

# Cartographic presentation – from simple to complex map

## Abstract

Nowadays a lot of people are trying to make maps, and especially digital maps. A wide range of computer tools and high graphic capabilities have together made maps increasingly popular and seemingly easy to prepare for any person who can use a computer. It seems necessary to verify the bases of the cartographic presentation methods. There is a need for a new, formalized view of the method as a sequence of steps from data collection, to correct presentation, to map. Two terms related to cartographic presentation should be distinguished in this article: “methods” and “forms.” A method is understood as the process by which data is transformed into a presentation. A form is understood as the end result of this process, i.e. the resulting graphical image or map. In the article five types of cartographic presentation are indicated. In the successive types, one can observe an increasing degree of complexity of cartographic presentation.

## Keywords

Cartographic presentation • map • cartographic presentation methods • cartographic presentation forms • complexity of presentation

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**Jolanta Korycka-Skorupa,  
Tomasz Nowacki**

Department of Geoinformatics,  
Cartography and Remote Sensing,  
Faculty of Geography and Regional Studies,  
University of Warsaw, Poland  
e-mail: j.skorupa@uw.edu.pl  
e-mail: t.nowacki@uw.edu.pl

Received: 8 March 2018

Accepted: 19 July 2018

## Introduction

The concept of a “method” or “technique” accompanies various scientific fields. Much is being said about “methods of action,” “methods of proceeding,” and “methods of scientific research.” There are numerous definitions of this concept, in which the awareness and repeatability of a process are underlined. Therefore, it can be stated that “a ‘method’ is a conscious and recurrent manner of proceeding which leads to a defined goal, to the solution of a problem” (Korycka-Skorupa 2001).

## Cartographic presentation

Methods in cartography have been discussed for many years, and with different meanings. In cartography textbooks one can find sections dedicated to “methods of field studies,” “methods of map making” and “methods of using maps,” as well as “methods (techniques) of cartographic presentation.”

The terminology related to presentation techniques or methods has not been standardised. In Austria, Switzerland and Germany “kartographische Darstellungsmethoden” are discussed, while in the Czech Republic there are methods of “mapového vyjadrovania.” The word “method” also appears in the equivalents of “presentation methods” in the following languages:

- Bulgarian “картографски метод изобразяване”
- Danish and Norwegian “kartografisk framstillningsmetode”
- French “méthode de représentation cartographique”
- Spanish “método de representación”
- Dutch “metode van voorstellen”
- Portuguese “método de representação cartográfica”
- Russian “картографический метод изображения”
- Slovak “kartografická metóda znázornenia”
- Swedish “kartografisk framställningsmetod.”

In Poland the most frequently quoted classification of cartographic presentation methods was provided by L. Ratajski (1989). He divided presentation methods into qualitative and quantitative. Many other authors have quoted this classification, frequently introducing some modifications (Paslowski 2005).

A slightly different approach to classification of cartographic presentation methods was introduced by A.H. Robinson (Robinson et al. 1995), who proposed a division into methods in accordance with applied spatial dimension (point, linear, areal, 3D). In each of these groups he distinguished qualitative and quantitative methods. Within the cartographic presentation methods he also included methods of presenting land relief. A similar approach was proposed by M.J. Kraak and F. Ormeling (1996). Methods of visualizing terrain are also found in the classification by T. Slocum (Slocum 2005) together with quantitative methods.

Therefore, there is no single “applicable” classification of presentation methods; the criteria used in distinguishing the methods are also not consistent. A definition of the concept of a “cartographic presentation method” is lacking.

A wide range of computer tools, high graphic capabilities, ease of introducing corrections and updates, and a greater number of diverse and popular cartographic presentation methods (cartograms, and dynamic and multimedia presentations) have made maps more and more popular, and seemingly easy to prepare for any person who can use a computer.

One can observe the application of an increasing number of methods (techniques), and therefore increasing chaos in their classification. It is necessary to verify, arrange and complete the classification of methods (techniques). We need a new formalized approach to the methods, as a sequence of activities



Figure 1. From data to cartographic presentation. Source: own elaboration

which allow the transformation of a data set into a good and proper presentation. When speaking of presentation techniques and methods we apply various approaches and criteria. They are hard to classify, as classification should be exhaustive and mutually exclusive. Sometimes we deal with methods that are difficult to unambiguously name. There are numerous indirect solutions. One could consider whether in the context of cartographic presentation we should not speak instead of a typology, which unlike a classification does not have to fulfill the two listed conditions.

Typology involves distinguishing one or more types within a collection of methods, comparing particular methods according to established types and grouping, arranging and dividing methods in accordance with established types. The purpose of a typology is to systematize and describe a data set, as well as to develop, systematize and specify concepts.

### Cartographic presentation methods and forms

The basis of a typology of cartographic presentations should include a division between two concepts related to cartographic presentation: **method (technique)** and **form** (Korycka-Skorupa 2002 a, b).

**A method (technique) is understood as a transition process from data to the presentation forms, as a certain sequence of actions leading to a meaningful presentation, as a way of proceeding which starts from data and leads to a presentation.**

**A form is understood as the final outcome of this process – a graphic image, a result, a map.** This concept is similar to the term “cartographic representation” (Żyszkowska 2016), the difference is that this phrase focuses only on the final result of the cartographer’s work. The data features that will be presented on the map are very important. Therefore, the level of data measurement is essential; in other words, whether we deal with data that describes a phenomenon in terms that are:

- qualitative (distinguishing objects),
- ordered (placing objects in order using type descriptions: few–average–many),
- quantitative (numerical characteristics of objects, numbers).

The character of the data is highly significant: is it absolute or relative? This determines the application of certain presentation methods (e.g. a choropleth map). The method to be used also depends on the spatial arrangement of geographic phenomena: point, linear or areal objects. The manner of data classification is also important – in other words, whether it will be presented in classes (as a classed map) or without classes (as a continuous presentation in which each value of the phenomenon is presented individually).

At this stage, one establishes the number of choropleth map classes, and one decides on the manner of scaling proportional symbols (linear scaling of bars, superficial scaling of circles and squares, or volumetric mathematical scaling of spheres and cubes) and their size (adjusted to map content). At this moment, the data should be adjusted to the presentation, as it may require an appropriate transformation – in other words, a change of one of the listed presentation features.

Having adjusted the data to the requirements of the presentation methods, it is time for them to be visualized. The graphic sign (point, linear or plane) applied on the map is

important, as well as the features or attributes of the sign, which are expressed through graphic variables.

**A METHOD can in fact be treated as a mental process as a result of which data is processed and adjusted to the presentation requirements.** Therefore, methodical procedures involve adjusting data to the presentation methods, defining all conditions, and conducting the necessary calculations and transformations. **A FORM is a graphical expression of a method or a combination of methods; it is data distributed in visual space and dressed as a graphic (as the result of visualization).** A form constitutes the result of visualization, a graphic outcome which can be simple or complex. The form of presentation is a much wider concept, because, according to this definition, it can be the result of the application of various presentation methods. The visualization of results is described as a presentation form, complete with a legend, a scale, a frame and necessary descriptions. All this will constitute a map (Fig. 1). Without them we cannot expect a map to be interpreted correctly.

The distinction between method and form allows complex presentation forms to be considered (e.g. combinations of numerous methods on a single map). Classification or typology of cartographic *methods* can include basic solutions (choropleth maps, proportional symbols, dot maps, etc.). However, classification or typology of cartographic *forms* will certainly be much more complex. It will include both simple forms, which can be found in method classification, and more complex forms.

### Types of cartographic presentation

Due to presentation complexity one can distinguish different cartographic presentation types – in other words, cases in which different combinations of presentation methods and forms are applied. These start from the simplest solutions (type 1) and progress to complex solutions in which numerous presentation methods are applied simultaneously (types 2–5).

#### Type 1: One method → one form → one map

Type 1 is the simplest type of cartographic presentation (Fig. 2). It uses one simple method, and as a result of visualization one cartographic presentation form is obtained and, as a consequence, one simple map. One example of a type 1 map is that showing the population in different voivodeships (provinces in Poland) using proportional symbols, the size of which changes according to the phenomenon values (Fig. 3); another example is that showing urbanization, which is the percentage of urban population in a voivodeship’s total population, and this is presented on a choropleth map (Fig. 4). In each case there is one simple methodical procedure, which results in one simple cartographic form, and it all happens on one map.

At the TRANSFORMATION stage the manner of presenting proportional symbols, the manner of their scaling, appropriate proportional calculation of their size, and the appropriate distribution of diagrams are all established. Having completed all these findings, visualization begins, which means translation of the prepared data into graphics using visual variables (Bertin 1983). Appropriate diagram sizes for the map are selected, as well as relevant colors. Diagrams can be larger when there is less content on the map, or smaller if there is other additional content on the map. Finally, a legend should be added to describe the scale and other elements.



Figure 2. Type 1: One method → one form → one map. Source: own elaboration



Figure 3. Type 1 map: One method → one form → one map. Source: own elaboration

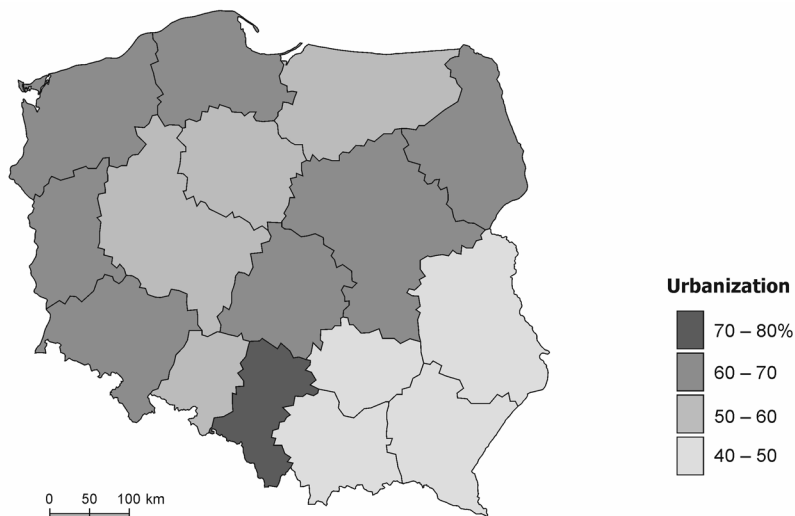


Figure 4. Another type 1 map: One method → one form → one map. Source: own elaboration

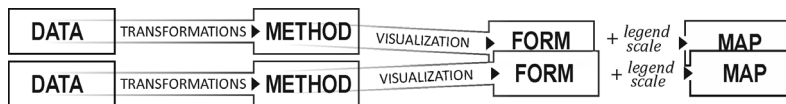


Figure 5. Type 1 (modified): One method → one form → one map (two separate maps). Source: own elaboration

It is similar in the case of a choropleth map (Fig. 4). The TRANSFORMATION stage involves organizing data, and deciding about their presentation (classed or unclassed) and about how class intervals will be applied in data classification. At the VISUALIZATION stage (which leads to a cartographic presentation form) the editor of the map will select a color scale.

Two simple graphic solutions can be juxtaposed (as two separate maps – Figs. 3, 4). However, it needs to be highlighted that juxtaposition of maps (e.g. on the same page in an atlas) cannot be coincidental. On the basis of such juxtapositions one can draw conclusions or interpret a collection of maps. Such a joint presentation (Fig. 5) carries more information than individual maps.

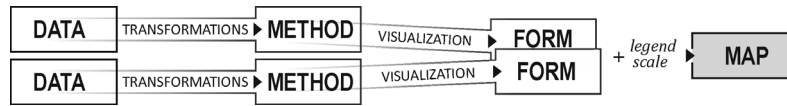


Figure 6. Type 2: Two methods → two forms → one map. Source: own elaboration

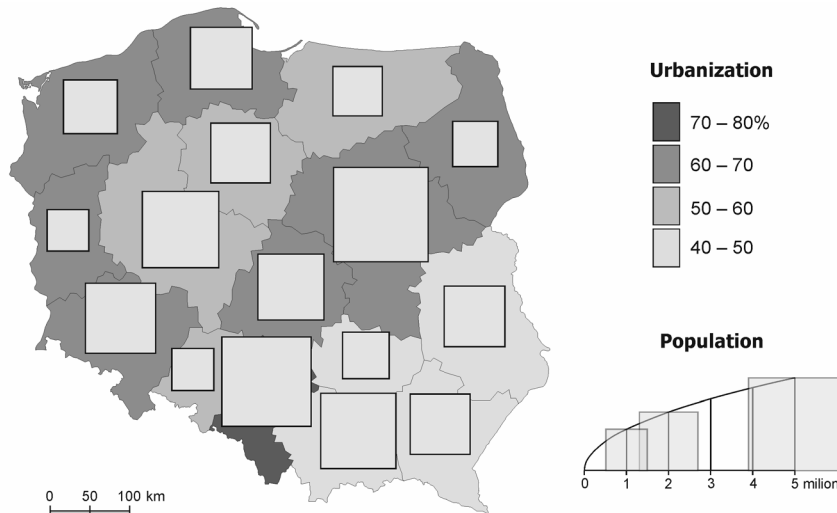


Figure 7. Type 2 map: Two methods → two forms → one map. Source: own elaboration.

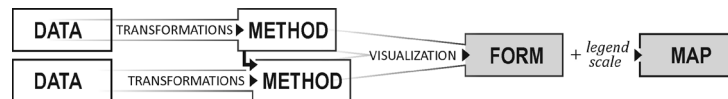


Figure 8. Type 3: Two methods of various significance → one form → one map. Source: own elaboration

With such simple maps, distinguishing a method and a form can seem unnecessary. However, it becomes significant when the map is more graphically complex and its interpretation requires greater map-reading skills of the recipient.

**Type 2: Two methods → two forms → one map**

A map author may suggest that the map user “simultaneously” interpret two interrelated concepts (Fig. 6) in different ways. The concepts presented in Figs. 3 and 4 can be combined by a cartographer when the map is being edited. Then we are dealing with a case in which two methods are developed independently, but they result in the creation of a single map (Fig. 7).

Such methodical solutions have to be selected in such a way that their combination allows for new information to be derived. At the TRANSFORMATION stage the size of the diagrams is established so that the choropleth method, which constitutes the map background, is visible. Data for a choropleth map has to be prepared (requiring selection of a classed or unclassed approach to data classification). These two independently applied METHODS lead to two graphic forms being presented on a single map. They require graphic adjustment. Using such a graphic solution the user clearly sees a suggested correlation between phenomena. On the map each form exists separately; they overlap each other, but each of them can be also interpreted independently. This cartographic presentation type (type 2) is more complex than type 1, and requires more map editing work and greater competence in map reading and interpreting by the recipient.

**Type 3: Two methods of various significance → one complex form → one map**

Another cartographic presentation type (Fig. 8) involves two various methods leading to one complex graphic form. The dependency between phenomena is underlined more clearly. One method dominates, e.g. becoming the base for the other. During the map editing process the correct sequence must be maintained.

A choropleth map in diagrams is an example (Fig. 9) of diagrams becoming the basic field of the choropleth map. Two method were used, but one “joint” graphic form was obtained. Proportional symbols constitute the dominant method – the method which had to be used earlier in order to become the base for the choropleth map. In such cases data not only has to be combined, but there also has to be the mathematical possibility to combine it. This combination should result in new information for the user of the map.

Proportional symbols presenting the size and structure of a phenomenon (Fig. 10) also constitutes a dominant method. There are two sets of data, and therefore two kinds of symbols, that have been combined in a graphic form. The sequence, however, was not random. It was necessary to calculate the size of the symbols first, and only then to calculate percentage shares of the structure elements. At the TRANSFORMATION stage, selection of data is important; the phenomena have to be strictly related (one should constitute particulars of the other, and an element of its structure).

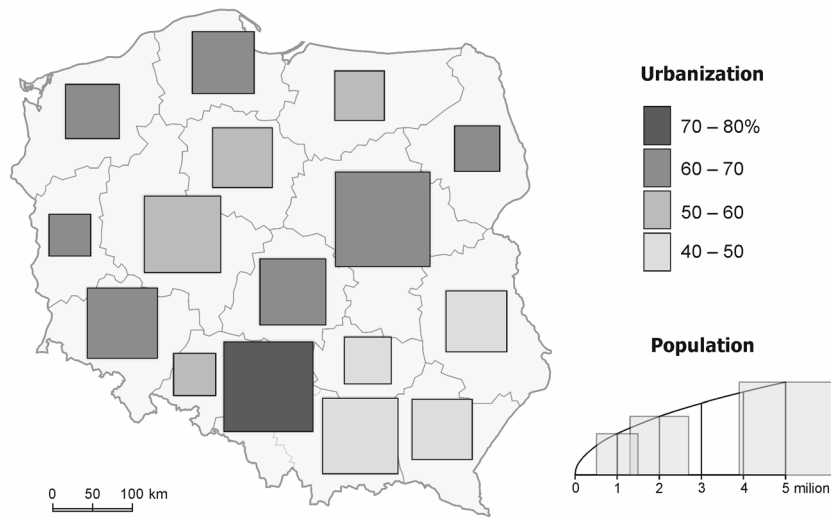


Figure 9. Type 3 map: Two methods of various significance → one form → one map. Source: own elaboration

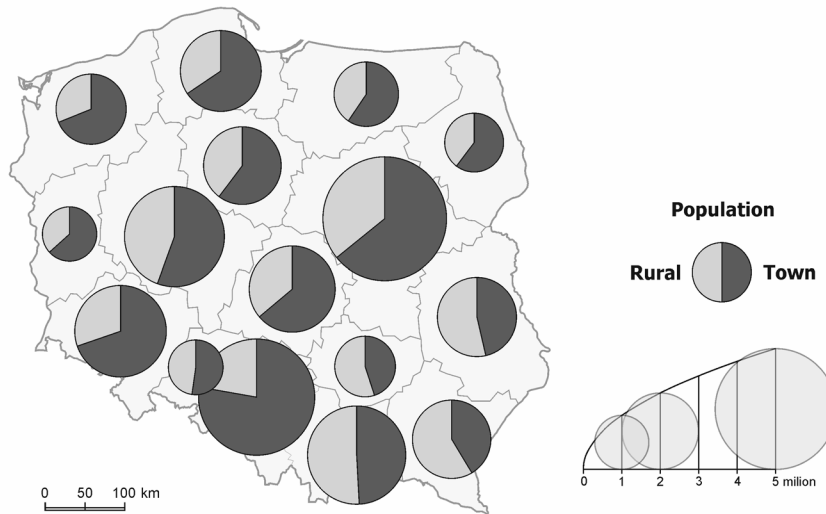


Figure 10. Type 3 map: Two methods → one form → one map. Source: own elaboration

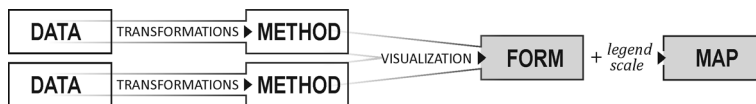


Figure 11. Type 4: Two equally important methods → one form → one map. Source: own elaboration

**Type 4: Two equally important methods → one complex form → one map**

Two equally important, independently applied methods leading to one presentation form are schematically presented in Fig. 11. One example of such a graphic solution is a map on which two diagram halves are used to present the same phenomenon in two different years (Fig. 12).

Such a presentation is supposed to allow the recipient to compare the two phenomena. The editor of the map juxtaposed diagrams in order to facilitate comparative analysis. The two methods applied are equally important. However, it should not be forgotten that at the TRANSFORMATION stage it was possible

to compare two sets of data, e.g. the same phenomenon in different years or the number of males and females. Diagrams should be equally scaled. Only then can they be compared and properly read and estimated.

**Type 5: One complex method → one complex form → one map**

The most complex case of cartographic presentation is a presentation resulting in a single methodical procedure being applied in parallel to two sets of data. As a result, one complex presentation form is obtained (Fig. 13).

The bivariate choropleth map presented in Fig. 14 is an example. Convinced that two sets of data can be juxtaposed,

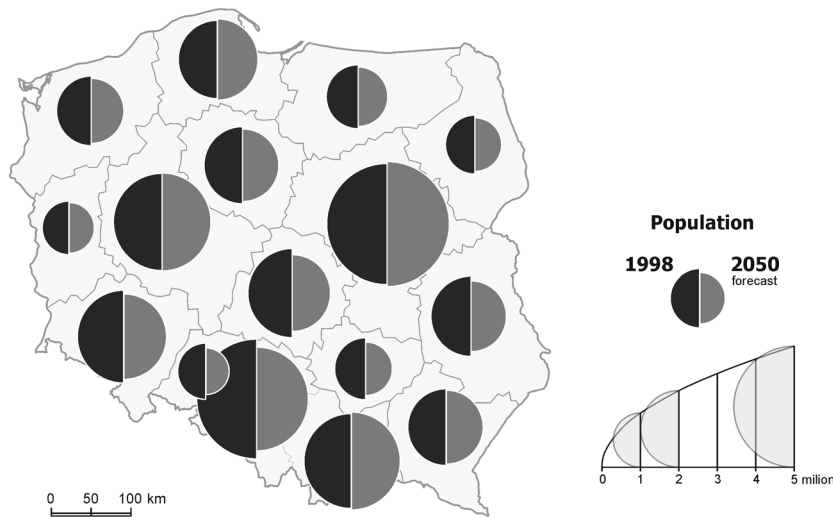


Figure 12. Type 4 map: Two equally important methods → one form → one map. Source: own elaboration



Figure 13. Type 5: One complex method → one complex form → one map. Source: own elaboration

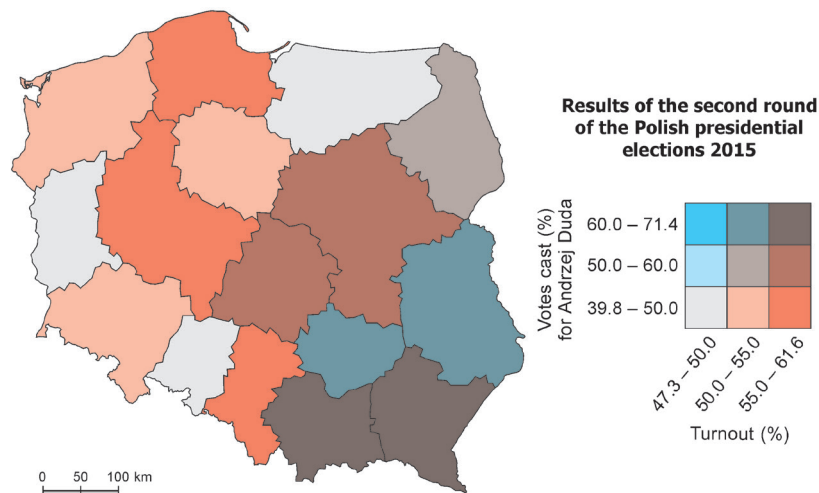


Figure 14. Type 5 map: One complex method → one complex form → one map. Source: own elaboration

the editor of the map created this combination by applying one method – a bivariate choropleth map. Combining two sets of data required the appropriate selection of classes. Graphic development was based on the complementary colors, red and cyan. The logical selection of colors is extremely important in such cases.

An equally complex presentation form is presented in Fig. 15. It is a bivariate map in which attributes are represented by the width and height of a rectangular diagram. Multiplying two sets of data results in a third value – another set of data (that results from the previous data). Each side of the rectangle can be

interpreted separately, but it is also possible to combine them and indirectly read the third value. At the TRANSFORMATION stage two diagram scaling manners were applied.

### Conclusion

In the described successive types (from 1 to 5), one can observe an increasing degree of complexity of cartographic presentation, starting from type 1, which is a very simple graphic solution, to type 5, which is difficult and complex regarding both its development and its interpretation (Fig. 16). The increased complexity of presentation is also related to more and more



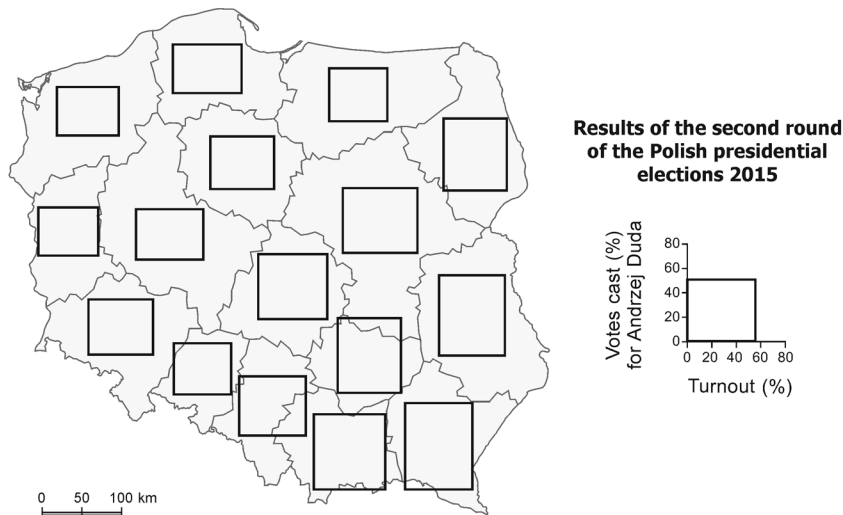


Figure 15. Another type 5 map: One complex method → one complex form → one map. Source: own elaboration

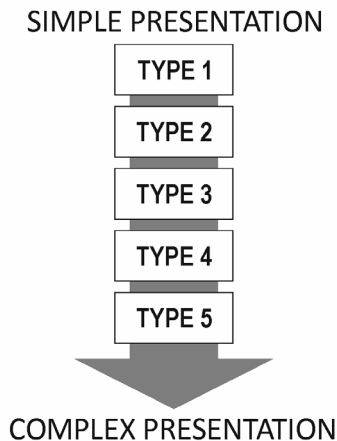


Figure 16. Types of cartographic presentation. Source: own elaboration

methodical procedures being performed, and results in increasingly complex forms of cartographic presentation.

More complex presentation also requires increased knowledge and attention from the map user. Such an approach makes it possible to look at presentation methods and forms separately. It also allows the process of methodical procedures to be followed and for both simple and complex presentation forms to be analyzed.

**Acknowledgements**

This research was supported by the project by the Polish National Science Centre [Grant number UMO-2016/23/B/HS6/03846], "Evaluation of cartographic presentation methods in the context of map perception and effectiveness of visual transmission."

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