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Current Questions in the Design and Production of Maps for Studying the Earth Sciences Module in Universities

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CURRENT QUESTIONS IN THE DESIGN AND PRODUCTION OF MAPS FOR STUDYING THE EARTH SCIENCES MODULE IN UNIVERSITIES

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Abstract
The widespread introduction of GIS, electronic maps and infographics into the teaching of geographical disciplines at universities poses new urgent tasks for cartographers to scientifically substantiate the design, production and practical use of educational maps. The purpose of the study is to analyze the classical experience of creating and using maps for studying the module "Earth Sciences," in particular, geographical nomenclature, in higher education institutions. The article analyzes educational cartographic aids for the study of geographical nomenclature and formulates requirements for their content and design. It is noted that the study of geographical nomenclature begins in high school, so it is appropriate to use gaming technologies here. In universities, for group and pair work of students, not only electronic, but also printed maps are relevant as they allow simultaneous comparative analysis and geographic reference of the desired objects. It was revealed that printed wall maps for universities, despite the need for them, are practically not published due to high costs. The problem can be solved by printing small runs ordered by specific universities using high-quality copy equipment. The development of mobile applications displaying geographic objects is not economically feasible due to the requirement for continuous updating of the content, while a multi-page pdf document with object cards is convenient for use by students on smartphones and is easily accessible for editing the content. Testing the level of knowledge of geographical nomenclature can be carried out at different levels in the form of testing or hand-drawing by students of a map diagram showing the geographical similarity of objects. The need for such infographics in the topic under consideration is obviously high. The study showed that the most successful is the combination of various techniques, technologies and teaching aids - educational games, printed wall maps, electronic teaching aids for mobile devices, as well as classic maps in teacher presentations and tasks for students in the form of tests or infographics.

Key words: *map, geographic nomenclature, map design, map production*

INTRODUCTION

Research has a big value for the study of the Earth Science module in universities. In this module, knowledge of geographical nomenclature plays an important role, since this is the basis on which further study of geography is built.

The issue under consideration is relevant due to the fact that in order to study the Earth sciences, it is necessary to have high-quality cartographic support that has a certain content and design.

There are a number of problems connected with the development and publication of such cartographic works. The map must be easy to read, have an optimal load and at the same time have signatures of objects of geographical nomenclature.

One of the methods of interacting with the map is gaming technology. With their help, it is easier for the student to study and memorize geographical objects, since the method includes both a method of association and a method of memorization.

It is relevant to note the importance of printed cartographic works, since they are convenient in group and pair work for performing simultaneous comparative analysis and geographic reference of the desired objects. The problem of publishing printed cartographic works is the economic inefficiency of publishing small editions due to their high cost, however, such manuals are in demand in the modern educational process.

Electronic cartographic manuals are no less important for studying geographical nomenclature. They are convenient for individual work and allow the use of interactive functions and animation. Currently, there is a need for high-quality electronic educational maps.

The program of the Earth Sciences module is not limited by the study of geographical nomenclature. Educational thematic maps are needed, especially natural phenomena and socio-economic ones.

For these purposes, electronic cartographic manuals on geographical disciplines are relevant, that are developed with taking into account the specifics of the disciplines being studied and updated in a timely manner. This is a different topic for research.

ANALYSIS OF THE CLASSIC EXPERIENCE OF CARTOGRAPHIC SUPPORT FOR THE STUDY OF GEOGRAPHICAL NOMENCLATURE

Currently, there is a relatively small number of cartographic works that meet the needs of the modern study of geographical nomenclature. The predecessors of modern manuals were, for example, cards published in 1859 by Mauritius Osipovich Wolf (80 pieces in a pack). The cards contained information about geographical objects, the national composition of the territory, various statistical data, etc. The cards described serve as a good basis for creating modern cartographic aids (Fig. 1).

Figure 1. Educational cards on geography of 1859 in the reading room of cartographic publications of the Russian State Library

Feature cards are most effectively used in conjunction with a map, as in the cartographic manual “Stadtteil Quartett” compiled by Frankfurter Spielbetrieb in 2009 (Figure 2). The manual is published in the German language and is intended for studying Frankfurt. The set consists of a map and 43 cards with information about the city's districts. The map of Frankfurt clearly represents the administrative division of the city; the cards provide information about the districts: the year the district was founded, area, number of residents, solvency of citizens, annual birth rate, number of officially registered cars and a photograph of the main landmark with an explanatory caption. This cartographic manual has a laconic design of cards, and a map that can be easily navigated.

Figure 2. Cartographic manual “Stadtteil Quartett”, 2009

An analysis of cartographic manuals that are used to study geographical nomenclature showed that in most cases it is often either insufficient or redundant in terms of the amount of information. Such manuals are good for understanding field-specific topics, but they do not allow you to study objects of geographical nomenclature in a complex manner (Fig. 3).

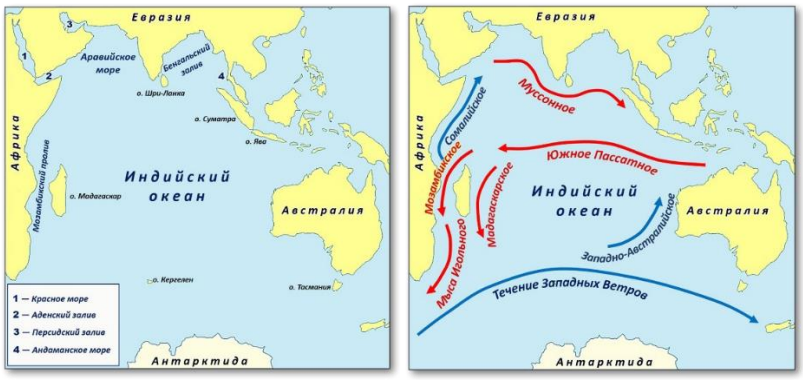

Figure 3. Geographical nomenclature of the "Indian Ocean Currents"

The example presented is based on the memorization method, but this is not the most effective method of memorizing nomenclature. According to a study, the results of which are illustrated by the Ebbinghaus curve, a person forgets approximately 60% of the information received in 1 hour, another 15% in 6 days, then the forgetting process slows down. About 20% of the information remains in memory (Fig. 4). Formal learning through frequent repetition usually leads to difficulties when finding the same objects on maps of other scales or on maps with other map projections. Bright associations and logical connections are remembered much better, which should be taken into account when preparing classes.

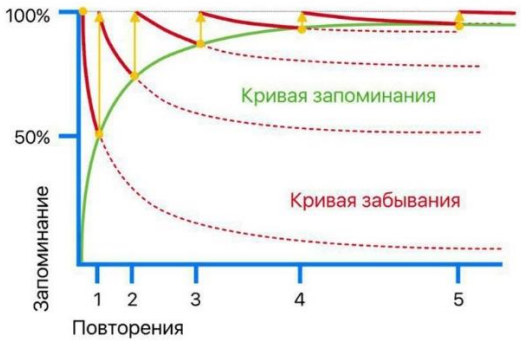

Figure 4. Ebbinghaus Forgetting Curve

WAYS TO STUDY GEOGRAPHICAL NOMENCLATURE

Studying geographic nomenclature is the work of finding and remembering the location and names of geographic features on a map. It starts with the first geography lessons in high school. The way the learning process occurs, as well as the student's interest in geography in general play a big role.

The choice of one or another method of studying geographical nomenclature depends on the age of the students, the technical capabilities of the educational institution and the creative approach of the teacher. Let us name and briefly describe some of these methods.

Currently, the most common traditional option is when students master geographic nomenclature using maps from textbooks and school atlases, as well as printed and electronic wall maps, and knowledge testing is carried out using contour maps or in personal communication between the teacher and the student. As a result of the meaningful creative work of teachers and students, a deep level of knowledge in the field of geographical nomenclature is achieved, the ability to quickly and accurately name and show the necessary objects on the map. Obviously, for these purposes, first of all, high-quality cartographic support is required.

For studying geographical nomenclature in secondary school, the association method gives good results. This may be focusing on the characteristic shape of an object (the Apennine Peninsula has the shape of a “boot” or Africa – an “elephant”). This method is often used at the initial stages of studying geography. Teachers can use applications to help the child associate a particular geographical object with a certain shape for its associative search and memorization (Fig. 5).

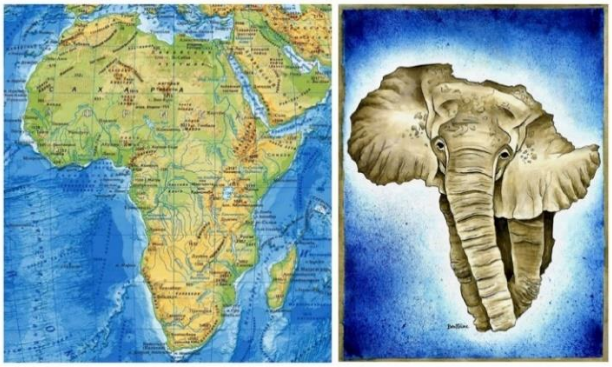

Figure 5. The association method applied to the shape of Africa. Artist Ben Heine

In order to develop correct ideas about the area of the studied territories, cut-outs are superimposed on the contours of other geographical objects, the sizes of which are compared. For such purposes, equal-area projections that do not distort the area of objects are suitable. Work can be carried out with maps both in printed and electronic form.

When studying nomenclature, it is important that the student develops an interest in a geographical object, for which you can tell, for example, the history of the origin of its name, interesting facts, or show colorful illustrations or videos. Thus, the method of association is connected with the formation of a visual image of a geographical object.

When studying geographic nomenclature, the speed of finding objects is also important. For finding objects, it is necessary to pay attention to the relative position of hydrographic objects, terrain, etc. You can use a system of landmarks in order to do this. For example, the student remembers that the Mediterranean Sea should be looked for on the map between Europe and Africa.

When the student shows the desired object, it is useful for him to pronounce its name and indicate landmarks (from large to small). It develops map reading skills, helps the study of geographic terminology (including the correct placement of stress in words), understanding the internal logic of geographic location and the connection of objects.

Another way to study geographic nomenclature in middle school is to use teaching tools such as cards with information, icons, flags, arrows, strings, etc., as well as tactile map manuals and three-dimensional models. This approach is used not only in schools for visually impaired and blind students (Fig. 6), but also in regular schools, because it can increase students’ interest in mastering the map (for example, three-dimensional models, relief maps and cards with information about geographical objects).

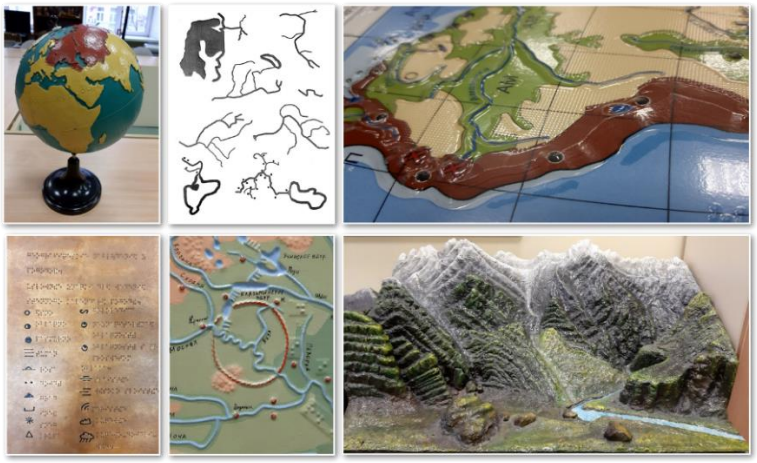

Figure 6. Tactile didactic manuals for studying geographical nomenclature by visually impaired and blind students

In recent years, small-scale thematic maps and schematic maps made in GIS that do not have object labels have become widespread. Such maps are called “dumb”. In most cases, they use the methods of cartograms, map diagrams and areas. It is assumed that the user has sufficient knowledge of geography to decipher the information without the use of additional maps, but in most cases it does not work like that. Thus, “ dumb” maps can be supplemented with interactive functions that allow to obtain information on the names of countries, regions, hydrographic objects, etc at the user’s request.

The classic form of testing knowledge of geographical nomenclature in secondary schools and higher educational institutions, as mentioned above, is to work with another type of “ dumb maps” (contour maps for geography). They are used in training both in Russia and in other countries. Contour maps show the mathematical basis, hydrographic objects and, less often, relief, borders and populated areas. Students use maps of the world, continents, oceans, countries and regions to label objects.

Another version of the test tasks is associated with the compilation of so-called “mental maps”: map diagrams that, in the most simplified form, represent the relative location of geographical objects and their topological connections (Fig.7). Students make such maps by hand, which is useful for developing drawing and sketching from an early age.

Figure 7. Students passing geographical nomenclature using “mental maps”

Gaming technologies are useful educational technologies that help to deepen geographic knowledge and improve skills in working with maps. For example in geography these are games for guessing objects based on their symbols or contours, speed competitions of finding objects based on verbal descriptions, travel games, and others. An example of such a game is the geographical quiz game “World”, made by the author while working on his bachelor’s thesis at the cartographic department of MIIGAiK (Fig. 8).

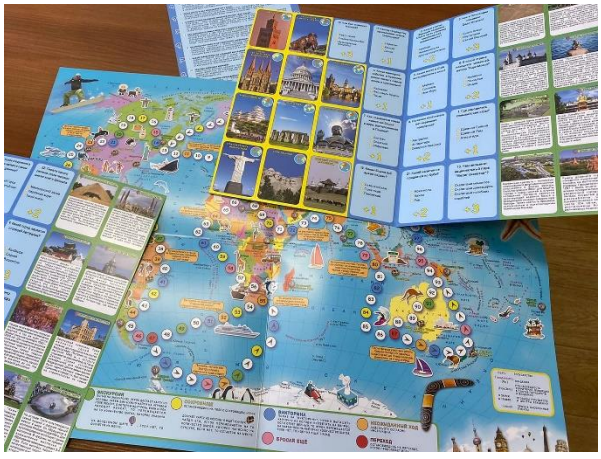

Figure 8. Geography quiz game "World". Work by D. Glebova, 2021

There is a misconception that gaming technologies are only suitable for younger children, but experience shows that even for high school students games can become a powerful means of improving cartographic culture and motivating them to study the disciplines of the Earth Sciences module. Geography games, quizzes and simulators are available in both printed and electronic formats.

PROBLEMS OF DESIGN AND PRODUCTION OF MAPS FOR STUDYING GEOGRAPHICAL NOMENCLATURE

Publishing cartographic manuals requires a lot of preparatory work to update information, develop design and print copies. When developing the design of a cartographic work, in addition to collecting and analyzing source data and developing the content of the map, a specialist faces several interrelated tasks in its design: designing a symbol system that is intuitive to the user; choice of technology and artistic techniques (color combinations, plastic images, font design, etc.); development of a design layout for the appearance of a cartographic work.

The tasks described above are solved depending on the purpose, type, method of use, and the cartographic work being created. It is important to consider the relevance of the product, ease of use, information content, modern design requirements, as well as readability and visibility in the process of creating a map.

To study geographical nomenclature, one of the most important requirements is its good readability, which is achieved through the correct placement of labels on the map and the absence of intersections between the symbols of important objects and signatures. When developing a system of symbols, it is important to observe a logical connection between signs, hierarchy and order of content elements.

For all maps, both printed and electronic, the main requirements are good readability, distinguishability of fonts among themselves and letters within one font, high-quality reproduction, and aesthetics.

REQUIREMENTS FOR THE CONTENT AND DESIGN OF TEACHING CARTOGRAPHIC MANUALS

The main requirements for the content of an educational map used to study geographical nomenclature are its relevance, reliability, and compliance with the program of the discipline being studied. The design of the maps should provide the ease of use, the presence and good readability of the necessary objects and their signatures, well-chosen colors, the possibility of long-term use and the most successful compositional solution, taking into account the method of using the maps. In addition to the objects included in the study, the names of landmark objects should be displayed and labeled.

It is necessary to distinguish the design requirements of printed cartographic products from and electronic maps, choosing the best technologies for specific purposes. Modern typography trends should be taken into account for font design of electronic maps:

- Use of mainly straight fonts (with the exception of hydrographic objects). The use of inscriptions on maps in capital letters only, which allows you to choose a smaller point size;
- Fonts with less difference between uppercase and lowercase letters;
- Low-contrast fonts;
- Outline and translucent fonts for signatures of large objects (continents, countries, etc.);
- Animated inscriptions and symbols on maps;
- Author's typography for map titles and schematic maps.

Taking into account the fact that the didactic method of interaction with the map is one of the most informative, it was decided to develop a textbook for studying geographical nomenclature in universities, including a world map and cards for each object indicating the category. Initially, a printed version of the cartographic manual was developed. Objects of the same category have the same design on the back of the card and the color scheme of the fields. Each card contains:

- category of objects (Fig. 9);
- location;
- characteristics;
- landmarks on the map.

Figure 9. Categories of objects on cards. Work by D. Glebova, 2023

The geographical location is indicated on the schematic map and presented in text form. Most of the card area is occupied by colorful illustrations. Thanks to the indication of landmarks, the student can easily find the desired object. Names that may not yet be known to students and therefore raise questions about pronunciation are emphasized.

In addition to the cards (178 pieces) (Fig. 10), the set includes a physical map of the world, which contains labels of objects and landmarks within the scope of the university program (Fig. 11). Some natural objects are indicated by icons: waterfalls, mountain peaks, active volcanoes, dormant volcanoes.

Figure 10. Cards with information about geographic objects. Work by D. Glebova, 2023

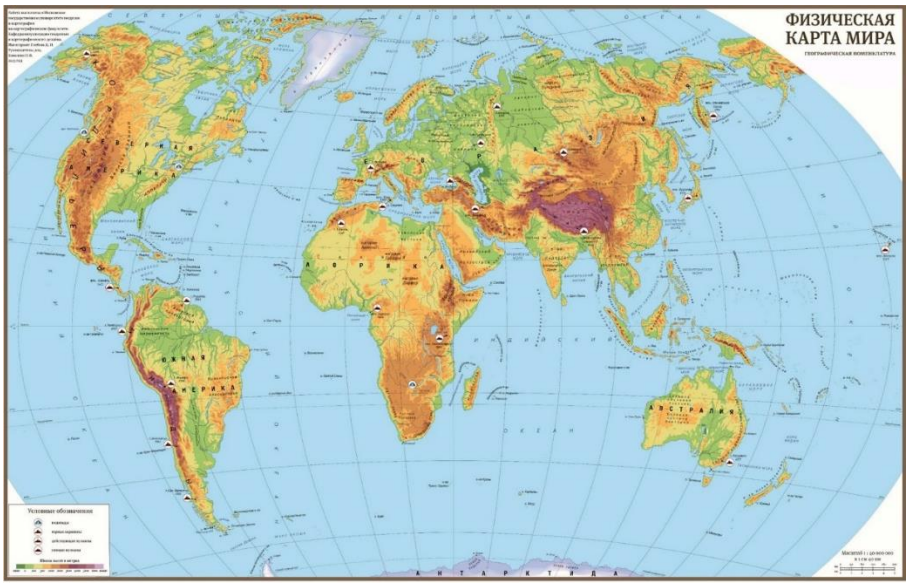

Figure 11. Educational map for studying geographical nomenclature at a university. Work by D. Glebova, 2023

Practice has shown that this version of the teaching manual is most suitable for use in groups. With the help of information about an object and its location, the memorization process becomes easier, since visual images, a method of repetition, and logical connections between objects are used.

The efficiency of this method of interacting with the map was proven by using a control group of students who used a similar cartographic manual for the first time and also had approximately the same level of knowledge on this topic. The students' task was to find the object after reading the information on the card. At the end, the number of correct answers was counted. The average time for finding objects was less than a minute and all objects were successfully found on the map.

ELECTRONIC CARTOGRAPHIC MANUALS FOR STUDYING GEOGRAPHICAL NOMENCLATURE

Currently, there are a small number of high quality electronic cartographic manuals. Some of them are scanned printed maps posted online, others are made in GIS and are not brought to the required level of quality. Thus, the topic of developing electronic cartographic manuals for universities is very relevant.

Electronic cartographic manuals have disadvantages compared to printed maps, but there are also a number of advantages. The electronic manual does not have sufficient visibility. The student cannot look at the entire mapped area due to the fact that he has to enlarge the desired area to fill the entire screen to read the names, while most of the map remains outside of it.

The positive side of the electronic cartographic manual is its ease of use for independent study outside educational institutions. This increases the accessibility of knowledge, and the memorization process goes faster. Another important aspect that makes the introduction of electronic cartographic manuals desirable is the widespread introduction of digital technologies in education: smart boards, interactive panels, tablets, etc.

The problem is that the development of specialized applications is not cost-effective due to the need to update data, as well as due to the different curriculum of educational institutions. Creating this application will require labor and financial costs, but will not pay off. To maintain the functionality of the application, you will also need funds that can be obtained exclusively from the sale of the application and its updates. From a user who mainly wants to receive a free product without advertising, this application will not be in demand.

There may be several solutions to this problem. For example, concluding an agreement with an educational institution, developing an application for their curriculum and paying the customer for the required number of licenses. However, there is another option, the simplest and most cost-effective: developing a multi-page PDF document that includes the necessary information about the geographical nomenclature. Objects are divided into several categories, for each object a card is created containing the name, location, characteristics of the object, landmarks and illustrations. The technology concerned is much easier to edit and maintain. In general, this option of using an electronic cartographic aid is more reliable and accessible. For these purposes, it is possible to use the developed printed version of the manual with its modification for electronic use.

The access to the electronic educational map on the websites of educational institutions should be possible, for example, via a QR code or link.

Of course, printed maps are fading into the background and are largely being replaced by electronic ones, but the quality of modern electronic products does not allow us to completely refuse to use printed publications, which show their good side due to visibility, accessibility without the Internet and the possibility of learning in groups. In this regard, we propose to develop both directions when creating educational cartographic manuals, since both of them have advantages.

WAYS TO SOLVE THE PROBLEMS

The study made it possible to identify the problems of cartographic support for the study of geographical nomenclature in schools and universities and outline solutions.

1. Due to small print runs, printing such cartographic manuals is not economically feasible. In this regard, we propose to print wall survey maps as an order from specific universities and schools, including certain geographical nomenclature. This solution will ensure the low cost of publishing such manuals due to printing on a high-quality plotter.

2. Creation of a unified cartographic manual for a program focused on the education program has been established by state education standards. Such a manual will be less useful compared to individual versions of the publication, but it will

help to balance the level of students' knowledge, which will solve the problem of insufficient preparation of applicants in the field of geography entering universities.

3. Active implementation of accessible, high-quality electronic manuals. Such manuals will be available to students at any time, which will help them not to miss the next stage of repeating the information. The use of this manual is possible in all three options described earlier. The electronic cartographic manual must be posted on the portal, accessed via a link or QR code. The advantage of such a map is the ability to use additional interactive functions, the disadvantage is the inability to see the entire map on the screen with sufficient magnification.

CONCLUSION

As a result of the study, it was revealed that high-quality educational cartographic manuals are a necessary condition for the successful study of geographical nomenclature in schools and universities. Their introduction into the educational process will help to significantly improve the level of students' knowledge.

The design of such manuals must fully correspond to the purpose of the map: be simple, concise in content and design, convenient for long-term work. The map must have an optimal load, determined by the program of the academic discipline. Symbols and inscriptions should be easy to read and intuitive.

The production of printed cartographic manuals is not economically profitable due to small circulations. The cost of a cartographic work can be reduced by printing in small quantities on a plotter. This solution to the problem will help provide schools and universities with educational materials, taking into account the requirements for the size and content of maps. Electronic geography manuals should be developed and implemented along with printed maps.

The theoretical significance of the study lies in the scientific substantiation of the requirements for cartographic support for the study of geographical nomenclature in schools and universities. Practical significance is in the implementation of methods for developing cartographic support for the study of geographical nomenclature and in the development of a teaching manual that corresponds to the goals and objectives of individual categories of students, as well as the use of such support in practice in schools and universities.

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BIOGRAPHY

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