Geography: Space, Interconnections, and Global Thinking

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Fractal Academy
Issue 4 (Autumn 2026), Article 9
Series: “Developing Mental Mechanisms Through School Subjects”
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DOI: [to be assigned]
Publication date: 1.11.2026

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Title (English): «Geography: Space, Interconnections, and Global Thinking»
URL: https://fractal-academy.com/articles/article-4-9/
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Annotation

In this article, I show how geography as a school subject can become a unique space for the development of mental mechanisms - provided that we stop reducing it to memorizing the names of capitals and memorizing maps. Drawing on the CPLC model presented in previous articles of the module, and on current research of 2024-2025 in the field of geographical education, I substantiate that geography possesses exceptional potential for the development of spatial imagination, the construction of cause-and-effect relationships, forecasting and strategic thinking, critical thinking, information search and analysis, systems thinking, as well as eloquence. I propose specific examples of lessons and tasks in which work with maps, GIS technologies, environmental modeling and analysis of global problems serve not as an end in themselves, but as a means of developing thinking. I pay special attention to the diagnostics of progress and the connection of subject-based learning with the school's infrastructure - a cartographic studio, a geographical site, a tourism club. I also substantiate that the restructuring of geography teaching is not merely a methodological question, but a strategic task: it is precisely through geography that the cognitive apparatus capable of spatial, systems and global thinking is formed - the type of thinking that is necessary for understanding interconnections in a complex, rapidly changing world.

Keywords: geography, mental mechanisms, spatial thinking, systems thinking, cause-and-effect thinking, forecasting, critical thinking, GIS, diagnostics, infrastructure.

A Map That No Longer Fits on the Desk

I will begin with a statement that may seem contentious, but which I consider fundamental. Geography at school is not a subject about how to memorize the names of countries and rivers, but a subject about how space is structured, how everything is connected to everything else, and how we can understand and change the world in which we live. It is a subject through which a person learns to see connections - between climate and economy, between relief and settlement, between human actions and the state of the planet. Of course, knowledge of the map and the ability to navigate are important. But this is a tool, not a goal. The goal is the ability to think spatially; the ability to see cause-and-effect relationships in global and local processes; the ability to forecast the consequences of changes; the ability to critically evaluate information; the ability to work with heterogeneous data; the ability to think systemically [1; 5].

Here it is appropriate to recall the old portolans - nautical charts by which medieval navigators crossed the oceans. They had neither a coordinate grid nor a scale in the modern sense. There were only outlines of coastlines, compass roses and lines connecting ports. But it was precisely by these maps that people discovered new lands. Because a map is not merely an image. It is a way of thinking about space. The portolan told the sailor: here it is safe, and here there are reefs. Here there is a tailwind, and here there is a calm. The map was not a description of the world, but an instrument of action. And geography at school should be the same. Not a description of the world, but an instrument of understanding it. Because the world in which our children live no longer fits on a desk. It is global, connected, dynamic. And to live in it, one must be able to see connections. Not only between countries on a map. But also between processes. Between decisions. Between people. And geography is the only subject that dares to show these connections. Not because it has all the answers. But because it has the courage to ask questions about the whole.

As I have already shown in the first article of this series [5], the principle of the dual purpose of a lesson means that every geography lesson must simultaneously solve two tasks: the subject task - the mastery of geographical content,

and the meta-subject task - the development of mental mechanisms. These tasks do not contradict each other - on the contrary, they mutually reinforce each other. It is important to emphasize: geography creates the conditions of possibility for the development of mental mechanisms, but is not their sufficient cause. In itself, memorizing maps or viewing atlases will not develop systems thinking. Development occurs only through specially organized pedagogical activity, where the teacher acts as a facilitator and architect of the cognitive apparatus [5; 6].

Research confirms: geographical thinking is the cornerstone of modern geographical education. As an international study of the curricula of nine countries notes, despite its universal value, there are significant gaps, in particular the insufficient representation of place as a central concept and the absence of an explicit emphasis on geographical thinking [8]. Researchers emphasize the need for stronger interconnections [8]. Contemporary research shows that traditional approaches in geographical education are often limited to static maps and memorization of facts and do not always stimulate higher-order thinking skills [11]. The integration of digital technologies into geography teaching has opened new opportunities for the development of critical thinking among students [11]. Geographic information systems, interactive maps and educational platforms not only improve spatial literacy, but also encourage students to interpret, question and transform their social reality [11]. But I want to go further and show how each of the eleven mental mechanisms can be developed through geography teaching - and how this changes the very approach to the subject. Geography is not merely a natural science among others. It is the science of interconnections, of how space, nature and society form a single whole. That is precisely why geography, in my view, is a key subject for the formation of the communicative-cognitive framework of the personality [1]. Moreover, the restructuring of geography teaching is not merely a methodological question. It is part of that historical necessity of changing the pedagogical paradigm about which I wrote in articles [3] and [4]. The industrial school reduced geography to a set of names and coordinates to be memorized. But post-industrial society needs people capable of thinking, creating, adapting - and geography here is a key instrument. As I showed in article [2], subject-centrism is one of the main reasons for the vitality of the old model. Overcoming this subject-centrism begins with a rethinking of the role of geography in education.

Space That Can Be Seen

Spatial imagination develops through geography in the most direct and natural way. Working with maps, analyzing spatial data, representing relief and landscapes - all of this requires and develops spatial thinking. The ability to read and interpret maps. The ability to represent three-dimensional relief from contour lines. The ability to move mentally in space. The ability to see spatial patterns. The teacher must consciously create situations that require spatial thinking. Not simply to look at a map, but to imagine what this locality looks like in reality. Not simply to name coordinates, but to understand how location influences climate and economy. Research confirms the importance of this approach. A study conducted in Georgia showed that purposeful and consistent work on spatial tasks significantly improved students' abilities to read maps, recognize spatial interrelationships and make rational decisions [14]. The study emphasizes that spatial thinking is an important component of human cognitive development, enabling an understanding of the interrelationships between objects and space [14].

It is like an architect who looks at a plan and sees a building. He does not see lines. He sees space. He sees how people will walk. How the light will fall. How the echo will sound. And he can change the plan so that the building becomes better. But a student who does not know how to see space sees only lines. And cannot change the plan. Because he does not understand what stands behind it. And behind it stands the world. Which can be seen. If one learns to look. And if one knows where to look.

The construction of cause-and-effect relationships is a mechanism that geography develops through an understanding of interconnections. Geography is the science of interconnections. Climate influences vegetation. Relief influences settlement. Human activity influences the environment. Understanding geography requires an understanding of these cause-and-effect chains. The ability to explain why different regions have different climates. The ability to understand how natural conditions influence economic activity. The ability to build chains from causes to consequences in ecological and social processes. The teacher must focus attention on the cause-and-effect logic of geographical phenomena. Do not memorize the climatic zone, but explain why the climate here is like this. Do not learn the location of cities, but understand why people settled precisely here. Research shows that the visualization of cause-and-effect relationships is an important element of geographical education [10]. School geography curricula address climate change, but experience difficulties in explaining the complexity of actors and systemic cause-and-effect relationships

[10]. This is precisely what makes geography an ideal subject for the development of cause-and-effect thinking. It is like a detective who looks at a crime scene and sees not evidence, but a story. He sees what happened. Why it happened. And who stands behind it. So too in geography. A student who sees only the map does not understand geography. A student who sees the cause understands. And receives pleasure not from memorization, but from the fact that he has arrived at this himself. With his own mind. With his own thought. By his own path. Which began with a question. And ended with understanding. Which has become yours. Because you built it. As a builder builds a house. From bricks. From thoughts. From logic. And this is the most important thing. Not the map. But the path. That leads to it. And that remains with you. Even when the map is forgotten. Because the path is a skill. And a skill is not forgotten.

Forecasting and strategic thinking is a mechanism that geography requires and develops. Geography requires constant forecasting. How will the climate in the region change in fifty years? What will be the consequences of urbanization? What will happen to the ecosystem when economic activity changes? The ability to forecast changes in natural and social systems. The ability to assess risks and plan adaptation strategies. The use of the POE method - prediction, observation, explanation - as applied to geographical phenomena. Research shows that the POE learning model promotes a deeper understanding of geographical phenomena [12]. The use of this method in combination with augmented reality significantly improves geography learning outcomes for students with different cognitive styles [12]. It is like a doctor who looks at test results and sees not numbers, but a disease. He sees what will happen if it is not treated. He sees what will happen if it is treated. And he chooses the path. That leads to life. And not to death. So too in geography. A student who knows how to forecast sees not only what is. He sees what will be. And can choose. What to do. So that it becomes better. And not worse. And this is the most important thing. Not the forecast. But the choice. That stands behind it. And that makes you responsible. For yourself. For others. For the world. Which is not alien. But yours. Because you are part of it. And geography teaches this. Every day. In every lesson. With every forecast. Which is not simply made. It is experienced.

A World That No Longer Fits in an Atlas

Critical thinking is another mechanism that geography develops in a unique way. Geography provides unique opportunities for the development of critical thinking. The analysis of climate data, the evaluation of environmental information, the interpretation of demographic trends - all of this requires a critical approach. The ability to assess the reliability of geographical information. The ability to analyze data and draw substantiated conclusions. The ability to see the multiplicity of interpretations. The use of problem-oriented learning. Research shows that the Spatial Problem Based Learning model significantly influences the improvement of critical thinking skills [13]. SPBL is especially effective for students with a high level of environmental literacy [13]. Research also shows that the inclusion of debates in geography teaching allows for the awakening of students' critical thinking by explaining political deadlocks and contentious debates [10]. Metacognitive tools guide students toward substantiated and systemic geography [10].

Here it is appropriate to recall the maps of the Middle Ages, where lions, dragons and sea monsters were drawn at the edges. This was not naivety. It was an acknowledgment: here knowledge ends, and the unknown begins. Today's maps seem more precise. But they too do not tell the whole truth. Because behind every border, behind every color, behind every line stands an interpretation. Someone decided where to draw the border. Someone decided which color to use. Someone decided what to show and what to hide. And critical thinking is the ability to see these decisions. Not to accept the map as a given. But to ask: who drew it? Why? What remained beyond the frame? And then the map becomes not merely an image, but a text. Which can be read. And understood. And, perhaps, rewritten. If you disagree. If you see more. If you know that the world is more complex than the lines on paper.

Information search and analysis is a mechanism that geography requires and develops. Contemporary geography is work with enormous arrays of data: climatic, demographic, economic, environmental. The ability to find, analyze and interpret information becomes key. The ability to work with geographical databases. The ability to analyze statistical data. The ability to interpret maps, graphs, diagrams. The use of digital technologies. Research shows that an ICT-based instructional package in geography effectively improves awareness of anthropogenic climate change and students' critical thinking [9]. It is like an archivist who searches for documents in dusty folders. He does not simply find papers. He reads them. Compares them. Checks them. And only then draws a conclusion. But if he simply takes the first paper that comes to hand and says that this is the answer, he is mistaken. And his mistake can cost

dearly. So too in geography. A student who does not know how to search for information takes the first article that comes to hand. And applies it inappropriately. And obtains an incorrect conclusion. But a student who knows how to search finds several sources. Compares them. Checks them. And only then draws a conclusion. And his conclusion turns out to be correct. Because he did not simply find. He understood. And this is the most important thing. Not information. But understanding. Which comes not from quantity. But from quality. Not from speed. But from depth. And geography teaches this depth. Every day. In every lesson. With every study. Which is not simply conducted. It is comprehended.

Eloquence and systems thinking are mechanisms that geography also develops. Geography develops eloquence through the necessity of explaining complex geographical concepts, arguing one's conclusions, and presenting the results of research. And systems thinking through an understanding of how all the elements of a geographical system are connected to each other. Research shows that systems thinking in geographical education includes the ability to understand the complexity of actors and systemic cause-and-effect relationships [10]. Systems thinking has the potential to overcome subjective statements on certain social issues [10]. It is like a conductor who hears not individual instruments, but a symphony. He hears how the violins echo the cellos. How the flute responds to the oboe. How the drum holds the rhythm. And he can change the sound so that the symphony becomes better. But a student who does not know how to hear the system hears only individual sounds. And cannot change the symphony. Because he does not understand what stands behind it. And behind it stands the world. Which can be heard. If one learns to listen. And if one knows where to listen.

A Lesson That Begins with a Map

Now I will turn to specifics. What does a geography lesson built on the principle of dual purpose look like? I propose several examples - from simple to complex. The traditional approach: show a map, explain what is where. The approach that develops thinking: propose solving a real spatial task requiring analysis of a map and decision-making. An example of a task for the sixth-seventh grade. You are a city planner. You need to choose a location for a new city in the region. You have a map with relief, rivers, roads, and mineral resources. Analysis: analyze the map. Which factors are important for choosing a location - relief, water, transport, resources, climate? Cause-and-effect relationships: why are some places suitable for a city and others not? Which cause-and-effect relationships operate here? Decision: choose the optimal location for the city. Justify your choice. Forecasting: what problems may arise in the chosen location in fifty years? How can they be prevented? Research shows that problem-oriented learning effectively develops spatial thinking [14]. A study in Georgia showed that five interventions, including settlement planning, selection of protected areas and infrastructure placement, significantly improved students' abilities to read maps, recognize spatial interrelationships and make rational decisions [14]. Which mental mechanisms are developed? Spatial imagination - through work with the map. Cause-and-effect relationships - through the analysis of factors. Forecasting - through forecasting problems. Eloquence - through justifying the decision [1]. It is like a child assembling a puzzle. He does not simply connect pieces. He sees in his mind what should result. He imagines how the picture will look. And if something does not fit, he changes the pieces. And imagines again. And so on until what he has conceived is achieved. But if he does not know how to imagine, he simply connects the pieces at random. And often makes mistakes. And gives up. Because he does not see the result. And the result is not what turns out. It is what you see in your mind. Before it turns out. And geography teaches this. To see before it turns out. To imagine before you build.

Walls in Which the World Lives

The development of mental mechanisms requires not only new teaching methods, but also appropriate infrastructure. For geography, this means creating spaces where spatial and systems thinking can develop through practical, research and creative activity. By creating this infrastructure, we form what Andy Clark and Kim Sterelny call a cognitive niche. Infrastructure is not merely premises, but the material part of the environment that provides scaffolding for the development of mental mechanisms. Without this niche, the mechanisms remain abstract concepts. A cartographic studio: a space with physical and digital maps, GIS programs, and equipment for creating maps. Research shows that the integration of GIS and the STEM approach provides stronger support for the development of students' spatial thinking skills [15]. A geographical site or school plot: a space for observations in nature, meteorological observations, study of soils and landscapes. A living laboratory for the development of spatial and systems thinking. A tourism club: a space for the practical application of geographical knowledge in hikes,

expeditions, and excursions. Develops spatial thinking, cause-and-effect relationships, forecasting. A weather station: a space for collecting and analyzing climate data. Research shows that an ICT-based instructional package in geography effectively improves awareness of anthropogenic climate change and critical thinking [9]. The creation of this infrastructure is not an expense, but a strategic investment. Every child who finds through these spaces their point of entry - whether it be cartography, GIS analysis or tourism projects - receives a powerful impulse for the development of all the other mental mechanisms [1].

Roots and Branches

Geography does not exist in isolation. It is connected with all other subjects - and these connections can be used for the development of mental mechanisms. Geography and mathematics: statistical processing of data, construction of graphs, work with scale and coordinates - all of this requires mathematical thinking [6]. Geography and physics: climatology, oceanography, geophysics - understanding of the physical processes that form the geographical environment [1]. Geography and biology: biogeography, ecology - understanding of the distribution of life on the planet and its dependence on geographical factors [6]. Geography and history: historical geography - understanding of how borders, settlement, and economy changed in historical perspective [1]. Geography and informatics: GIS technologies, processing of spatial data, creation of digital maps - direct application of computational thinking [11]. Geography and economics as a new subject: economic geography, location of production, global supply chains - understanding of economic processes in space [1]. Geography and social studies: geopolitics, urban studies, demography - understanding of social processes in space [1].

The Science of Interconnections

I want to end this article with what is perhaps the most important. Geography is not merely a school subject. It is the science of interconnections, of how everything is connected to everything else in space and time. It teaches us to see the world as a complex, dynamic system in which a change in one element influences all the others. It forms the cognitive apparatus capable of spatial, systems and global thinking. That is precisely why geography, in my view, is a key subject for the formation of the communicative-cognitive framework of the personality [1]. When we teach a child geography, we teach him not simply to memorize names and coordinates. We teach him to see space - to understand how the world around us is structured. We teach him to think systemically - to see the connections between climate and economy, between relief and settlement, between human actions and the state of the planet. We teach him to think globally - to understand that we are part of a single system where every action has consequences.

That is precisely why the restructuring of geography teaching is not merely a methodological question. It is a strategic task. As I showed in the article on epistemological recursion [7], without the development of mental mechanisms, without the formation of the communicative-cognitive framework of the personality, humanity will not be able to solve the difficult problems of the 21st century. Geography is the instrument through which the capacity for spatial, systems and global thinking is formed. And if we want our children to become not merely knowledgeable of facts, but understanding of the world - we must give them this instrument in full measure. Not for the sake of grades. Not for the sake of exams. For the sake of understanding the world. For the sake of life. For the sake of enabling them to see the world not as a set of separate countries and rivers, but as a system of connections. And so that they can not merely live in this world, but understand it. And, perhaps, change it. For the better. With the help of geography. Which does not merely describe. It connects. Like the old portolans that guided navigators across the oceans. Like modern GIS that show not only where, but also why. Like a geographer who sees the truth where there is as yet only a contour on the map. And this is the most important thing. Not the contour. But the truth. That stands behind it. And that can be seen. If one learns to look. And if one knows where to look. And geography teaches this. Every day. In every lesson. With every child. With every map. Which is not simply examined. It is read. And in this is its strength. And in this is its beauty. And in this is its meaning. Which does not end. As geography does not end. As thought does not end. As life does not end.

In the next article I will turn to the subject that, in my view, connects geography with history and social studies, showing how humanity interacted with space over time - to history. I will show how this subject can develop not only knowledge of dates and events, but also the capacity for cause-and-effect thinking, critical analysis of sources, forecasting and strategic thinking. This will be the next step. The next door. The next house. And I invite the reader to walk this path together with me. Not as an observer. But as a participant. Because school is not what others do. It is what we do. All together. Teachers. Students. Parents. Society. And if we want to change school, we must begin

with ourselves. With every lesson. With every map. With every thought. And then, perhaps, in twenty years we will see a different school. Different children. A different world. A world in which thought is not afraid of itself. A world in which questions are valued no less than answers. A world in which education is not preparation for an exam. But preparation for life. And this will not be a utopia. It will be a reality. Which we have created ourselves. With our own hands. With our own thoughts. With our own lessons. And this is the greatest thing we can do. Not for ourselves. But for them. For the children. For the future. For life. Which continues. In every space. In every connection. In every thought. Which seeks. And finds. And seeks again. Because in this is the meaning. Not in answers. But in questions. Not in periods. But in ellipses. Not in the end. But in the continuation. Which is always possible. As long as there is a map. As long as there is space. As long as there is thought. As long as there is life.

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Conflict of Interest
The author declares no conflict of interest related to the publication of this article.

Funding
The research was conducted without external funding.

Data Availability Statement
The data discussed in the article are contained in the text of the publication. Additional materials can be requested from the author.

Author Contributions
Aleksandr Kleymenov - concept, research, text writing, final editing.

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