

# Development of Cognitive Geography Ideas in a Digital Educational Environment

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## ABSTRACT

The purpose of this article is to identify the key ideas of cognitive geography related to the modeling of images of space, and present them as a theoretical and methodological tool for updating the content of school geography. The paper discusses the methodological features of perception and processing of information related to the formation of the image of geographical space in schoolchildren. The cognitive limitations of traditional teaching methods reinforced by the features of clip thinking of modern teenagers are revealed. The possibilities of implementing the relationship between cognitive and information technologies in the formation of spatial thinking in the process of organizing educational and cognitive activities are considered. The analysis of didactic possibilities of digital technologies, which are most often used in teaching geography at school, is performed. It is proposed to use GIS technologies and modeling in the aspect of combination with traditional abstract-logical and sign-symbolic schemes as the most effective for creating a digital image of the territory. The advantages of digital technologies that optimize the process of forming spatial thinking in cognitive geography are considered on the examples of solving different types of educational and cognitive tasks.

**Keywords:** *geographical space, spatial thinking, cognitive geography, GIS technologies, space modeling*

## 1. INTRODUCTION

The main goal and fundamental value of school geographical education is to introduce younger generations to geographical culture. Its content-semantic constructs are represented by such categories as the scientific geographical picture of the world, geographical thinking, a system of value orientations and values associated with the cognitive and transformative activities of a person in geographical space. The picture of the world as the content basis of geographical culture is the leading one, represented by a system of images of different types and levels of complexity. The most common of them is the global image of geographical space, identified with the geographical picture of the world [1]. To achieve the goal of geographical education, it is of fundamental importance that images of space are not only a description and explanation of a territory as an objectively existing fact, but also information ordered in a certain way. It is important that these characteristics translate the methodological traditions and attitudes of geographical thinking, the system of its language, which students master by means of the educational subject. In the modern world, due to the high rate of obsolescence of information and knowledge, it is necessary to design competences that allow students to master the cognitive mechanism of working with electronic media, aimed at training, education and self-training.

## 2. PROBLEM STATEMENT

In Russian geographical science, and then in school geography of the 20th century, there was a stable tradition of representing geographical images of various territories on the basis of a system of scientific concepts, using abstract-logical schemes necessary to explain the laws of the organization of geographical space and the features of its development. Mandatory elements that create an image of a territory include a text description and a geographical map. An important feature of the methodology of objective thinking is to identify and reflect the general, typical characteristic of different territories. In geographical science, the typological approach always served as an important methodological tool [2].

As a result, the textual characteristics of the territory, which continue to be the main element of the content of educational literature, correspond to the structure accepted in science, the logic of presentation, based on the genetic principle of space organization. The text characteristic plan is an ordered scheme that shows the interconnectedness and interdependence of natural and socio-economic components. Each subsequent point of the characteristic becomes a logical continuation of the previous part and the basis for the presentation of multi-sided direct and reverse cause-and-effect relationships. The mandatory element of the characteristic is the

conclusions that lead the student to understand the main thing in the text.

The geographical map traditionally serves as an important tool for teaching and learning about geography, enabling to fill the world picture and image of the territory with precise mathematically defined characteristics of terrain features using the means of sign and symbolic visibility. Thus, the translation of the scientific style of thinking into the content of school geography over a long period of geography development set methodological guidelines for students' acquisition of general patterns of organization and development of geographical space at different levels of its organization. The management of cognitive activity was largely determined by a strict scientific presentation of the educational content, which ensured the predominance of concepts, theoretical schemes, and accurate images of the territory using maps in educational cognition.

Along with this, in the theory and practice of teaching, a special place was always given to the formation of an empirical, sensory basis for geographical images. Therefore, when studying the geography of the area, the system of one's own observations, which are the basic elements of the local history principle of learning, is a boundary condition for the acquisition of general concepts and laws. In the end, it was assumed that students formed a more or less meaningful, structured, organized image of the geographical picture of the world.

Thus, in the conditions of traditional education, geographical images were formed in schoolchildren on the basis of the methodology of generalized methods of scientific knowledge of classical geography. Then these methods served for a person as the main cognitive schemes of perception, processing information about the nearest and more distant geographical environment. The established attitudes corresponded to the classical principles of selecting and structuring the content of the educational subject. Among them are the principles of science, accessibility, systematicity and consistency, visibility with the leading role of the first. The beginning of standardization, including the introduction of Federal state standards of basic general education, has not significantly changed the methodological guidelines for solving the main task of the methodology - the development of the content of school geography. Today, in the age of global information flows and dynamic changes, when a person constantly faces new situations, plots which are changing rapidly, the current determination of the content of the educational subject requires theoretical and methodological correction.

### **3. METHODS OF RESEARCH**

In the second half of the 20th century, a new problem area emerged - cognitive geography, for which the cognitive approach serves as a methodological basis [3,4]. The fact that geographers paid special attention to the mechanisms of perception, processing of information about geographical space, building images about it as the basis of human behavior, has its explanation associated with the

accumulation of a huge array of information in a dynamic social life, the emergence of new forms of social, economic, demographic, and ethno-cultural processes. The dynamism of social change requires a person to adapt more to society and the ability to "cope" with this situation, to optimize activities in it. Because of this, the mechanisms of cognition of geographical space, the construction of its images that determine human behavior, become the subject of cognitive geography [5].

A geographical image is defined as a representation of a certain space, its model, a certain cognitive interpretation of a place filled with symbolic meanings and personal meanings [4]. As an element of the sign-symbolic senses, the geographical image is formed purposefully and can be understood within a certain symbolic system related to the recipient's communicative competence.

In this regard, the conclusions of psychologists that the image of the world intrinsic to a particular person is the most important component of his consciousness and the area of behavior regulators are of particular importance (E. A. Klimov, A. N. Leontyev, S. D. Smirnov). From a cognitive-psychological point of view, synonyms of a geographical image are a frame, mental representations, a cognitive scheme, etc., based on territorial associations with a given place. A geographical image is a compressed representation of a certain territory that "works" as a sign-symbolic system and is studied, respectively, using the methodology of hermeneutics and semiotics, structural analysis, etc. In this interpretation, a geographical image is a sign and symbol of a territory intended for "reading" by a competent reader: geographical maps, elements of the cultural landscape, verbal and non-verbal texts, etc.

The analysis of the literature makes it possible to identify the main ideas and problem areas, the research of which is associated with the development and structuring of scientific knowledge of cognitive geography (M. Bark, G. D. Gachev, J. Gold, L. N. Gumilev, D. N. Zamyatin, G. Z. Kaganov, A. G. Levinson, K. Lynch, D. Spencer, S. V. Fedulov). The methodological basis of this research is interdisciplinary and is based on the intersection of geography, psychology and computer science. Information technologies that most fully meet the goals of forming spatial thinking in cognitive geography include two main didactic tools: geographical information systems (GIS) and modeling. In traditional geography, models include descriptions, maps and plans, satellite images, profiles, mathematical formulas, and symbols.

A geographical map is a mathematically defined, reduced, generalized image of the Earth's surface, showing the location of objects in the accepted system of conventional signs. All concepts of modern science are involved in the process of forming the image of the territory: 1) the communicative concept considers the map as a means of communication, a channel of information (E. Arnberger, A. Kolachniy, A. Robinson, etc.); 2) the language concept considers the map as a special text made with the help of conventional signs (A. F. Aslanikashvili, A. A. Lyuti, Ya. Pravda); 3) the geoinformation concept considers the map as an image-sign model of reality (A. M. Berlyant) [6,7].

The map continues to play the main scientific and methodological role in geographical education, and the cartographic method remains a cross-cutting general scientific one. The educational potential of the map is inexhaustible, especially due to the active introduction of GIS technologies into the educational process [8].

#### **4. RESULTS AND DISCUSSION**

The study of school practice shows that for various reasons, primarily individual characteristics, some students find it difficult to master the basic content of general education and experience problems during the final certification. Traditional approaches used in school do not contribute to the growth of students' cognitive interest in studying the nature of their native land. Analysis of the results of the All-Russian Geographical dictation, conducted annually by the Russian Geographical Society, showed that the inhabitants of the Ural region have a low level of local lore knowledge.

The schoolchildren's low level of preparation in geography is confirmed by the results of the state final certification SFC-11 in the period 2016-2019. According to the statistical and analytical report of the Subject Commission on the general subject "Geography" for the mentioned period, there is a trend towards a systematic decrease in the number of graduates who sit this exam (400-500 people a year in Sverdlovsk oblast) and whose level of its knowledge is advanced and high.

The low level of indicators is also noted among students who show increased interest in the regional stage of the All-Russian Olympiad in Geography in 2020: the winners of the regional round among grades 9-11 did not qualify for the final stage of the Olympiad in Geography (the winner among 9th grades received 37 points out of 100, with a passing score of 52 points; among grades 10-11 - 50 points with a passing score of 57.5).

According to special studies, up to 30 % of modern school children need help due to psychogenic disadaptation [9]. In relation to school geography, we will add such characteristics as lack of interest in the study of the subject, insufficiently systematic, fragmentary knowledge. As a rule, representations about specific territories are incomplete, inaccurate, and superficial. Students demonstrate ignorance of the geography of their place of residence, alienation of developing events and problems from their own system of meanings and values. Manifestations of school problems are aggravated by the phenomenon of clip thinking (clip in English - segment, text fragment, movie excerpt). Acting as a kind of alternative to thinking which is rational and systemic in nature, it is based on the perception of low-content, but dynamic, bright images, not connected by a common sense mosaic, that are represented by audio-visual means; the child's attention is focused on observation instead of reasoning [10]. For modern teenagers, referred to as the "generation of gamers", "generation D" ("digital generation"), who grew up in a media culture, the technology of which provides rapid immersion in

information flows, convenient and accessible ways to search for information, this thinking becomes decisive. Its mechanisms are aimed at the perception of ready-made images that are evaluated not rationally, but emotionally (like-dislike). Communication by pictures, the ability to easily rearrange audio-visual series, "clickability", displaces text communication, gives rise to a superficial character, narrow focus, fragmented knowledge, a low level of critical perception and evaluation of information [11]. According to scientists (N. V. Azarenok, J. Weiss, S. V. Dokuka, M. N. Kozlova, A. Moles, A. Toffler, etc.), this thinking is emotional, associative, dynamic and, as a result, superficial, unsystematic. It does not involve a deep explanation, analysis, or the establishment of various connections, i.e. thoughtful understanding of information - the central link of the learning mechanism.

In this regard, the question of how a schoolchild can fully learn, especially independently, if he develops not rational, but clip, i.e. illogical, uncritical thinking since the childhood? We will project this situation into the educational process in geography, which is largely associated with the purposeful formation of images of space. It is easy to assume that the mechanisms of clip thinking contradict the accepted schemes of rational explanation, transform them, causing students a sense of discomfort. The study of the school confirms our assumption that there is a cognitive conflict between the schemes of presentation and explanation of educational material by the teacher, first of all, theory, and the experience of teenagers in understanding reality by means of clip thinking. Its interpretation in the framework of the theory of cognitive dissonance, proposed by L. Festinger [12], makes it possible to assert that in such a situation, schoolchildren tend to eliminate the resulting sense of discomfort. Normally, a person actively avoids situations that can strengthen it. The desire to restore cognitive harmony is a powerful motivator of human behavior and attitude to the world. This provision emphasizes the need to update the content of geographical education, one of the significant resources of which can be a cognitive approach. Orientation in the world around us has always been a natural human need. In the conditions of dynamic social life, which is manifested in the acceleration of social processes, it increases significantly. One can navigate the modern world only by being able to explain more or less adequately what is happening around, interpret the observed facts, predict the possible course of events, and make appropriate decisions. Without the development of such cognitive abilities, it is easy to lose the meaning of not only what is happening, but also one's own place in it. The dynamism of social change requires a person not only to adapt more to society, but also to be able to "cope" with this situation and optimize their activities in it. Understanding how our knowledge of the world relates to changes in it is necessary for every person.

The mechanisms of knowledge of geographical space, the construction of its images that determine human behavior purposefully or unintentionally have developed in the practice of teaching geography throughout history. We will indicate the main problem areas related to space

image modeling: 1. How the space which is studied based on the needs of a person, group, society is organized. Scientists believe that geographical space has a dual nature: the objective environment as the world of reality and the behavioral environment or the world of consciousness; it is the behavioral environment that is the basis for human decision-making and behavior. 2. How a person feels and perceives geographical space; what the mechanisms for forming its images in the individual and mass consciousness are. Experts emphasize that each person forms their own models of space, saturating them with a system of values, relationships, worldview ideas, and subjective experience. 3. What factors affect the perception and processing of information in the geographical space. 4. How a person processes information about geographical space. Not only abstract-logical thinking techniques are taken into account, but also cognitive methods of obtaining, converting, and encoding information. 5. What the characteristics of behavior of a person or group in the geographical space are. The special role of motives, emotions, attitudes, and cognitive control in behavioral responses (organization of personal space, preference for certain places, and desire to learn new territories) is emphasized. 6. Human behavior in extreme situations of the geospace.

The organic connection of the main ideas of cognitive geography with psychology gives it a complex character. In explaining the relationship between man and the environment, experts try to simultaneously take into account natural and socio-cultural factors, cognitive processes that affect the formation of knowledge about the geographical space, as well as phenomena related to the personal characteristics of the organization of the human cognitive sphere. The psychological validity of these ideas enables considering them as an important source of updating the content of school geography. Translation of their content by building special texts with augmented reality in school textbooks will help significantly enrich the methodological tools for forming geospatial images for schoolchildren. Methodological triad of traditional geographic thinking (logic-map-common) is supplemented with the methodological ways of creating images of space, reflecting their uniqueness, originality, enriches them not only with shared values but also personal meanings. Cognitive methods of representation, formation, modeling, construction, recognition, and transformation of geospatial images integrate cognitive processes related to the formation of geographical knowledge, extracting information about geographical reality, and making decisions related to behavior in the environment.

What will change in a student under the influence of ideas of cognitive geography? It can be assumed that his cognitive attitude to geographical information is changing, namely, how he perceives this information, concentrates his capabilities, includes the existing educational and not yet structured life experience, forming spatial schemes, mental maps, "...on which he will mark down the impressions caused by the geographical localization during his life" [1].

In such conditions of goal setting, it is optimal to actively implement digital technologies aimed at optimizing information management processes and increasing the cognitive interest of students. These technologies for spatial thinking include GIS technologies and modeling.

The use of GIS technologies becomes a necessary condition for the formation of cartographic literacy of students. A geographic information system (GIS) is a computer technology used for mapping and analyzing real-world objects and events. This technology combines traditional database operations, such as query and statistical analysis, with the benefits of full visualization and spatial analysis that the map provides. Difference of digital maps from the traditional ones lies not so much in the visualization and display using computer graphics, which attracts today's children, but in the way of supporting each mapped object when digitizing and depicting with the expanded information component displayed in the attribute table which is a basic component of the database. Any information entered in the attribute table can be visualized and a new map can be obtained. This means that the modern teacher has the opportunity to teach students using the most up-to-date, rapidly changing geographical information at different levels of the organization of geographical space. Each object shown on a digital map can be characterized based on an unlimited set of parameters. For example, rivers that traditionally serve as an element of general geographical content can be visualized depending on the set educational task in accordance with the direction of search activity. The information capacity of a digital map enables to get detailed information about the objects depicted, and to get attribute, geometric, and topological information.

The difference between digital maps and traditional maps is the ability to navigate and zoom when viewed. Digital maps, therefore, embody a fundamentally new approach to working with spatial data. This computer system makes it possible to display not only geographical data on an electronic map, but also statistical information, as well as to apply a variety of analytical operations. GIS has a unique ability to identify hidden relationships and trends that cannot be established on paper. There is a qualitatively new meaning of data, different from the mechanical set of individual parts. In addition, GIS stores not just a static image, but a full-fledged spatial model of the area. Models of geographical objects, processes or phenomena created using GIS technologies give an opportunity to enter a definition of the concept based on the visual perception of students, so that the concept is supported by a meaningful, clearly presented image of the corresponding geographical object or process; to present hidden geographical connections and patterns in an obvious form; to present the provisions of theoretical knowledge that are clearly difficult to perceive; to show the relationship and interdependence; to follow the course of reasoning leading to the desired conclusion; to identify a prompt to solve the problem.

Spatial thinking is based on interrelated processes of analysis and synthesis, assumes a high level of generality and abstraction of judgments, consistency and such

qualities of thinking as flexibility, constructiveness, criticality and intuition. The systematic use of GIS technologies in the educational process contributes to the development of spatial thinking with its value and meaning component, reflecting the system of personal meanings and relationships of the student, his subjective experience associated with the study and modeling of geographical space. Geographical knowledge, permeated with a system of personal meanings, attitudes, and relationships, creates its own geographical picture of the world, which, in turn, affects the formation of mentality, personality orientation, and regulates consciousness, behavior, and human activity. Therefore the inclusion of GIS technologies in the educational process stimulates the processes of human self-determination, generates processes of meaning determination.

Here is an example of a task from a practical work in the course "Geography of continents and oceans". Students of the 7th grade studying the topic "Internal waters of Eurasia" are asked to compare the outline of the Aral sea-lake in different years (1972, 1987, 1999, 2011, 2020 years), using the technique of layering maps; determine how and why the lake was drying up; predict and explain how the area of the sea-lake will change in 50 years. As a rule, these are tasks whose content describes real geographical objects, phenomena, events, processes, and situations in order to identify, justify, and explain certain geographical characteristics. The main method of solving such problems is modeling and forecasting as a description of real processes and phenomena in the language of geographical science. Solving the assessment problem in the framework of search activity, the student interprets the situation not only in the context of general provisions of geographical science, but also individual experience, and extracts personal meaning in the study.

The purposeful use of GIS technologies in geography lessons helps to overcome psychological barriers that arise in students in the processes of perception, imagination, representation, understanding of cartographic knowledge in their traditional formation. In such an information educational environment, the object of study is not so much a static fact, but also allows students to organize the activities of search and research orientation to track the dynamics and evolution of the development of natural complexes in the region in the form of completing the model, redesigning and modification. Mathematical modeling methods integrated with territory visualization are one of the most effective tools for data mining and knowledge acquisition.

The introduction of digital technologies in the educational process is associated with a number of limiting factors. This is primarily the presence of a certain material and technical base, including software. In addition, there is still a digital inequality between modern schoolchildren, representatives of the generation of the so called "digital natives" and teachers, who mostly belong to "digital immigrants". The ubiquitous digital environment forces today's students to think and process information in a fundamentally different way than teachers do. Optimization of learning processes can bring positive

results only by obtaining the appropriate levels of digital technology proficiency on both sides of the educational process, taking into account their cognitive styles.

## 5. CONCLUSION

Thus, within the framework of cognitive geography new methodological orientations of scientific knowledge are developing, through which modeling of the geographic image includes content and meaning constructs: the image of the place is saturated with emotions and values; it includes past experience of human behavior in the environment; represents the typical and unique, the objective and subjective, and is formed specifically, individually. Digital technologies in cognitive geography serve as a means of learning and have a high didactic potential, making it possible to manage the information flow and build it into a meaningful logical field. It can be assumed that cognitive methods of image modeling can correct the techniques of clip thinking of teenagers, give it signs of logical and meaningful certainty and consistency. At the same time, the solution of the highlighted problem in the methodological aspect requires scientific justification of the ways of reasonable compilation and integration of information and educational technologies from a system perspective. The use of GIS technologies and space modeling as a way of forming spatial thinking in combination with traditional abstract-logical descriptive and sign-symbolic cartographic models gives consistently high results. This process is based on the analysis of the effectiveness of interaction between the teacher and students both during training and in educational activities, and depends not only on the possession of relevant competences, but also on the emotional mood created during the justified use of information technologies in the learning process.

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