Epistemological Recursion in Cognitive Science: Mental Mechanisms as a Tool for Overcoming the "Hard Problem" of Consciousness

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Fractal Academy
Issue 3 (Autumn 2026) Article 1
Series: "Thinkers Who Changed the Map of Consciousness: From the 'Hard Problem' to a New Pedagogy"
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DOI: [to be assigned]
Publication date: 1.11.2026

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Title (English): «Epistemological Recursion in Cognitive Science: Mental Mechanisms as a Tool for Overcoming the "Hard Problem" of Consciousness»
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Abstract

The article proposes and substantiates the hypothesis that the fundamental limit of modern neuroscience lies not in a lack of technological power, but in the epistemological mismatch between the complexity of the observed object (the brain) and the cognitive apparatus of the observer. Relying on T.V. Chernigovskaya's thesis on the fundamental incomprehensibility of the nature of the brain by modern methods [5], as well as on F. Varela's neurophenomenology [7], E. Morin's epistemology of complexity [8], and second-order cybernetics, the author shows that the hard problem of consciousness is not a problem of missing data, but a problem of an exhausted conceptual framework. It follows that the solution requires not just a "more powerful scanner," but a cognitive act of re-conceptualization. Such an act, in turn, requires certain operational abilities, which I formulate as six requirements. From these requirements, I derive six core mechanisms and five support mechanisms within my proposed model of the communicative-cognitive framework of personality (CCFP). The article responds to C. McGinn's "cognitive closure" hypothesis and substantiates the thesis that pedagogy ceases to be an applied discipline, becoming a strategy for the evolution of the cognitive potential of the species Homo sapiens. The principle of epistemological commensurability is introduced, stating that for the ascending recursion of cognition, the researcher's cognitive apparatus must possess complexity comparable to that of the object.

Keywords: communicative-cognitive framework of personality, mental mechanisms, epistemological recursion, principle of epistemological commensurability, hard problem of consciousness, neurophenomenology, guided neuroplasticity, cognitive closure, cognitive apparatus of the observer.

Introduction: The Observer Paradox in Neuroscience

In 2023, during one of her public lectures, Tatyana Vladimirovna Chernigovskaya asked a question that sounds like a verdict on the reductionist optimism of modern science: "What is the brain?" And immediately gave an honest, from the point of view of fundamental epistemology, answer: "I do not know." And, most importantly, no one else knows either [5].

Modern cognitive neuroscience has reached an unprecedented technological level. We can record hemodynamic responses with the highest precision using fMRI, register patterns of electrical activity, and even decode simple visual images from signals in the visual cortex. However, as D. Chalmers rightly notes when formulating the "hard problem of consciousness," knowing where and when a neural network activates gives us not the slightest idea of how and why this physical activity is accompanied by subjective experience - that very ineffable sensation of the taste of coffee, pain, or the color red - and generates meaning [1]. Between neural processes and subjective experience lies what the philosopher J. Levine called the "explanatory gap": we cannot logically derive facts about consciousness from facts about the physics of the brain - we can only register their correlation [11].

We are stuck in a trap of correlations. Science states the results of the brain's work, but remains blind to the mechanism of its self-organization. I will venture to hypothesize that the way out of this dead end lies not in the plane of creating even more powerful scanners or artificial intelligence algorithms, but in the plane of the evolution of the knowing subject itself. Humanity will approach the answer to the question of the nature of the brain only when it arms itself with "tools" of a fundamentally different quality. And these tools are purposefully developed mental mechanisms (MM) within the framework of the communicative-cognitive framework of personality (CCFP) [6].

Here it is appropriate to recall the famous story "On Exactitude in Science" by Jorge Luis Borges. It tells of how in one empire, cartographers created a map that was so exact that it coincided with the empire itself - every house, every river, every path was reproduced with absolute precision. But later generations, seeing this map, realized that it was useless: why have a map if it is equal to the territory? And they abandoned it to the elements, leaving it under the scorching sun and rain. Modern neuroscience reminds me of these cartographers. It creates increasingly accurate maps of brain activity - fMRI, electroencephalograms, connectomes. But these maps do not explain what consciousness is. They describe the territory, but do not understand what it means to "be" that territory. The principle of epistemological commensurability, which I propose, is an attempt to answer the question: how to create a map that not only describes the territory, but also allows one to understand what it means to live on it.

The Hard Problem as a Paradigmatic, Not a "Data" Problem

Before moving on to the principle of epistemological commensurability, I must clarify what the task is for which this principle is intended. This clarification is of fundamental importance, because the entire further argumentation depends on it. In neuroscience, there is an unspoken assumption: if we collect enough data, find sufficiently accurate correlations, and build sufficiently detailed activation maps, the answer to the question of consciousness will appear by itself. This assumption underlies grand research programs - from the Human Connectome Project to modern projects on decoding brain activity. And it is precisely this assumption, in my view, that is erroneous.

The hard problem is not a problem of missing data. It is a problem of an exhausted conceptual framework. Here I rely on the concept of Thomas Kuhn, which I analyzed in detail in my article on the structure of scientific revolutions [13]. Kuhn showed that science develops not through the linear accumulation of facts, but through paradigm shifts. A paradigm is not just a theory. It is a set of fundamental assumptions, methods, and problem-solving models that the scientific community accepts as a given and which determine what questions can be asked and what cannot. During "normal science," scientists solve puzzles within the accepted paradigm. They do not question its foundations. But sooner or later, anomalies begin to accumulate - facts that do not fit into the paradigm. First, they are ignored, then declared errors, then ad hoc explanations are sought. And only when there are too many anomalies does a crisis occur, which is resolved by a scientific revolution - a paradigm shift.

Modern neuroscience, in my deep conviction, is in exactly this phase - the phase of accumulating anomalies with an exhausted paradigm. The paradigm of the "brain as a computational system" - the very computer metaphor that has dominated since the cognitive revolution of the 1950s and 1960s - has stopped working. It allows solving private tasks (how visual information is processed, how memory works, how decisions are made), but it is fundamentally incapable of explaining why all these processes are accompanied by subjective experience. What happens when a paradigm is exhausted? Scientists continue to work, but their work becomes increasingly fragmented, increasingly technical, and increasingly less conceptually meaningful. Thousands of articles about correlations appear, but none of them brings us closer to the answer to the main question. This is the "trap of correlations" that I talk about in the article on epistemological recursion [7]: we record the results of the brain's work, but we do not understand the mechanism of its self-organization.

And here a key question arises: how does a paradigm shift actually occur? What must a researcher do to go beyond the limits of the exhausted framework and see the problem from a new angle? Kuhn answers this question as follows: the paradigm shift is made not by those who are deeply integrated into the old paradigm, but by those who are able to see its limitations. But the ability to see limitations is not an innate quality or an "insight." It is the result of a certain cognitive preparation. And it is precisely here that pedagogy enters the game.

If the hard problem is a paradigmatic problem, then the solution requires not just a "more powerful scanner," but a cognitive act of re-conceptualization. And such an act, in turn, requires certain operational abilities: the ability to hold a contradiction, deconstruct axioms, see multi-level connections, and calculate the consequences of theoretical moves. Without these abilities, the researcher is doomed to "normal science" - the endless solving of puzzles within a framework that no longer works. Thus, the hard problem ceases to be purely neuroscientific. It becomes epistemological and pedagogical. And it is in this sense that I say that pedagogy is not an "applied discipline," but a strategy for the evolution of the cognitive potential of the species.

The Principle of Epistemological Commensurability: Philosophical Foundations

Now that the task is formulated, I can move on to the principle that, in my view, explains why modern neuroscience cannot solve it. I call this principle the principle of epistemological commensurability. The formulation of the principle is as follows: in order for the recursion of cognition to be ascending (and not degenerate into closed repetition), the cognitive apparatus of the researcher at each new turn must possess complexity comparable to or exceeding the complexity of the object. In simple terms: to study the ocean, you need to build a submarine, not just look at the water from the shore.

This principle is connected with another principle - epistemological recursion. In modern literature, this term usually describes the cyclical, self-sustaining nature of cognition: research results, verification data, and debates are used to launch new cycles of study. This is an important, but insufficient, characteristic. Epistemological recursion describes the process of cognition (cycle - cycle - cycle). The principle of epistemological commensurability describes the necessary condition for this process: without increasing the complexity of the knowing subject, recursion degenerates into repetition, not development. This is exactly what we observe in modern neuroscience: huge arrays of fMRI data, but - the same unanswered questions.

This principle finds confirmation in three powerful scientific and philosophical traditions, which until now have developed in parallel, but which I propose to synthesize into a single conceptual framework. First, the neurophenomenology of Francisco Varela. The Chilean neurobiologist and philosopher in the 1990s formulated the problem he called the "explanatory gap." Varela insisted that "third parties" (neurobiologists with fMRI) will never understand subjective experience unless they use rigorous "first-person" methods [7]. Imagine trying to understand the greatness of Beethoven's symphony by looking at a spectrogram of sound waves and the chemical composition of the air in the hall. You will get a lot of data, but you will not hear the music itself. Varela argued that to understand the brain, it is necessary to train the "mental mechanisms" of attention, introspection, and meta-awareness. He showed that introspection can be as rigorous as working with a microscope - but only if it is trained. Varela developed this idea in dialogue with Buddhist contemplative traditions, which have been refining methods of attention training for millennia.

Second, the epistemology of complexity of Edgar Morin. The French philosopher, in his concept of "complex thinking," directly states: we cannot understand complex systems (such as the brain, society, or an ecosystem) using simplified, reductionist cognitive tools [8]. Trying to understand the workings of a living forest by studying a single separate leaf under a microscope means deliberately missing the essence of the ecosystem. Morin asserts that to know complexity, the observer must modernize their own cognitive apparatus. He formulated three principles of such thinking - the dialogic principle (holding contradictions), the principle of organizational recursion (when products and producers generate each other), and the holographic principle (when each part contains information about the whole).

Third, the second-order cybernetics of Heinz von Foerster. Its founder formulated the principle: "The observer is part of the observed system." A brain studying a brain is a system trying to describe itself (the so-called "strange loop" described by D. Hofstadter) [9]. It is like trying to see your own back of the head with your own eyes without the help of a mirror. In order for the system (the scientist's brain) to adequately describe the system (the brain as an object), it must increase its own computational and conceptual complexity. Foerster showed that science in this situation suffers from a "blind spot": it sees the world, but does not see how it itself constructs the image of this world. The way out is to increase the complexity of the observer [14]. And here is the fourth foundation, which I consider necessary to add: the idea of Douglas Hofstadter that the "I" is not a substance, but a process of self-reference arising in a sufficiently complex symbolic system [9]. Epistemological recursion is the very "strange loop" in which the brain, studying the brain, creates a symbol denoting the very process of study. In order for this loop to become a tool of cognition, and not a trap, it is necessary to develop the cognitive apparatus of the researcher - and this is exactly what the principle of epistemological commensurability describes [6].

The industrial model of education, which I criticized in previous works, prepares thinkers capable of linear, cause-and-effect first-order logic and the manipulation of ready-made facts. Such a cognitive apparatus is fundamentally inadequate for studying the brain, which is a non-linear, dynamic, self-organizing system with emergent properties (that is, possessing properties that its individual parts do not have, just as consciousness cannot be found in a single neuron). Attempting to explain the workings of the connectome (a complete map of the brain's neural connections)

using linear thinking is like trying to measure temperature with a ruler: the tool does not match the nature of the object being measured. Consequently, pedagogy oriented towards the development of the CCFP ceases to be merely a branch of knowledge about "school learning." It becomes a strategy for modernizing the cognitive potential of the species Homo sapiens [6]. By developing specific mental mechanisms in children, we literally "upgrade" the tool of cognition, making it capable of holding the multidimensionality of neurobiological processes.

Response to the Hypothesis of Cognitive Closure: Why Optimism is Justified

Before moving on to specific mental mechanisms, I must answer a powerful counterargument. In the philosophy of mind, there is a well-known hypothesis of "cognitive closure," put forward by the philosopher Colin McGinn [10]. He argues that the human brain evolved to solve survival tasks in the savanna, not to understand its own nature. Therefore, according to McGinn, we are fundamentally incapable of solving the "hard problem of consciousness," just as a dog is incapable of understanding the Pythagorean theorem - not because it is stupid, but because its cognitive apparatus is not designed for abstract mathematical thinking. This hypothesis seems destructive to my position. But only at first glance.

The fact is that McGinn considers the brain as a biologically determined structure, unchanging in its cognitive limits. However, humans are the only creatures possessing the unique ability for managed cultural and pedagogical evolution. By developing mental mechanisms, we do not just use the brain - we modernize it, going beyond basic evolutionary "closure." L.S. Vygotsky proved that higher mental functions are not given biologically, but are formed through the appropriation of cultural tools (signs, speech, concepts) [3]. He formulated the "genetic law of cultural development": any higher mental function develops twice - first as interpsychological (between people), then as intrapsychological (inside the person). The "zone of proximal development" plays a key role here - the distance between what a child can do independently and what they can do with the help of an adult. It is precisely in this zone that the real restructuring of the brain occurs through the appropriation of cultural tools. This means that the human brain is not a closed system, but an open structure capable of radical restructuring under the influence of purposeful pedagogical activity.

Here it is appropriate to recall Ludwig Wittgenstein and his famous "ladder" metaphor. In the "Tractatus Logico-Philosophicus," he wrote: "My propositions serve as elucidations in the following way: anyone who understands me eventually recognizes them as nonsensical, when he has used them - as steps - to climb up beyond them. (He must, so to speak, throw away the ladder after he has climbed up it.) He must transcend these propositions, and then he will see the world rightly." The old paradigm of the "brain as a computer" was such a ladder. We climbed it - it allowed us to create neuroimaging, connectomics, cognitive psychology. But now we stand at the top and see that the ladder leads to a dead end. We must throw it away. Not because it was bad, but because it has already done its job. To go further, we need a new ladder - and this ladder is created not from new scanners, but from a new cognitive apparatus. My answer to McGinn is not an "optimistic declaration." It relies on Vygotsky's concept, which has empirical confirmation (studies of neuroplasticity, studies of London taxi drivers). If higher mental functions are indeed formed through the appropriation of cultural tools, then the cognitive limits of a person are not fixed - they can be expanded through pedagogy.

Which Specific Mechanisms Are Needed: From Requirements to the Core

Now I come to the key question: if the solution to the hard problem requires the development of the knowing subject, then what specific mechanisms must be developed? In previous sections, I showed that the hard problem is a paradigmatic problem, and that its solution requires a cognitive act of re-conceptualization. But what is this act? What does it consist of? I propose to derive mechanisms not from the tradition of "21st-century skills," but from the structure of the task they are designed to solve. If the hard problem is a paradigmatic problem, then the cognitive apparatus capable of solving it must be able to at least: distinguish correlation from causality - otherwise the "trap of correlations" is insoluble; hold the first and third perspectives simultaneously - otherwise experience will be reduced to neurons, or neurons to experience; deconstruct the basic axioms of one's own paradigm - otherwise the researcher will not go beyond the limits of the exhausted framework; hold a multidimensional dynamic model of the object - otherwise the brain will be coarsened to flat schemes; calculate the consequences of theoretical moves - otherwise the theory will not generate a research program.

These requirements correspond to six mechanisms, which I call the core: MM-1 (cause-and-effect relationships), MM-3 (emotional intelligence), MM-5 (Socratic dialogue), MM-6 (critical thinking), MM-10 (spatial imagination), MM-11 (forecasting). Without any of them, the act of solving the hard problem is impossible - not because it is "less effective," but because it is logically incomplete. The remaining five mechanisms - MM-2 (eloquence), MM-4 (mnemonics), MM-7 (constructive debate), MM-8 (non-verbal communication), MM-9 (information search) - I call support mechanisms. They do not constitute the act of solution, but without them, the core does not work: memory holds the material, communication makes thought transmittable, debate protects the community from dogmatism, and information search supplies material for criticism. Such a structure allows answering the question of the openness of the list. The core is defined by the task and cannot be expanded arbitrarily - otherwise we lose the connection with the hard problem. The support level is open: as pedagogical science and practice develop, new mechanisms can be added to it. It is in this sense that I say that the list is not final.

Guided Neuroplasticity: The Brain Modifies Itself

The strongest argument in favor of my hypothesis is the biological mechanism underlying the development of mental mechanisms. The formation of MM is not an abstract pedagogical process. It is an act of guided neuroplasticity. Imagine a dense forest. The first time you walk through it is difficult - you have to push through the undergrowth. But if people start walking the same route regularly, the grass is trampled, a path appears, and eventually a full-fledged road. When we teach a child not just to memorize facts, but, for example, to build information search strategies and synthesize them into a new concept (MM-9 and MM-5), we physically "beat a path" new roads in their connectome. We strengthen connections between the prefrontal cortex (responsible for executive control) and the hippocampus, forming new, more efficient neural ensembles [6].

This is confirmed by modern research. A classic example is the study of London taxi drivers: those who spend years memorizing thousands of streets in the metropolis are found to have a significant increase in the hippocampus [15]. This is not an innate feature - it is the result of purposeful training. In the same way, the development of MM leaves a physical trace in the structure of neural connections. The adult human brain is not a static structure, but a dynamic system constantly restructuring itself under the influence of purposeful activity. The development of specific MM is not a metaphor, but a biological fact: each trained mechanism leaves a physical trace in the structure of neural connections. Thus, a paradoxical but beautiful recursion is realized: the brain uses pedagogically organized experience for its own structural modernization, so that in the future, having become the brain of a scientist, it possesses sufficient computational and conceptual power to understand its own nature. We create a tool adequate to the task by purposefully changing the biology of this tool.

Pedagogy as a Strategy for the Evolution of the Species

The hypothesis proposed in this article radically changes the status of pedagogy in the system of scientific knowledge. If we recognize that technological progress in the study of the brain has hit the ceiling of the cognitive capabilities of the modern researcher, then the task of developing the communicative-cognitive framework of personality becomes a task of primary importance for the survival and evolution of science [6]. Pedagogy ceases to be a "secondary," applied discipline serving the needs of the school. It becomes a strategy for the evolution of the cognitive potential of the species. Through the purposeful formation of mental mechanisms in children, we prepare not just "good students" or "successful graduates" - we prepare the next generation of researchers capable of solving those tasks that today seem unsolvable. This is not an exaggeration or pathos. It is a logical consequence of the principle of epistemological commensurability: to know a system of maximum complexity, it is necessary to grow a knowing subject with a corresponding cognitive architecture. And this is the task of pedagogy.

But here I want to make an important clarification, without which my entire argument would be vulnerable. I do not claim that the development of these mechanisms guarantees a paradigm shift. I claim that without them, a paradigm shift is structurally impossible. Mechanisms are conditions of possibility, not sufficient causes. A paradigm shift is a collective and historical event in which many factors participate, including chance and social conditions. Pedagogy creates the conditions. Whether the event will occur is an open question. This distinction protects me from two opposite accusations. First: "You claim that pedagogy will solve the hard problem of consciousness" - no, I claim that it creates the conditions without which a solution is impossible. Second: "You claim that nothing will change without pedagogy" - no, I claim that without pedagogy, the change will not be conscious and systemic. It may happen by chance, under the pressure of external circumstances, but not as a result of a purposeful strategy.

It is in this sense that I say that pedagogy is not "training personnel for neuroscience" or "developing useful skills." It is the formation of a subject capable of an act of paradigm shift. And if we want such a subject to appear, we must not only rewrite textbooks and retrain teachers. We must create a space in which a child can try, make mistakes, find their strengths, and through them develop their cognitive architecture. This space is not a luxury. It is a condition of the possibility of the future of science.

Conclusion

We are not just teaching children to "think better" or "speak more beautifully." We are purposefully forming mental mechanisms that, in 20-30 years, will allow a new generation of scientists not just to register electrical impulses, but to decipher the code by which matter acquires the ability to ask the question: "What am I?". Without this pedagogical foundation, any technological breakthroughs in neuroscience risk remaining a set of beautiful, but meaningless, pictures. Scanners will become more powerful, algorithms more sophisticated, data more voluminous. But without a cognitive apparatus capable of interpreting this data, we will not come any closer to the answer to the question that T.V. Chernigovskaya honestly called unresolved [5]. My hypothesis is not a promise of a quick answer. It is an indication of a path: a path through the development of mental mechanisms, through the formation of the communicative-cognitive framework of personality, through the purposeful modernization of the cognitive apparatus of the researcher [6]. It is a long path, requiring the restructuring of the entire education system. But it is the only path that allows us to hope that someday a scientist of the future will say: "I know."

References

1. Chalmers D.J. Facing up to the problem of consciousness // Journal of Consciousness Studies. - 1995. - Vol. 2, No. 3. - P. 200-219.
2. Tononi G., Boly M., Massimini M., Koch C. Integrated information theory: from consciousness to its physical substrate // Nature Reviews Neuroscience. - 2016. - Vol. 17, No. 7. - P. 450-461.
3. Vygotsky L.S. History of the Development of Higher Mental Functions. - M.: Pedagogika, 1983.
4. Friston K. The free-energy principle: a unified brain theory? // Nature Reviews Neuroscience. - 2010. - Vol. 11, No. 2. - P. 127-138.
5. Chernigovskaya T.V. The Cheshire Cat's Smile of Schrödinger: Language and Consciousness. - M.: Languages of Slavic Culture, 2023.
6. Kleymenov A. Basic mental mechanisms: the structure of the communicative-cognitive framework of personality // Fractal Academy. - 2026. - Issue 1. - Art. 5. https://fractal-academy.com/articles/article-1-5/
7. Varela F.J., Shear J. (Eds.). The View from Within: First-Person Approaches to the Study of Consciousness. - Thorverton: Imprint Academic, 1999.
8. Morin E. Introduction à la pensée complexe. - Paris: Éditions du Seuil, 1990.
9. Hofstadter D.R. Gödel, Escher, Bach: An Eternal Golden Braid. - New York: Basic Books, 1979.
10. McGinn C. Can We Solve the Mind-Body Problem? // Mind. - 1989. - Vol. 98, No. 391. - P. 349-366.
11. Levine J. Materialism and Qualia: The Explanatory Gap // Pacific Philosophical Quarterly. - 1983. - Vol. 64, No. 4. - P. 354-361.
12. Kleymenov A. The Current State of Pedagogical Science and Practice: Diagnosis of a Systemic Gap // Fractal Academy. - 2026. - Issue 1. - Art. 1. https://fractal-academy.com/articles/article-1-1/
13. Kuhn T.S. The Structure of Scientific Revolutions. - Chicago: University of Chicago Press, 1962.
14. von Foerster H. Understanding Understanding: Essays in the Philosophy of Science and Cognition. - New York: SUNY Press, 2003.

15. Maguire E.A., et al. Navigation-related structural change in the hippocampus of taxi drivers // Proceedings of the National Academy of Sciences. - 2000. - Vol. 97, No. 8. - P. 4398-4403.

Appendix. Navigator for the Series "Thinkers Who Changed the Map of Consciousness"

This article relies on the ideas of fifteen thinkers, each of whom has contributed to the formation of the hypothesis of epistemological recursion. For readers wishing to delve deeper into each of these ideas, a series of companion articles has been prepared, united under the general title "Thinkers Who Changed the Map of Consciousness: From the 'Hard Problem' to a New Pedagogy." The series is structured according to the logic of the problem's development: from posing the question - through awareness of complexity - to the search for new methods - and, finally, to understanding the mechanism of scientific breakthrough.

In the first block - "Problem Statement: Why We Are Stuck" - the reader will meet David Chalmers, who distinguished between the "easy" and "hard" problems of consciousness and showed that knowledge of neural correlates does not explain subjective experience. His metaphor: "We can map all the chemical reactions in the kitchen, but that does not explain why the cake tastes good." Here also is Colin McGinn with the hypothesis of "cognitive closure": the brain is evolutionarily "closed" to self-understanding, just as a dog cannot understand the Pythagorean theorem. His metaphor: "A mouse cannot understand the architecture of the maze it lives in - it sees only the walls."

In the second block - "Awareness of Complexity: Why Old Tools Do Not Work" - is Edgar Morin with his "complex thinking," which requires holding contradictions, recursion, and holographic vision. His metaphor: "Trying to understand a symphony by studying each note separately means missing the music." Here also is Heinz von Foerster with second-order cybernetics: "The observer is part of the observed system." His metaphor: "A knife cannot cut itself. An eye cannot see itself. But the brain can reflect on itself - and in this lies its paradox." And Douglas Hofstadter with "strange loops": the "I" is not a substance, but a process of self-reference. His metaphor: "Two mirrors placed opposite each other create an infinite corridor. Consciousness is such a corridor inside the brain."

In the third block - "New Approaches: How to Study What Cannot Be Simplified" - is Francisco Varela with neurophenomenology and the "view from within." His metaphor: "Studying consciousness only through fMRI is like studying the taste of honey by analyzing its chemical composition, but never tasting it." Here also is Karl Friston with the free-energy principle: the brain as an active "predictor," not a passive receiver. His metaphor: "The brain is not a camera, but an artist who constantly paints the world and only touches up the strokes when reality does not match the picture." And Giulio Tononi with integrated information theory: consciousness is not a "thing," but a "measure." His metaphor: "Consciousness is not a 'thing', but a 'measure'. Just as temperature is not a substance, but a measure of molecular motion."

In the fourth block - "The Path Through Subject Development: Answering the Challenge" - is Lev Vygotsky with his concept of higher mental functions as cultural tools. His metaphor: "A child is not born with thinking - they 'appropriate' it from culture, like language." Here also is Tatyana Chernigovskaya with the "Cheshire smile" of the brain: epistemological modesty as a scientific virtue. Her metaphor: "We are trying to catch the wind with a net. The tool does not match the object."

In the fifth block - "Epistemic Virtues and the Cognitive Niche" - are Ernest Sosa and Linda Zagzebski with virtue epistemology: why epistemology should focus not on individual beliefs, but on the intellectual virtues of the knower. Their metaphor: "A good shooter is not the one who sometimes hits the target, but the one who has a steady hand and a true eye." Here also are David Perkins and Shari Tishman with thinking dispositions: "good thinking" is not just a high IQ, but a set of dispositions. Their metaphor: "A smart person who is not used to doubting is like a fast car without brakes: it goes fast, but not where it needs to." And Andy Clark and Kim Sterelny with the cognitive niche: cognition is distributed between the brain, the body, and the environment. Their metaphor: "A mouse is not smarter than a mousetrap, but the mousetrap makes its behavior effective. A human is not smarter than their tools, but the tools make their thinking possible."

And, finally, in the sixth block - "Methodology of Revolution: How to Change a Paradigm" - is Thomas Kuhn with his structure of scientific revolutions: normal science, anomalies, crisis, revolution. His metaphor: "Scientists are not

just accumulators of facts. They are people who one day realize that the map of the world they have been drawing is incorrect."

How to read this series? If you want to get a holistic picture - read the articles sequentially, from the first to the fourteenth. This will take about 5-6 hours of thoughtful reading, but you will go through the entire path of the problem's development from its statement to the proposed solution. If you are interested in a specific thinker - start with their portrait. Each article is autonomous and contains all the necessary contextual explanations. If you are already familiar with the main article - use the navigator as a "map" to delve into individual ideas. Together, these texts form a single scientific program in which pedagogy ceases to be an "applied discipline" and becomes a strategy for the evolution of the cognitive potential of the species Homo sapiens.

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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