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Using Area Cartograms in Teaching Geography in Secondary Schools

Anna Markowska [a, *]

[a] *Institute of Geodesy and Cartography, anna.markowska@igik.edu.pl*

* Corresponding author

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Abstract:

An area cartogram is one of the cartographic presentation forms. It is a unique way of presenting statistical data, in which the surface of the individual spatial units is proportional to the value of the phenomenon. Due to its specificity, the area cartogram is an interesting way of graphical representation of phenomena, in particular, the demographic and economic problems of the world.

In my research, I discuss an empirical study that I have conducted among pupils of the secondary school in Poland. On the basis of the list of advantages and disadvantages of area cartograms collected by B.D. Denta (1999), I assumed that contiguous area cartograms seem to be more useful in teaching in the secondary schools than non-contiguous cartograms. I compared the three types of contiguous area cartograms (preserving the spatial continuity of the presentation, having no gaps between neighboring units - Figure 1): square cartograms, mosaic cartograms and diffusion-based cartograms (Gastner-Newman algorithm).

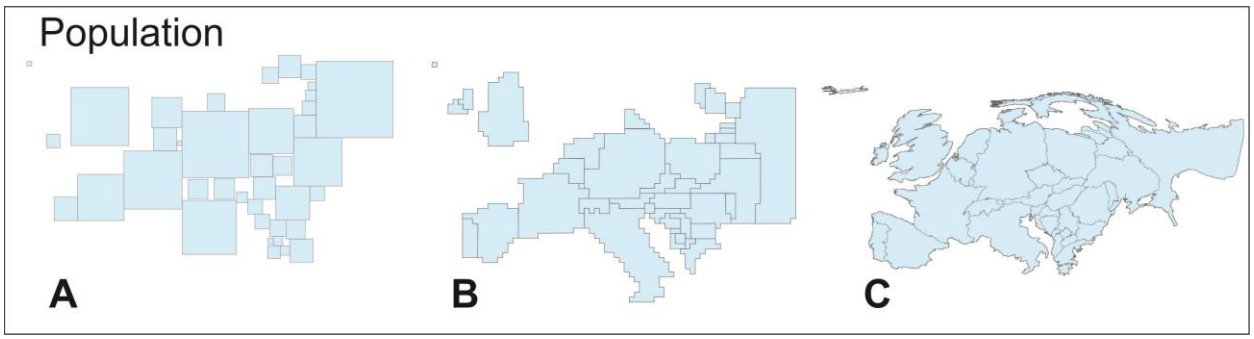

Figure 1. Types of area cartograms: A. square cartogram, B. mosaic cartogram, C. diffusion-based method cartogram.

Reflections on the subject of area cartograms and the possibility of their application in teaching in the secondary schools were the starting point for formulating the main research questions:

1. *Which type of area cartograms is the most useful in teaching geography in secondary schools?*
2. *Are the area cartograms a form of a cartographic presentation no less useful in illustrating socio-economic phenomena during lessons in secondary schools than traditional forms of presenting data on a map?*
3. *Are the area cartograms understandable for secondary school students who have less geographical knowledge?*

The hypothesis was formulated for each research question (9 hypotheses in total). In the verification of hypotheses, I used statistical analyzes:

- logistic regression, dichotomous data, the probability of indicating the correct answer; α=0,05;
- multivariate repeated measures ANOVA, comparison of averages; α= 0,001;
- one-way univariate repeated measures ANOVA, four skills groups ; α=0,05;
- Chi-squared test, test between two nominal variables; α=0,05.

For the empirical study, I prepared maps of socio-economic phenomena in Europe (Figure 2). After developing each map, I calculated the representation of the value of the phenomenon.

I prepared a five-part online survey, which consisted of 27 tasks and three questionnaire questions. The survey was designed on the basis of the original concept and then carried out using the web application made in Python 2.6 and Django 1.6.0 technologies. The application saves data in a database operating on the MySQL server. Both the application and the database were installed on the LinuxPL's commercial hosting account. After opened the web address of the application and loading the website with the web application pupils started the questionnaire. A unique user number was added each time the survey was started. After completing the survey, the data was saved in the MySQL database and could be retrieved from it a set of SQL queries. The response time was measured both for the entire survey and for individual boards. After the survey, students received a percentage of correct answers, but the result was anonymous and was not passed on. Teachers in schools did not have access to the survey results. The application can be edited and used for further usefulness studies of area cartograms.

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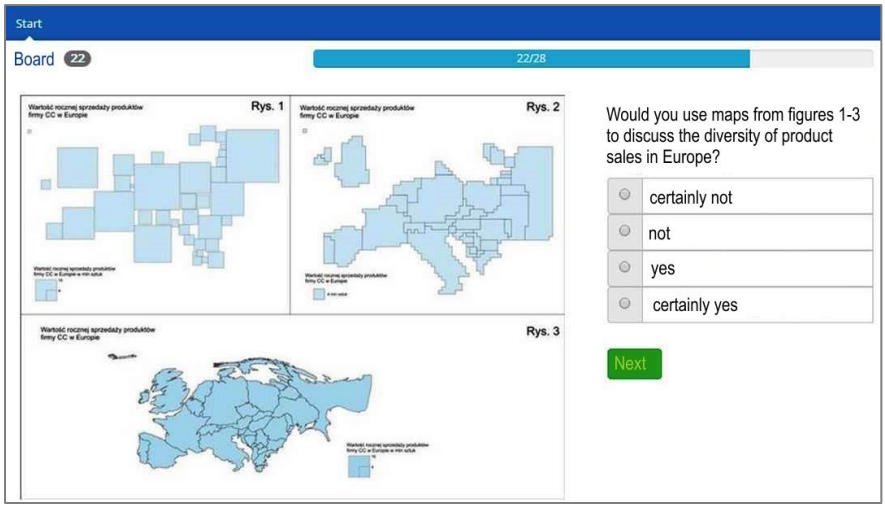

Figure 2. An example board from the questionnaire.

When analyzing the collected data, I divided the pupils into four groups of geographical skills. I considered the relationship between geographical skills and response correctness as well as response time. I verified whether geographic skills are related to the opinion on cartograms by respondents.

The division into groups was aimed at comparing the correctness and time of students' answers to particular tasks and the questionnaire. In order to develop the division of students into groups according to geographical skills, I made a summary of how many students correctly solved a given number of tasks. I took into account 23 tasks - from 1 to 17, 19 and from 23 to 27. Other tasks related to the preferences of users. After reviewing the size of groups at individual divisions (3, 4, 5 or 6 groups), I decided that the best division for my research is the division into four groups of skills (Figure 3).

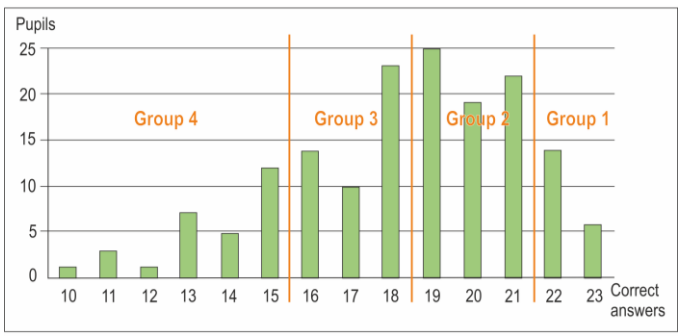

Figure 3. Four pupils' groups of geographical skills.

According to the collected data, I found that the most useful type of area cartograms for secondary school teaching is mosaic cartogram (Figure 1B). This type of cartograms is particularly useful for a detailed and general level of map reading. Moreover, the correctness of the response to the tasks was related to the group of geographical skills, whereas the time of solving individual tasks was not related to the group of geographical skills. Finally, the group of geographical skills does not affect the students' assessment of cartograms.

When considering particular types of area cartograms, I noticed some important issues related to their use in teaching in secondary schools. It took the most time for pupils to complete tasks using square cartograms. Mainly tasks related to the detailed and indirect level of map reading. Square cartograms are useful in identifying the unit with the highest value of the phenomenon, but not helpful when a pupil should give the name of this unit (state). Square cartograms are less useful than mosaic and diffusion-based cartograms on the general level of map reading. Mosaic cartograms should be used to present the phenomenon at the detailed level of map reading, mainly when the name of a country should be given. This type of cartograms is most useful in presenting information on the general level of map reading. Diffusion-based cartograms are not useful at the detailed level of map reading.

The use of contiguous area cartograms is a part of the provisions of the designed core curriculum for secondary schools. In particular, the method can be helpful for issues related to the implementation of cognitive objectives on the basis of various graphics and cartographic forms, use of data or conducting analyses of the natural environment.

Further research into the use of area cartograms in secondary schools should be directed towards checking the competence of teachers in the subject of cartograms. An important issue is the development of indicators to verify the correctness of generating various types of area cartograms.