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LEARNING THE SPACE

THE CHANGE OF SPATIAL COGNITION OF A CITY CENTRE BY HIGH-SCHOOL STUDENTS IN THE LIGHT OF MENTAL MAPS AND SKETCHES

ABSTRACT

Gaining knowledge is a lifelong process. Humans tend to learn new things entire life, especially in recent, technologically-demanding times. This process is contradicted by lowered learning potential with aging and is often economic-dependant too, so the digital divide is a serious, growing problem. The fact of learning and gaining new thing can be easily transposed to cognition, including space cognition as people learn space. Beside formal education with maps, atlases and GIS, one learns by experience and interaction with that space. Education can be seen as a duty and to some it may be unpleasant. Gaining knowledge about the environment by simply using it, exploring, and living in it is trouble-free – it is not to be tested like the formal knowledge is expected to be. One can benefit only by gain extra skills in space-perception and orienteering. These skills are pretty useful while a bit diminishing recently due to global positioning and location based digital services which offer a ready-to-use solutions and answers without experiencing spatial-problem solving processes.

This paper tries to explore the process of learning a new place and finding evidences of it and ways to present it. The case study deals with high-school students coming to schools in the city of Lublin from outside it (not living there). It is expected their knowledge changes (increases) during the whole education process – from the first to the third class. The method used to test students' knowledge is drawing mental sketches, analysing and translating them into GIS environment to visualise and explore.

Mental mapping is a method with over half of the century research tradition, but with some controversies. The first is the terminology as "mental map", "sketch map" and "cognitive map" are sometimes used as synonyms while sometimes the differences are pointed out. In the second case "cognitive" is a term related to cognition and psychology, "mental" to storing information in user's memory and "sketch" being a graphical representation of this information (Nieścioruk, 2016; Götz and Holmén, 2018). The other possible problem with sketch maps relates to its literal sketch nature as for surveyed users (respondents) who are on different level of drawing and spatial awareness skills it is hard to compare the results. Maps may be influenced by the initial form of a base material. From blank sheet of paper

(so-called basic sketches) to background-data filled sheets (cued mapping) (Kitchin, 1996), from paper and pencil to touch-screen or mouse – all this can be a potential source of problems.

Regardless the precise definition of the term, mental mapping has a long tradition in the field of psychology and geography – or broader – space-related science as pioneering work of Lynch (1960) deals with city environment and architecture. It was followed by more Earth science works of Gould (1966) and Gould and White (1974) and – later – by broad fields of implementation. Different aspect of sketches and different aspect of cognition were and still are analysed. The most obvious is to use mental sketch as an insight into human perception of a place, no matter how the place itself is defined. It can be a small, local, often build-up area of a city with different aspects of life and living in the place and its valuation in mind (Rengert and Pelfrey, 1997; Gendźwiłł, 2006; Dobák, 2007; Boschmann and Cubbon, 2014; Skryhan, 2016), but also an image of global or regional spatial ideas (Saarinen, 1987; Padło, 2015; Bláha and Nováček, 2016; Holmén, 2018).

Beside knowledge of the space, other aspect of cognition can be tested with sketches. Despite some technical problems with drawing abilities and paper limitations, spatial distortion are often tested, showing how space is perceived against proper metric relations. Revival of this approach can be seen as a result of technical advance in the field of geoinformation tools (Waterman and Gordon, 1984; Lloyd and Heivly, 1987 Huynh and Doherty, 2007).

GIS opened new possibilities in analysing mental sketches, gathering data and visualizing the results, but also created some new problems with data loss and digitization of data as well as digital acquisition and problems with on-screen drawing (Huynh and Doherty, 2007 Bell and Iong, 2009; Bláha and Nováček, 2016).

Mental sketches, from the point of view of cartographers, are profound source of information not only about the space, but also about cartographic literacy, skills and design. Hence it can serve as a tool to test the knowledge of cartography students or test maps as commercial products as seen by their users (Nieścioruk, 2016 Bláha and Hudeček, 2010).

Students are important group of participants of mental mapping experiments as these tests are often organized in an academic environment. School pupils are similar case and their education process includes space-related classes of geography (Żyszkowska, 1996; Huynh and Doherty, 2007; Öcal, 2011; Bláha and Pastuchová Nováková, 2013; Nieścioruk, 2013; Padło, 2015; Bláha and Nováček, 2016; Costa and Bonetti, 2018; Holmén, 2018). Special groups selected on purpose are often tested as well, with attributes of residence place, profession, interest, ethnicity or social behaviour patterns being highlighted (Lloyd and Heivly, 1987; Feinberg et al., 2003; Kulczyńska and Matykowski, 2011; Boschmann and Cubbon, 2014; Mitchell, 2014).

CASE STUDY

This paper, dealing with a classic use of mental sketches, is a part of a broader project on cognition, learning the space and cartographic skills among young people. The described part of the research concentrates on the use of mental sketches in the field of analysing spatial features perceived by test group members and to check if their qualitative and quantitative characteristics change with the process of increasing space knowledge with age and experience. The methodical problem of cartographic visualisation of data is discussed as well.

The survey took place in Lublin (Poland) in the beginning of school year 2017-2018 and its participants were high-school students. The survey group comprised of students of two schools (third level of compulsory education[1]) and three classes each. One school was the State Schools of Construction and Geodesy (a profession technical school, later referred to as TG) and the second school was the 16th High School at A. and J. Vetter Economic Schools (later referred to as HS). In both cases 3 classes were tested, what – in case of TG – was not a full spectrum as this school comprises of 4 classes. It was done to guarantee comparable results however. The survey tested spatial and mapping skills hence it should be mentioned HS students had more general geography lessons, while TG students had more map-related topics taught during their professional subjects.

During the research over 100 students were surveyed, but a dozen of sketches were useless due to misunderstanding the task or unreadable materials. Ninety-one sketches were used to analyse the definition of city centre (Nieścioruk, 2019), as it was the main goal of the survey (see below). Of this group 58 sketches (19 of the first, 21 of the second and 18 of the third class students) were taken into consideration to analyse the phenomena of gaining spatial knowledge and testing the perception of the city space through the teenagers' eyes. The first goal was the reason to select only sketches done by students living outside Lublin and coming there to school mainly. This provides a group that has smaller chance to learn a city space in everyday life as they live outside this city. Students living outside Lublin formed a significant group in each class. For HS it was 15 (out of 32) and for TG it was 43 out of 52 of all surveyed. Three years analysed was expected to provide results showing the change of perception of city features in terms of quality and quantity of objects. The research hypothesis was the knowledge of a space should increase as students have more chances to experience the city. Time should also broaden the spectrum of object types, but it all may vary significantly depending on the person. The limitation of this approach is that to receive a comparable results, the same people should be questioned year after year and not three different years consisting of different people at the same time.

The cartographic methodology question asked during this research was how to present cumulative information from many sketches onto one map. What features should be shown, what attributes to present and what visualisation methods should be used.

The task given to students was to draw the city centre of Lublin. As sketches were to be used in different analyses (the presented one is part of three conducted) no instructions on cartographic visualisation, city centre limits nor depicted objects were given. It was to be done on a blank sheet of paper – a "basic sketch map" approach (Kitchin, 1996). There are controversies over using this method in the GIS environment connected to losing and distorting data (Brennan-Horley and Gibson, 2009), but the author thinks it is a better solution for a given task then a cued map with street lines and basic background data that could impose the answers.

RESULTS

The sketches were analysed: depicted features were counted and tables were prepared in a spreadsheet file. The cartographic background was created to visualize gathered data. OpenStreetMap data were used to show street lines and manual point input option was used to create points of interest locations. Using table join function, spreadsheet data with counted occurrences of given features were connected with these features on a map, so quantitative and qualitative visualization was possible.

The Fig. 1 shows streets of the central part of Lublin with information on number of their occurrences on the survey participants' sketches. Two main zones may be distinguished. The first is Krakowskie Przedmieście street (plus its pedestrian part) – 3 Maja street line[2] and the second is an area of a long-distance bus station (NE of the map). Both are no surprise. Krakowskie Przemieście street, being one of the main streets in the centre, with its pedestrian zone packed with shops and restaurant, forms a functional centre of the city. The main landmark in the area is the Litewski square, bordered by Krakowskie Przedmieście street (south) and 3 Maja street (west). Both streets were marked on over twenty sketches. The square is a popular place of meeting and passing time. The presence of bus station zone on sketches seems to be obvious as the analysed group consists of students living outside Lublin. It can be assumed bus is a typical mean of commuting for many of them, hence bus station is a place their visit frequently, what results in gaining knowledge of its vicinity. With the analysis done with type of school in mind, results differ slightly (Fig. 2, Fig. 3). In case of both HS and TG bus station zone streets are represented in high numbers. For HS representation of streets around the old town and south of it are higher than for TG. The high school is located at Bernardyńska street, so the students often walk around this area, no matter if they go to the bus station or just wanders around. For geodesy school the virtual, statistic centre of mass of data moves toward west as the school is located at Racławickie alleys near Długosza alleys. The most often depicted streets form a line leading toward the Litewski square: Racławickie alleys, Krakowskie Przedmieście street, with side-streets of Lipowa, 3 Maja and a few others included on sketches.

In terms of cartographic methodology, these three maps, generated on a base of data in attribute tables of objects (streets) are easy to create and not vulnerable to

possible serious errors. The colour scale selection for streets is the most important part, especially in case of black and white map.

Knowing the quantitative information on streets per school years and types, it is worth looking at change tendencies by comparing the results for each year. It may be expected that third year students know more about the space than the first year ones, as they spent two more years learning and experiencing it. It must be stressed however the results here are not – in fact – fully comparable as they are not from the same test group, as it was mentioned. It gives no 100% reliable answer as each person is an individual, with different space cognition, different attitude to the environment and different interest in what arounds him/her. It is however worth looking at the results in search of the general answer and to test the approach in methodology terms.

The difference between a number of the second and the first year participants depicting each street is shown on Fig 4. The biggest positive change is observed for the Litewski square area: pedestrian zone, 3 Maja street and Kołłątaja street. The negative change is more significant and visible in case of omitting the bus station area. However, it should be remembered that the survey had been based on a very general question (to depict the city centre). The change thus may be seen not as a result of paying less attention to this place, but as a difference in understanding what is the centre of Lublin.

The Fig. 5 shows the change between the third and the second year. To a surprise, a lot of negative changes can be observed. However, the area marked as the city centre contains mainly positive change and no-change streets. It can be interpreted as the situation in which third year students concentrated on showing the very centre of the city, with its details (see below), and not trying to depicts as much as possible just to prove they know it.

These two maps (Fig. 4 and Fig. 5) are very similar to three previous maps. The most important problem is the colour scale, which should be bipolar. It is easy to create on a colour map (blue for negative values, red for positive for example), but more problematic on a black and white picture. Using greyscale causes a perception problems, as no zero point is easily visible. That is why different symbols were used in addition to colour value. The solution is not perfect, but is easy to read.

Beside quantitative view on street occurrences, it is worth looking at points of interest – features that were depicted by surveyed young people. It gives an interesting insight into how they perceive space and what kinds of objects draw their attention. The general distribution of points can be seen on Fig. 6. Their concentrate mainly inside the area marked by a dark line limiting (according to over 25% of surveyed) the city centre (Nieścioruk, 2019). That is why the further, more detailed analysis below takes only this area into consideration.

Looking at the type of points (Fig. 7) a lot of restaurants and bars can be spotted. It should not be a surprise, as going out is an important element of young people life.

No matter if they live in a city or have to go to the bus to return home outside the city, there is (and should always be) the time to socialize and meeting with friends. This category includes mainly popular fast-foods, but also drink bars or even a sushi bar. Landmarks form a significant category too, but these points gather mainly around the Litewski square (four of them). The square itself is a significant spot on the city map, being a popular meeting place, car-free zone connected with a pedestrian part of Krakowskie Przedmieście street (leading to the Old Town and the castle) and – after its renovation – one of modern trademarks of Lublin, often described as the city centre (Pochwatka et al., 2017; Nieścioruk 2019). It consist of smaller, significant spots, for example a monument of Józef Piłsudski or a multimedia fountain. Some shops (convenience stores, clothes) and offices were marked too as well as object of special purposed playing a role of architecture landmarks (for example church or hotels in historical buildings). Outside the area shown on map on Fig. 7 some interesting cases were spotted too (for example a hospital located on the outskirt of the city centre and two pharmacies near it). When investigated more closely they would probably tell an interesting, personals stories and that is what mental sketches are sometime used for – they are less formal and more convenient way of telling about person's interests, problems or points of view.

The Fig. 8 shows the analysis of points of interests by year. There is – as explained above – a clear quantitative dominance of points around the Litewski square. The square itself and the fountain were often depicted by participants of each class. The southern façade of the square contains two prominent buildings, also often marked. One is the main post office, which form a long section of the façade and the other is an important spot for young people: McDonald's fast food. A corner building of the Grand Hotel is also present on many sketches. The last spot around the square which was marked in high number is… a bus stop. Outside the square area the Krakowska Gate (eastern edge of the map), being the enter to the Old Town, drew some attention of all three years of participants. The other points were present in little numbers, being depicted on up to three sketches, but mostly on single sketches only. What is the most important in case of these points is the facts the most of them are marked by the darkest bar on the map, meaning they were depicted by the third year students with some single lighter bars (the second year) and very little light grey bars (the first year). This means the third year pupils put the biggest number of objects on maps, proving the assumption they should know a lot about the city. It may be expected they know more about the space than first year students, as it was mentioned, as they simply had more time to encounter and learn it. It is more evident with points of interest than in case of streets as most of sketches concentrated on an area where streets are not present in big numbers – the city centre (as defined on sketches) consists of the square and the linear pedestrian zone going farther into main street of the Old Town.

This map showed where GIS software lacks as it needed a manual legend creation to explain bars properly. The main problem was the fact that generated legend consisted of only one, unscaled bar, giving no possibilities to assess the change of the value.

CONCLUSION

The results presented above proved the usefulness of GIS and cartography in mental sketches analyses. Both qualitative and quantitative attributes can be easily shown on maps. The first step has to be a construction of a correct, comprehensive database with information from the survey. The most vulnerable stage of introductory work is a vectorisation of sketches and transfer of the data into cartometric background material. It is always prone to errors, but other methods have their limitations too: it is hard to create sketches directly in the digital environment as participants often prefer analogue drawing techniques which are (for most of them) more natural. Having the data gathered in the base, it is easy to prepare visualisations in GIS. Number or share of participants marking certain area or object can be shown with diagrams or using visual variable of colour or saturation. The type of marked object can be shown with symbols of different kind, with point symbols being the most often used and the most universal in case of landmarks. GIS tools have their limitations too, but it is beyond the problem of mental maps. The most significant, in terms of visual communication, is often incorrect legend generated automatically, which needs a manual additional work in graphic manipulation software. The other problem can be a rich variety of options leading to improper maps created by an unexperienced user.

The result of analysis of sketches shows mainly two zones being most often depicted by the participants. Both are no surprise. The Litewski square area and the pedestrian part of Krakowskie Przedmieście street is often considered a functional (or one of) centre of Lublin. The long distance buses station area could also be expected as the zone of interest of participants, as they are young people living outside Lublin, so they probably commute often.

In case of points of interest the results also matched the potential expectations, as locations that interested young people most were eating out and meeting places. Beside this, some significant buildings and spots – landmarks were detected.

What was analysed also was the change of perception. In case of streets the assumption made at the beginning has not been proved, as there were no general increased in a percentage of students depicting streets. It worked for some areas only, while in other a decrease was observed in time, with worse results for the third year students, potentially knowing the town better. The reason may be connected with the fact that streets do not form landmarks in general. They serve as lines of communication, as barriers and as location of spots, but not as separate, important objects themselves. This often is a role of points of interest and (in that case) the increasing tendencies can be seen – year after year in most cases students depicted more objects or/and with higher percentage of depiction for each object too.

The problem of changing perception of the city environment should definitely be studied deeper. However, it is already seen the mental sketches can without a doubt be used to analyse not only the perception, but – with properly constructed survey – a change of it too.

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FIGURES

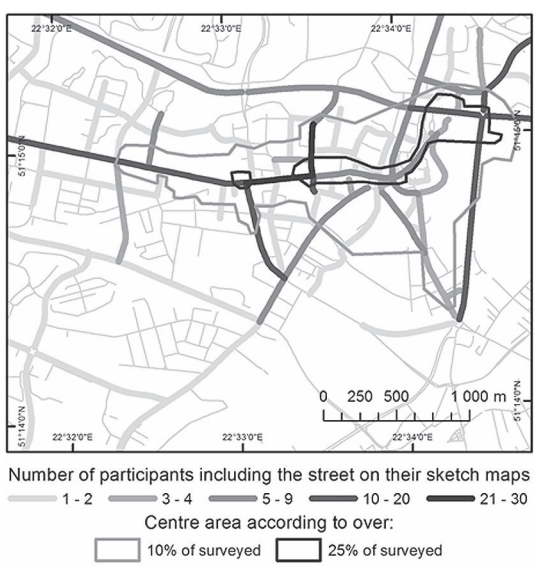

Fig. 1. Streets of the central part of Lublin with information on number of their occurrences on sketches (all maps use OpenStreetMap streets geometry data).

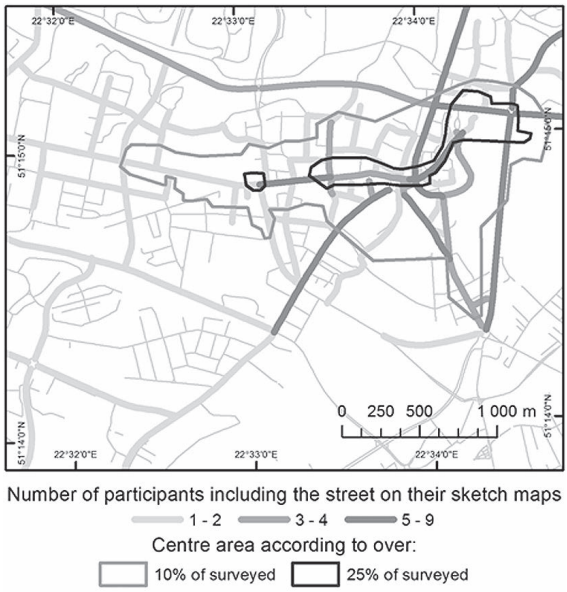

Fig. 2. Streets of the central part of Lublin with information on number of their occurrences on high school students' sketches.

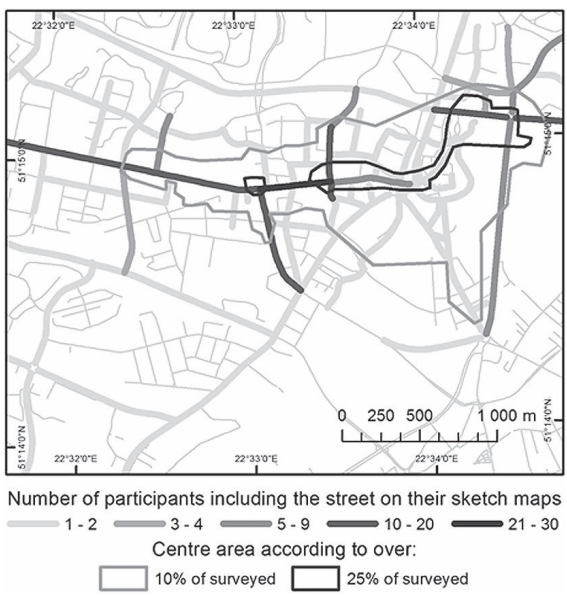

Fig. 3. Streets of the central part of Lublin with information on number of their occurrences on geodesy school students' sketches.

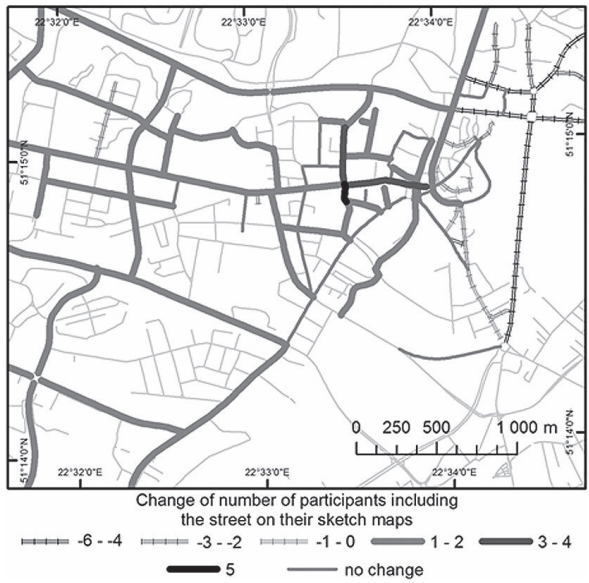

Fig. 4. The difference of streets occurrences between the second and the first year students' sketches.

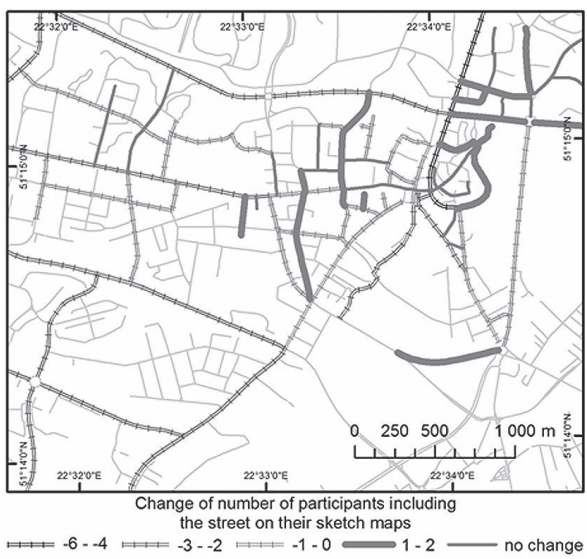

Fig. 5. The difference of streets occurrences between the third and the second year students' sketches.

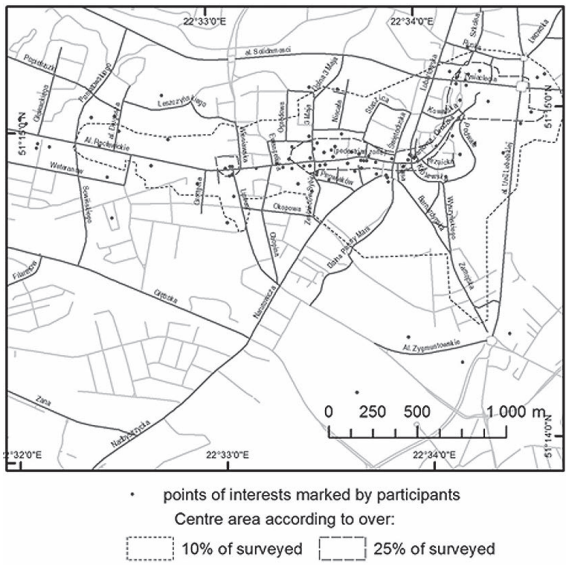

Fig. 6. Distribution of points of interest marked on sketches.

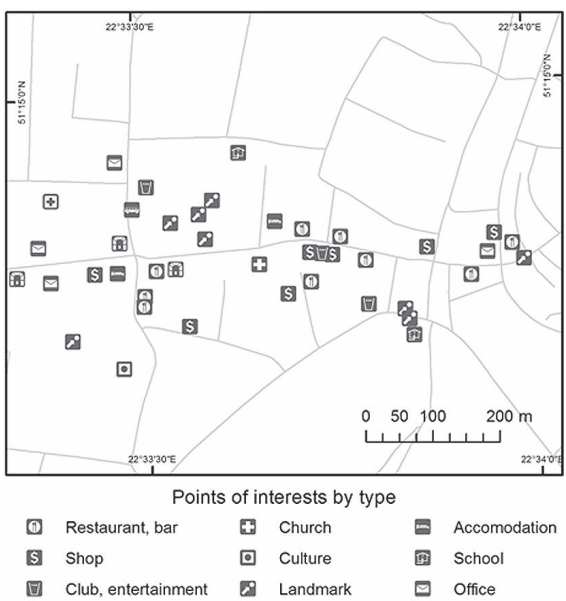

Fig. 7. Type of points of interest in a city centre.

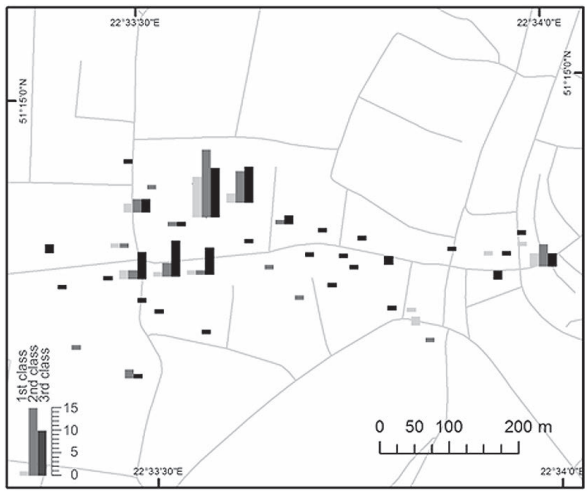

Fig. 8. Change in points of interest number per year.

NOTES

1. The education system in Poland has undergone the transformation process recently. During the survey there were three levels: 6-classes primary school, 3-classes gymnasium and the third level of different types (3-classes high-school (liceum), 3-classes vocation school (szkoła zawodowa) or 4-classes technical school (technikum)). The system introduced now is two-levels.

2. To provide a clean illustrations, streets are labeled on Fig. 6.