ratio (51.5% boys and 48.5% girls), it is a significantly higher proportion of boys as SEC clients.

Special education centres provide services to its clients primarily (65.9%) in centre domicile and their branches (Fig. 3). In some centres, staff departs for clients into schools (31.6%) and more rarely into the client's home (1.1%) and social service facilities (0.7%).
Transport plays a role in organizational activities SEC in two basic forms (transport clients to the city centres and transport workers for clients) and three types (walking/cycling, public transport and individually). The transport of the clients to the centres dominates over the transport for the clients in most centres. Rate of this difference is surprisingly high. Some centres depart for the clients very rarely. There are only seven centres, which provide a greater number of interventions in the field than in the centres and the transport for the client prevails. The surprise is related to the determination of the basic activities of the SEC which is to be support for education target groups (pupils in schools). This is probably a result of personnel and material conditions. A combination of forms and modes of transport is very diverse. The majority of the clients served by the foot (in the form of outpatient work in central and field at school or elsewhere) of four SECs is rather exceptional. This indirectly confirms that clients residing directly in the town which houses the SEC use their services more frequently than clients from distant settlements.

4.3. Analyses of professional activities of the SECs

The largest number of professional staff is in the SECs in the eastern part of the country where there is the largest number of potential clients (in and around Prague). Demographically the largest region (around Prague) is equipped with a relatively small number of professional staff. It is obvious that the clients of this region commute to SECs in Prague. Demographically the weakest regions have the least professional staff in the SECs. Special educators are present in all centres and in some centres they consist of 80% of professional staff, while social specialists are missing in a number of centres.
SECs reporting the largest number of clients are mostly focused on clients with speech impairments. SECs can be divided into two large groups. The first group provides services predominantly or almost exclusively to the clients with one kind of disabilities (mostly speech, hearing, autism spectrum disorders). Four centres provide care to the clients with only one disability. There is still a noticeable specialization of traditional centres at large special schools. The second group covers need for a wide range of disabilities. There are more than half of these centres (Fig. 4).

Persons without disabilities make up a tiny portion of clients centres. These are clients who have received services such as the screening. In the survey, most clients SEC showed a low disability. SECs with a focus on speech disability prevail. The clients with moderate disabilities are in SECs relatively evenly. There are a high number of the clients with speech impairments in the centres on the east of the country – in some SECs they make more than a half or even two-thirds of all clients. These are the SECs at "historic" special schools in many cases. Statistically significant differences in the depth disability in each SEC mismatch the actual distribution of depth of disability in the Czech population and show the absence of a mandatory uniform methodology for assessment of depth of disability for the purposes of education.

There are significant differences in the content of the SECs’ activity (type of service). Each SEC provides service "investigation" and “comprehensive investigation” in most SECs. However, these activities are in a smaller proportion to total amount of contacts to client. In many SECs “re-education” and “education” dominate. Several SECs provide more than three quarters of activities such as “education”. Only three centres have “re-education” as the dominant activity. “Intervention” dominates in seven SECs. In general, “screening” is
significantly minor – only a few centres provide about 5% of this activity. This analysis indicates inconsistencies in methodological guidance of SEC activities in the country.

4.4. Analyses of transport accessibility

Time accessibility of SEC in the form of individual road transport according to the rules road traffic of valid in 2011 was calculated. Data model road transport network in scale 1: 500 000 with an attribute describing the time-consuming (how much time is required to move within the road network) was designed. Since the average speed on roads is also affected by the state of the vehicle (allows its maximum speed), road width and number of lanes in one direction (which increase the average speed), a lower average speed than the maximum permissible speed, were considered in the calculation. The calculation itself was performed by network analysis within GIS.

Analysis of traffic accessibility to SEC provides answers to the question: for how many minutes you transport clients to the nearest SEC with his/her disability? Arrival time was calculated after 10 minutes. Accessibility areas of SEC (belonging a particular place to particular SEC) were calculated from the time of transport accessibility of SEC by individual transport. Accessibility areas of SEC were calculated to the city, which houses at least one SEC.

The accessibility areas of 82 cities with SEC domicile generate relatively small territories, as confirmed by the density of the network of these facilities. The only exception is the area of Pilsen city and south of Prague, where due to the concentration of the SECs in the regional capitals (and Prague) the accessibility areas are much larger. It should be noted that the analysis provides accessibility area of all centres without distinguishing their specialisation (Fig. 5 and 6). Thus, the analysis shows the SEC for the first contact with the professionals, however it can be misleading in terms of areas focusing on particular disability. Accessibility to the nearest SEC regardless of its specialisation is always the same, or usually better.

Analysis of accessibility areas of SEC provides answers to the question: which city is the closest to the SEC with particular specialisation?
5. Visualization

Visualisation is the way of presenting information by the visual means – drawings, graphs, maps etc. The authors developed so far neglected form for presentation of new findings in field of special education in the Czech Republic and worldwide as well. All maps have strong potential for further research by means of advanced computational methods introduced by authors (Dvorský, Snášel & Voženílek, 2010, Tuček, Pászto & Voženílek, 2009).

The research resulted in the concept, contents and visualisation methods of the Atlas of Special Education Centres in the Czech Republic (so-called ASPEC atlas) (Voženílek & Michalík, et al., 2013). The unusual theme of the atlas is reflected in the choice of cartographical visualisation methods (some of which are used rather
rarely). The ASPEC atlas presents a large amount of knowledge about the infrastructure, activities and performance of the SECs by most clear and simple way. The content of the Atlas is understandable without deeper knowledge of special educational user issues. The greatest attention is given to the activities of the SEC, ie information about what services the SEC offers its clients, which facilities are at SEC, etc. The addition of these characteristics is the processing of information on existing SECs’ infrastructure and its historical development, which includes for example review of the availability of individual departments in the SEC region. Additional texts acquaint readers with the terminology, issues and research methods.

The ASPEC atlas is thematically focused on the visualization of the results of research activities of the SECs in 2010-2012. The main mapping unit is the special education centre, the secondary units are municipalities, districts and regions of the Czech Republic. The Atlas expresses the result of partial statistical and spatial analyses and geographical syntheses of many aspects of the activities pursued by the SEC. Geometric and thematic topicality of spatial information is valid as at December 12, 2011.

The Atlas has been compiled in book form in A4 landscape format with a link to a short (left) edge. The main map scale of the Atlas is 1 : 1 300 000, in which most maps have been completed (Fig. 7). This scale was chosen with respect to carrying map complexity, their readability and practical usability. The aim was to provide the reader with a comprehensive overview of the distribution of research results in the whole country, while allowing information to read for the most detailed level expressed phenomenon – a single SEC. The additional map scales are 1 : 4 50 000 and 1 : 1 500 000, which were used for the transparent maps with different mapping units. In the Atlas there are also text fields, images, graphs, charts, diagrams and tables.
The content of the Atlas is divided into eight sections, as follows:

1 ISSUES OF SERVICES FOR PERSONS WITH DISABILITIES
2 DEMOGRAPHY OF PEOPLE WITH SPECIAL EDUCATIONAL NEEDS
3 INFRASTRUCTURE OF SPECIAL EDUCATION CENTRES
4 ORGANIZATIONAL ACTIVITIES OF SPECIAL EDUCATION CENTRES
5 PROFESSIONAL ACTIVITIES OF SPECIAL EDUCATION CENTRES
6 TRANSPORT ACCESSIBILITY OF SPECIAL EDUCATION CENTRES
7 CLIENTS WITH MENTAL DISABILITY
8 VISION, OPPORTUNITIES AND RISKS OF ACTIVITIES OF SPECIAL EDUCATION CENTRES

For the best readability of expressed information the simple and commonly used methods of thematic cartography, especially the method of point and area features, were applied to visualize mapped themes. All relationships in the map key base on theory of map language (Voženílek & Kaňok et al. 2011) are strictly followed in the graphs, diagrams and visual style of the ASPEC atlas (Fig. 8).
Fig. 8. Examples of thematic maps in the ASPEC atlas

Besides cartographic visualization of data obtained in the investigation, the Atlas is completed with a range of statistical evaluation presented in graphs and tables. Each chapter involves professional (special educational) evaluation of the topic and also evaluation of statistical and cartographic outputs.
6. Conclusions

The ASPEC atlas is an overview of SEC in the Czech Republic with an indication of contact addresses. It is intended primarily for SEC managers, personnel of departments of education and social affairs of the public authorities, the relevant department of the Ministry of Education and Ministry of Social Affairs and the wider public.

The ASPEC atlas provides a comprehensive overview of the activities of the SECs in the Czech Republic, including the historical development of the network of these institutions. The map products on this topic have not yet been published separately, so the Atlas is a unique presentation of spatial characteristics, together with an evaluation of interdependencies.

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The informational value of the Atlas will be used at all levels of the educational system of the Czech Republic. Ministry staff and regional offices (these authorities act as founders of the vast majority of SECs) acquire irreplaceable and still undetected in the Czech Republic on the structure of SEC activities, availability of services for clients of different groups (children and students, parents, schools) and in particular more or less (not) justifiable differences in activity comparable type of this type of advisory bodies. The SEC staff not only get in the Atlas epic presentation of its kind resource, but also they can, by comparing the selected output data and geoinformation consider the organizational design and content correction own activities. Finally, the Atlas meets the last entry made by investigators of the project: to provide a strong basis of the arguments of children and parents of students with disabilities (possibly their organizations) in their logical requirement for high-quality, standardized, accessible and professionally acceptable time special education diagnostic or advice service.

The Atlas becomes a strong argument and a source of expert claims for political decision-making at regional and national level.

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