The Principal Mental Mechanisms: The Structure of the Communicative-Cognitive Framework of Personality

Aleksandr Kleymenov

Fractal Academy
Issue 1 (Autumn 2026) Article 5
Series: "From the School-Conveyor to the School of Thinking: Theoretical Foundations and Practical Implementation of the Communicative-Cognitive Framework of Personality (CCFP)"
Author: Aleksandr Kleymenov
ORCID: 0009-0004-9404-2400
DOI: [to be assigned]
Publication date: 31.10.2026

© 2026 Aleksandr Kleymenov. This work is licensed under the terms of Creative Commons Attribution-ShareAlike 4.0 International License.
Title (English): «The Principal Mental Mechanisms: The Structure of the Communicative-Cognitive Framework of Personality»
URL: https://fractal-academy.com/articles/article-1-5/
(CC BY-SA 4.0)

Abstract

In this article, I move from criticizing the existing system to the constructive part of my project. I present a systematic description of what I call the communicative-cognitive framework of personality (CCFP). These are eleven interconnected mental mechanisms that, in my view, constitute the foundation of adaptive, creative intelligence. However, unlike a simple enumeration, I derive these mechanisms from the task they are designed to solve. I show 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. And such an act requires certain operational abilities, which I formulate as six requirements. From these requirements, I derive six core mechanisms that constitute the act of solving, and five support mechanisms without which the core does not function. Such a structure allows me to answer the question of the list's openness: the core is closed because it is defined by the task, while the periphery is open because it depends on the context. I also embed the list within the tradition of virtue epistemology, research on thinking dispositions, and the concept of the cognitive niche. I pay special attention to the principle of individualization through unique abilities and the infrastructure that makes this individualization possible.

Keywords: communicative-cognitive framework of personality, mental mechanisms, epistemological recursion, hard problem of consciousness, neurophenomenology, guided neuroplasticity, cognitive apparatus of the observer, individualization of education, school infrastructure.

Introduction: Why I Speak of a "Framework" Rather Than a "Set of Skills"

In previous articles in this series, I attempted to show that the modern school does not develop thinking, but suppresses it; that this situation is historically conditioned and economically disadvantageous [1], [2], [3], and also contradicts the evolutionary nature of man [4], [5], [6]. However, criticizing the current state of affairs is only half the task. The second, no less important half, is to offer an alternative.

When I speak of an alternative, I do not mean simply "another program" or "other textbooks." I am speaking of a shift in the very paradigm of education. At the center of this new paradigm is the development of the communicative-cognitive framework of personality (CCFP) - a set of mental mechanisms that make a person capable of adaptive, creative intelligence. The CCFP is an integrative structure of the cognitive and communicative spheres of the personality, its "skeleton" that holds the entire "superstructure" of knowledge, skills, and experience. Mental mechanisms (MM) are the specific skills, abilities, and operating systems - the tools with which a person thinks, communicates, and cognizes.

Why do I use the word "framework" rather than, say, "set of skills" or "competencies"? Because a framework is something structuring, load-bearing. It is what holds the form, yet is not rigid and immobile. A framework can be built upon, modified, and adapted to new tasks. This is exactly how, it seems to me, the mental mechanisms of a 21st-century person should work.

But there is another, deeper reason for this choice. In the article "Epistemological Recursion in Cognitive Science" [7], I substantiated the hypothesis that the current crisis in neuroscience - the "hard problem of consciousness" according to D. Chalmers [8] - is associated not with a lack of technological power, but with an epistemological mismatch between the complexity of the observed object (the brain) and the cognitive apparatus of the observer. To know a system of maximum complexity, the knowing subject must possess comparable or superior complexity. This

is the principle I call epistemological recursion [7]. The neurophenomenological approach of F. Varela and J. Shear [9] confirms this: the study of consciousness requires not only external observation but also the development of the observer themselves.

And here it becomes obvious: the mental mechanisms I propose in this article are not an arbitrary set of "useful skills." This is the very cognitive toolkit necessary to overcome the fundamental limitations of modern science [7], [8]. The development of the CCFP is not merely a pedagogical task. It is a strategy for the evolution of the cognitive potential of the species Homo sapiens. Through the formation of these mechanisms in children, we are preparing not just "successful graduates," but the next generation of researchers capable of deconstructing the logic of their own brain's work.

However, pedagogical methods alone are insufficient to realize this principle. Infrastructure is necessary to allow every child to manifest their unique abilities. Without studios, workshops, and sports facilities, the principle of individualization through unique abilities remains at the level of good intentions [10], [11]. I will address this in the section dedicated to individualization and in the conclusion.

The Hard Problem as a Paradigmatic Task

Before moving on to the mechanisms themselves, I must take a step without which the entire subsequent list will remain unsubstantiated. I must explain why I propose this specific set of mechanisms. And for this, I first need to clarify what the task is for which these mechanisms are intended.

In previous articles, I repeatedly referred to David Chalmers' "hard problem of consciousness" [8]. To recall its essence: even if we know everything about neural processes, we still will not understand why these processes are accompanied by subjective experience. Between neurons and qualia lies an "explanatory gap" [12] that is not eliminated by the simple accumulation of data.

However, here I want to make a clarification that is of fundamental importance for my entire model. The hard problem is not a problem of missing data. It is a problem of an exhausted conceptual framework. In neuroscience, there is an unspoken assumption: if we collect enough data, find sufficiently precise correlations, and build sufficiently detailed activation maps, the answer to the question of consciousness will emerge on its own. 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.

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 which 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. And only when there are too many anomalies does a crisis occur, which is resolved by a scientific revolution.

Modern neuroscience, in my deep conviction, is in exactly this phase - the phase of accumulating anomalies within 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 for solving specific tasks (how visual information is processed, how memory works), but it is fundamentally incapable of explaining why all these processes are accompanied by subjective experience. Scientists continue to work, but their work becomes increasingly fragmented, increasingly technical, and increasingly less conceptually meaningful. Thousands of articles on correlations appear, but none of them brings us closer to answering the main question. This is the "trap of correlations" that I speak of 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.

It is appropriate to recall Hegel's famous metaphor here: "The owl of Minerva begins its flight only with the falling of the dusk." The realization of the exhaustion of the old paradigm and the need for a change of course comes not in the midst of its triumph, but when it has already ceased to cope with new questions. The thought that a new framework is needed matures in the twilight of the old one.

And here arises the key question: how does a paradigm shift actually occur? What must a researcher do to step outside the boundaries of an exhausted framework and see the problem from a new angle? Kuhn answers this question as follows: paradigm shifts are accomplished not by those who are deeply integrated into the old paradigm, but by those who are capable of seeing 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 its 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.

Six Requirements for the Cognitive Apparatus

If the hard problem is a paradigmatic problem, then the cognitive apparatus capable of solving it must possess not "greater power" in the sense of memory volume or computation speed, but certain operational characteristics. I will try to formulate them as requirements - that is, as conditions without which the act of a paradigm shift is impossible.

The first requirement is the distinction between correlation and causality. The "trap of correlations" is not just a methodological error. It is a consequence of the cognitive habit of accepting co-occurrence as connection. An apparatus incapable of holding the distinction between "A accompanies B" and "A generates B" is doomed to accumulate correlations without approaching mechanisms. Discovering that the prefrontal cortex is active during a moral decision does not explain the mechanism of this decision. It is like noticing that ice cream sales and the number of drownings rise simultaneously, and concluding that ice cream drowns people.

The second requirement is access to experience as data. To hold the first-person perspective, the researcher must be able to access their own experience and describe it with sufficient rigor. Without this, the "first-person perspective" remains an empty phrase. One can talk endlessly about qualia - but if the researcher does not know how to work with their own experience as data, they will be unable to either verify their claims or distinguish experience from their interpretation of experience. It is as if a biologist did not know how to look through a microscope and described cells based on someone else's drawings.

The third requirement is holding the tension between perspectives. Even having access to experience, the researcher may collapse one perspective into another - reducing experience to neurons or neurons to experience. To prevent this, one needs the ability to hold both perspectives in dialogue, without prematurely resolving the contradiction. This is not "tolerance for uncertainty" in a psychological sense. It is the ability to work with two incompatible frameworks simultaneously, without reducing one to the other - what Varela called neurophenomenology [9], and what Kuhn described as a condition for a paradigm shift [13].

The fourth requirement is the ability to deconstruct the axioms of one's own paradigm. A paradigm is dangerous precisely because it makes its assumptions invisible. A researcher working within a paradigm usually does not realize its foundations - they accept them as "common sense." An apparatus incapable of asking the question "what if the basic assumption is wrong?" is doomed to "normal science" - the endless solving of puzzles within an exhausted framework. Deconstructing axioms is not "critical thinking" in the banal sense of "knowing how to argue." It is the ability to see that the very framework in which you are working is a construction, not a reflection of reality.

The fifth requirement is holding a multi-dimensional dynamic model of the object. The brain is not a flat diagram from a textbook. It is a four-dimensional (taking time into account) topological structure. Understanding connectomics, the work of glial networks, or the spatial organization of the hippocampus requires the scientist to be able to hold and mentally manipulate complex volumetric models. An apparatus thinking in two-dimensional diagrams will coarsen the object beyond recognition. It will see "activation zones" where dynamic processes are actually unfolding, and "structures" where there are actually flows.

The sixth requirement is foreseeing the consequences of theoretical moves. A paradigm shift is not only a new theory, but also a new research program. An apparatus incapable of calculating where a particular theoretical move leads will produce theories that do not generate researchable questions. It will create concepts that sound beautiful but do

not give researchers tools for further work. Foresight is not "forecasting" in the sense of predicting specific events. It is the ability to hold multiple scenarios of a theory's development in mind and evaluate their consequences.

These six requirements are not "skills" or "competencies" in the sense these words are used in educational standards. They are conditions for the possibility of the act of solving the hard problem. Without them, the act is impossible - just as it is impossible to write a symphony without knowing how to hold musical form, or to prove a theorem without knowing how to build a logical chain. And it is precisely from these requirements that I derive the structure of the CCFP.

The Core: Six Mechanisms Constituting the Act of Solving

The reader has the right to ask: why these specific mechanisms? Why not mathematical intuition, empathy, or a sense of humor? If each mechanism is justified individually, there will be no answer to this question: for any mechanism, one can ask "why not a twelfth?", and no answer will be found. Therefore, I propose a different approach: the mechanisms are derived from the requirements formulated above.

The core consists of six mechanisms that directly constitute the act of solving the hard problem, each corresponding to one of the requirements. Without any one of them, the act of solving is impossible.

First, I highlight **MM-1: Establishing Cause-and-Effect Relationships**. This is the ability to understand why certain events occur, to see connections between facts and phenomena, to determine causes, and to foresee consequences. Without this mechanism, neuroscience is doomed to the endless accumulation of correlations. The replication crisis in psychology is a direct consequence of the underdevelopment of this mechanism in a whole generation of researchers: they found correlations but did not build causal models, and the correlations did not replicate. A child masters this mechanism when they notice that plants on the windowsill grow better than those in the corner and ask "why?", building a chain from simple observation to an understanding of photosynthesis. An adult researcher does the same, but with more complex material: they see not just "A is related to B," but "A generates B through mechanism C, which in turn depends on D." A detailed analysis of this mechanism is presented in article [27].

The second core mechanism is **MM-3: Emotional Intelligence**. Here we are not talking about a "soft skill" for communication, but about the ability to work with one's own experience as data. "Third-person" neuroscience describes the brain as an object. But subjective experience is not an object; it is an experience. To hold it in the field of attention, the researcher must possess the ability to recognize and describe their own internal experience. Without it, the researcher will either reduce experience to neurons (because they do not know how to work with it) or ignore neurons in favor of experience. As Virginia Woolf wrote, human consciousness is a "luminous halo, a semi-transparent envelope surrounding us from the beginning of consciousness to the end." The researcher's task is not merely to fixate this flow, but to learn to work with it as a scientific instrument, using rigorous introspection. Without this, Varela's neurophenomenology [9] remains a beautiful idea but does not work in practice. A detailed analysis of this mechanism is presented in article [29].

The third mechanism is **MM-5: Socratic Dialogue**. This is the ability to ask the right questions that help clarify thought, find hidden assumptions, and arrive at a deeper understanding. If MM-3 works with access to internal experience, then MM-5 works with the dialogue between perspectives. Socratic dialogue is not just "knowing how to ask questions." It is the ability to hold the tension between different points of view, without reducing one to the other. In the context of the hard problem, this means: the ability to conduct a dialogue between neuroscience and phenomenology, between reductionists and holists, without sliding into the dogmatism of either side. Without this, the scientific community fragments into factions that do not hear each other - which is exactly what is happening today. Let us recall Mikhail Bakhtin's concept of polyphony: truth is not born in the monologue of a single discipline; it exists on the boundary of dialogue. Socratic dialogue allows holding the old and new paradigms in tension, preventing one from prematurely absorbing the other. A detailed analysis is presented in article [31].

The fourth mechanism is **MM-6: Critical Thinking**. This is the ability to evaluate information, check facts, and distinguish the reliable from the unreliable. In my model, the emphasis is placed not merely on "knowing how to argue," but on the ability to question one's own foundations. As Kuhn showed [13], scientific paradigms change not through the accumulation of facts, but through the deconstruction of outdated assumptions. The neurocomputational approach dominating today (the brain as a computer) has largely exhausted itself. The ability to ask "uncomfortable," fundamental questions and to doubt basic axioms is the very mechanism that allows the scientific community to break dogmas and birth new conceptual frameworks. Descartes began his "Meditations" with total doubt of everything in

order to find an unshakable point of support. Critical thinking in my model is its modern analogue: the ability to hold the question about the status of one's own foundations long enough for it to become productive. A detailed analysis is presented in article [32].

The fifth mechanism is **MM-10: Spatial Imagination and 3D Visualization**. This is the ability to create images of objects in one's imagination, to "see" them volumetrically, and to rotate them in the mind. The brain is not a flat diagram from a textbook. It is a dynamic, four-dimensional structure. In Edwin Abbott's famous novella "Flatland," two-dimensional creatures cannot comprehend the three-dimensional world because their perception is limited to a plane. An apparatus thinking in two-dimensional diagrams will coarsen the object beyond recognition. It will see "activation zones" where dynamic processes are actually unfolding. MM-10 forms precisely the neural architecture in the researcher's brain that is necessary for the intuitive grasping of multi-dimensional neurobiological data. A detailed analysis is presented in article [36].

The sixth mechanism is **MM-11: Forecasting and Strategic Thinking**. This is the ability to foresee the development of events, calculating probabilities and using patterns. A paradigm shift is not only a new theory, but also a new research program. An apparatus incapable of calculating where a particular theoretical move leads will produce theories that do not generate researchable questions. They will sound convincing at conferences, but will not give colleagues tools for further work. A high-level chess player differs from a novice not by seeing more pieces, but by calculating several moves ahead. A researcher possessing MM-11 calculates what consequences follow from a hypothesis, what experiments can be conducted, and what will happen if the results are negative. A detailed analysis is presented in article [37].

Without any of these six mechanisms, the act of solving the hard problem is impossible. That is why I call them the core.

Support: Five Mechanisms Without Which the Core Cannot Function

In addition to the core, there is a support level - five mechanisms that do not constitute the solution, but without which the core cannot function. They are like infrastructure: roads do not create the journey, but without them, the journey is impossible. Their absence does not make the solution logically incomplete - it makes it practically unfeasible.

MM-2: Eloquence and Conciseness makes thought transmittable. Without the ability to clearly express complex ideas, a researcher will be unable to formulate a hypothesis, convince colleagues, or enter into dialogue. Eloquence is not an "embellishment" of thought, but a condition for its existence within the scientific community [28]. **MM-4: Long-Term Memory and Mnemonics** holds the material. Without the ability to preserve and structure information, a researcher will be unable to work with complex arrays of data. Memory is not a "warehouse of facts," but the foundation of thinking: without holding information, it is impossible to establish connections [30]. **MM-7: Constructive Debate** protects the community from dogmatism. Without the ability to conduct a debate without turning it into a conflict, the scientific community will be unable to productively discuss fundamental questions. Debate is not a struggle where one wins, but a joint search for truth [33]. **MM-8: Non-verbal Communication and Charisma** ensures embodied communication. Science is not only "pure thinking," but also the interaction of living people, and the ability to understand non-verbal signals and manage one's body and voice is part of this interaction [34]. And finally, **MM-9: Information Search and Analysis** supplies material for criticism. Without the ability to find information, separate the signal from the noise, and synthesize data from different sources, the researcher drowns in information overload [35].

These five mechanisms do not constitute the solution, but without them, the core does not function.

Openness of the List: The Principle of Growth

I have repeatedly emphasized that the list of eleven mechanisms is not final and closed. But it is one thing to declare openness, and another to explain by what rule the list can grow. Without a rule, openness turns into arbitrariness - and then the objection "why not a twelfth mechanism?" remains unanswered.

Now, after introducing the hierarchy of core/support/context, I can formulate this rule precisely. The core is closed. The six mechanisms I named as the core constitute the act of solving the hard problem. They are derived from the six requirements, and the requirements, in turn, are derived from the nature of the task. This means that the core

cannot be expanded arbitrarily. If someone proposes a twelfth mechanism, they must either show that it constitutes the act of solving (and then we redefine the task), or agree that it belongs to the support level or context. This is not dogmatism - it is structural discipline. If tomorrow someone proves that the hard problem is not a paradigmatic problem, but something else, then the requirements will change, and the core will change.

The periphery is open. The support level can grow. As pedagogical science and practice develop, new mechanisms necessary for the functioning of the core in new conditions may be discovered. But they will not become the core - because they do not constitute the act of solving, but only ensure it. The context is radically open. Mechanisms depending on the cultural and institutional environment can be anything. I do not include them in the core because they are not universal conditions for solving the hard problem, but I do not exclude them because they may be important for specific research contexts.

This is exactly how, it seems to me, a scientific model should work: with a solid core and an open periphery. This does not mean that I consider my formulation final. I allow that someone may refine it, and then the core will change. But this refinement must be argued, not arbitrary.

The Negative Argument: What Happens Without Each Mechanism

In previous sections, I justified each mechanism positively: what it gives, how it works, how it develops. But a positive argument is always vulnerable: the reader may say "this is useful, but not necessary." Therefore, I want to present a negative argument: to show what happens when a mechanism is not developed. If the corresponding failure is reproduced without the mechanism, this is a strong indication of its necessity.

Without MM-1 (cause-and-effect relationships), we fall into the "trap of correlations" and the replication crisis. Like a detective who knows the victim and the suspect were in the same city, but cannot prove the suspect is the killer. Without MM-3 (emotional intelligence), neurophenomenology remains a declaration. Like a tuner who hears the piano is out of tune, but cannot determine which string is off. Without MM-5 (Socratic dialogue), the scientific community fragments into factions. Like arguers shouting in different languages, unaware they are talking about the same thing. Without MM-6 (critical thinking), we get dogmatism and an inability to shift paradigms. Like a traveler walking by a map, not noticing the map is hand-drawn and contains errors. Without MM-10 (spatial imagination), we get flat diagrams instead of volumetric models. Like an architect trying to design a house but seeing it from only one side. Without MM-11 (forecasting), theories appear that do not generate research. Like a chess player who sees only their next move.

This negative argument does not prove that six mechanisms are sufficient. But it shows that they are necessary: without them, the corresponding failures are reproduced. And this is no longer a declaration, but an argument. If we want to overcome the "trap of correlations," disciplinary fragmentation, and the inability to shift paradigms, we must develop these mechanisms - not because they are "useful," but because without them, the corresponding failures are inevitable.

The Tradition of Epistemic Virtues and the Cognitive Niche

I do not want my list to look like an invention out of thin air. It fits into an existing philosophical tradition - the tradition of virtue epistemology. Its founders - Ernest Sosa [22] and Linda Zagzebski [23] - argue that epistemic evaluation should focus not on individual beliefs, but on the intellectual virtues of the knower: on their abilities, dispositions, and character traits that make them capable of attaining truth. Epistemic achievements are not the result of passively receiving information. They are the result of the active formation of cognitive traits. This is exactly what I assert when I say that solving the hard problem requires the development of mental mechanisms.

A closely related direction is research on thinking dispositions, associated with the names of David Perkins and Shari Tishman [24]. They showed that "good thinking" is not just "high IQ." It is a set of dispositions: the inclination to ask questions, seek alternatives, check foundations, and hold tension. These dispositions can be purposefully formed through pedagogy - which is the subject of my model.

Another closely related direction is the concept of the cognitive niche, developed by Andy Clark [25] and Kim Sterelny [26]. They argue that human cognition is not a "purely internal" process. It is distributed between the brain, the body, and the environment. We create "cognitive niches" - external structures that enhance our thinking. Language, writing, scientific instruments, social institutions - all of these are cognitive niches. And the school is also

a cognitive niche that forms a certain type of thinking. The concept of the cognitive niche is important for my model in two respects. First, it explains why infrastructure is not an "additional option," but a condition: without a cognitive niche, mechanisms do not form. Second, it explains why the school can be both a source of development and a source of suppression: the school is a niche, and it can be designed differently. My model is a project of such a niche.

My model fits into this tradition, but takes the next step. Virtue epistemology speaks of virtues in general. Disposition research speaks of "good thinking" in general. The concept of the cognitive niche speaks of the environment in general. I, however, speak of a specific set of mechanisms necessary for a specific task - for solving the hard problem of consciousness. This is a concretization of the tradition applied to a specific epistemic task. It is in this sense that I say my list is not arbitrary.

Interconnection of Mechanisms and Individualization Through Unique Abilities

Until now, I have described the mechanisms separately - first the core, then the support. But in real pedagogical practice, they do not exist in isolation. They form a holistic system - the communicative-cognitive framework of personality. The development of one mechanism promotes the development of others. Critical thinking (MM-6) improves the ability to build cause-and-effect relationships (MM-1). Emotional intelligence (MM-3) improves the ability to conduct a constructive debate (MM-7). The framework holds the form, the mechanisms provide the movement - and together they form a system in which the whole is greater than the sum of its parts.

But here arises a question that I consider key to my entire model. If there are many mechanisms, if they are interconnected, where does one begin? How should pedagogical practice be structured so that every child can develop all these mechanisms without getting lost in their diversity? The answer I propose is the principle of individualization through unique abilities. Its essence is that every child enters the system of mechanisms through their strong side - through what comes most easily to them, what sparks their interest, what allows them to feel successful. And it is through this "point of entry" that they develop the remaining mechanisms.

This is not "adapting" learning to the child's abilities in the banal sense. It is using their natural strengths as a lever to develop the entire system. A child with musical abilities can develop cause-and-effect thinking through the analysis of musical structures, emotional intelligence through the expression of feelings in music, and eloquence through explaining musical works. A child with technical abilities can develop the same mechanisms through construction and the analysis of mechanisms. The core is one, but the paths to it are different. Moreover, this principle allows answering the question of the list's openness in its practical dimension. If the list is not final, how does the child know which mechanisms are available to them? Through trial. Through the opportunity to try themselves in different types of activities. It is precisely in these trials that the child discovers their "hidden" abilities, which become the "point of entry" for developing the entire system.

Infrastructure as a Condition, Not an "Additional Option"

But for this principle to be realized in practice, the school must provide the child with a space for trial. And here I turn to a question that often remains in the shadows of pedagogical discussions - the question of the material and technical base. Infrastructure is the condition for the possibility of trial, and trial is the condition for the possibility of individualization.

A child cannot discover an ability for music if the school has no instruments other than a piano in the assembly hall. They cannot manifest themselves in sports if the gym is just two wall bars and ten mats. They will not know they are capable of wood or metalworking if the school has no workshop. They will not discover a talent for photography if there is no photo studio. They will not try themselves in intellectual games if there is no room and equipment.

Therefore, I insist that the school must be equipped with truly diverse infrastructure: art studios with various materials; music studios with a sufficient set of instruments; dance studios; full-fledged sports facilities; workshops equipped with wood and metal lathes; photo studios; vocal studios; rooms for intellectual games. Of course, serious funds are necessary for such a list of objects. But I want to emphasize: these funds are not expenses. This is an investment in the future of the country, in the future of humanity. If the hard problem is paradigmatic, then the solution requires a subject capable of an act of re-conceptualization. And such a subject is formed not only through textbooks and lectures. They are formed through diverse experience that allows them to see the problem from different angles, find unexpected analogies, and develop those mechanisms that remain undeveloped in a standard school environment.

Infrastructure matters not only for individualization. It matters for the very possibility of solving the hard problem. If we want a future researcher to possess developed spatial imagination (MM-10), they must work with volumetric materials from childhood - sculpting, constructing, building. If we want them to possess developed emotional intelligence (MM-3), they must have experience expressing emotions through different mediums from childhood - music, dance, painting. Infrastructure is not "scenery." It is the material foundation for the formation of the core. The experience of Singapore [10] shows that systemic investments in infrastructure and teacher training yield outstanding results. The experience of Kyrgyzstan [11] shows that even limited resources directed at creating school spaces for innovation can yield measurable results. These examples confirm: infrastructure is not a "budget line item," but a strategic condition.

Conclusion: From Enumeration to Structure

In this article, I have attempted not merely to enumerate eleven mental mechanisms, but to derive them from a task and embed them in a structure. The line of reasoning was as follows. 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 a cognitive act of re-conceptualization. And such an act requires certain operational abilities, which I formulated as six requirements. From these requirements, I derived six core mechanisms. I assigned the remaining five mechanisms to the support level. I left contextual mechanisms radically open.

Such a structure allows answering the question of the list's openness more precisely. The core is closed - it is defined by the task. The periphery is open - it depends on the context. This is not arbitrariness, but principled openness: it has a rule. I also attempted to show that the list is not an invention out of thin air. It fits into the tradition of virtue epistemology, research on thinking dispositions, and the concept of the cognitive niche.

But I do not want this structure to look like a closed system. It is open to criticism and development. I fully allow that someone may refine my formulation of the task, and then the requirements will change. But this addition must be argued, not arbitrary. It is in this sense that I say the list is not final: it is open to development, but this development is subject to a rule.

And finally. In the section on individualization, I spoke of the principle of unique abilities. In the section on infrastructure, I spoke of space for trial. These two sections are connected to the main task not by chance. If the hard problem requires a subject capable of an act of re-conceptualization, then this subject must be non-standard. They must be able to see what others do not see. And for this, they need experience that goes beyond the standard school curriculum. Infrastructure is not an "additional option." It is a condition for the formation of a subject capable of a paradigm shift.

And here I want to make an important clarification, without which my entire argument would be vulnerable. I do not claim that developing 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 is important because it 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 without pedagogy nothing will change" - no, I claim that without pedagogy the change will not be conscious and systemic. It may occur 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 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 for the possibility of the future of science.

References

1. 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/
2. Kleymenov A. The Historical Necessity of Changing the Pedagogical Model: From the Industrial Conveyor to Post-Industrial Thinking // Fractal Academy. - 2026. - Issue 1. - Art. 3. https://fractal-academy.com/articles/article-1-3/
3. Kleymenov A. The Economic and Evolutionary Disadvantage of Old Models of Pedagogy // Fractal Academy. - 2026. - Issue 1. - Art. 4. https://fractal-academy.com/articles/article-1-4/
4. Geary D.C. The Evolved Male in the Modern Classroom // The ANNALS of the American Academy of Political and Social Science. - 2024.
5. Gruskin K., Griffin M., Bansal S., et al. Stakeholders' Roles in Evolutionizing Education: An Evolutionary-Based Toolkit Surrounding Elementary Education // Behavioral Sciences. - 2025. - Vol. 15, No. 1. - Article 92.
6. Evolutionary Mismatches Inherent in Elementary Education // Encyclopedia. - 2025. - Vol. 5, No. 3. - Article 105.
7. Kleymenov A. Epistemological recursion in cognitive science: mental mechanisms as a tool for overcoming the "hard problem" of consciousness // Fractal Academy. - 2026. - Issue 3. - Art. 1. https://fractal-academy.com/articles/article-3-1/
8. Chalmers D.J. Facing up to the problem of consciousness // Journal of Consciousness Studies. - 1995. - Vol. 2, No. 3. - P. 200-219.
9. Varela F.J., Shear J. (Eds.). The View from Within: First-Person Approaches to the Study of Consciousness. - Thorverton: Imprint Academic, 1999.
10. Kleymenov A. Singapore: Scaling Innovations through the SCAEL Model // Fractal Academy. - 2026. - Issue 2. - Art. 5. https://fractal-academy.com/articles/article-2-5/
11. Kleymenov A. Kyrgyzstan: School as a Center for Solution Design (Schools2030) // Fractal Academy. - 2026. - Issue 2. - Art. 6. https://fractal-academy.com/articles/article-2-6/
12. Levine J. Materialism and Qualia: The Explanatory Gap // Pacific Philosophical Quarterly. - 1983. - Vol. 64, No. 4. - P. 354-361.
13. Kuhn T.S. The Structure of Scientific Revolutions. - Chicago: University of Chicago Press, 1962.
14. Vygotsky L.S. Thought and Language. - M.: Labirint, 1999.
15. Galperin P.Ya. Experience in studying the formation of mental actions // Bulletin of Moscow University. Series 14. Psychology. - 2017. - No. 4. - P. 3-20.
16. Davydov V.V. Theory of Developing Education. - M.: INTOR, 1996.
17. Elkonin D.B. Psychology of Primary School Student Learning. - M.: Znanie, 1974.
18. Sukhomlinsky V.A. How to Raise a True Human. - M.: Pedagogika, 1990.
19. Amonashvili Sh.A. Hello, Children! - M.: Prosveshchenie, 1983.
20. Ushinsky K.D. Native Word. - St. Petersburg, 1864.
21. Morin E. Introduction à la pensée complexe. - Paris: Éditions du Seuil, 1990.
22. Sosa E. A Virtue Epistemology: Apt Belief and Reflective Knowledge. - Oxford: Oxford University Press, 2007.

23. Zagzebski L. Virtues of the Mind: An Inquiry into the Nature of Virtue and the Ethical Foundations of Knowledge. - Cambridge: Cambridge University Press, 1996.
24. Perkins D.N., Jay E., Tishman S. Beyond Abilities: A Dispositional Theory of Thinking // Merrill-Palmer Quarterly. - 1993. - Vol. 39, No. 1. - P. 1-21.
25. Clark A. Supersizing the Mind: Embodiment, Action, and Cognitive Extension. - Oxford: Oxford University Press, 2008.
26. Sterelny K. The Evolved Apprentice: How Evolution Made Humans Unique. - Cambridge, MA: MIT Press, 2012.
27. Kleymenov A. Mental Mechanism "Establishing Cause-and-Effect Relationships": The Foundation of Adaptive Thinking // Fractal Academy. - 2026. - Issue 5. - Art. 1. https://fractal-academy.com/articles/article-5-1/
28. Kleymenov A. Mental Mechanism "Eloquence and Conciseness": The Art of Word Mastery as the Foundation of Communication and Thinking // Fractal Academy. - 2026. - Issue 5. - Art. 2. https://fractal-academy.com/articles/article-5-2/
29. Kleymenov A. Mental Mechanism "Emotional Intelligence": Philosophical Foundations and Practical Significance // Fractal Academy. - 2026. - Issue 5. - Art. 3. https://fractal-academy.com/articles/article-5-3/
30. Kleymenov A. Mental Mechanism "Long-Term Memory (Mnemonics)": History, Philosophy, and Practice // Fractal Academy. - 2026. - Issue 5. - Art. 4. https://fractal-academy.com/articles/article-5-4/
31. Kleymenov A. Mental Mechanism "Socratic Dialogue": The Art of Questioning as a Path to Truth and Mutual Understanding // Fractal Academy. - 2026. - Issue 5. - Art. 6. https://fractal-academy.com/articles/article-5-6/
32. Kleymenov A. Mental Mechanism "Critical Thinking": The Art of Doubting as the Foundation of a Free Mind // Fractal Academy. - 2026. - Issue 5. - Art. 5. https://fractal-academy.com/articles/article-5-5/
33. Kleymenov A. Mental Mechanism "Constructive Debate": The Art of Argumentation as a Path to Agreement and Development // Fractal Academy. - 2026. - Issue 5. - Art. 7. https://fractal-academy.com/articles/article-5-7/
34. Kleymenov A. Mental Mechanism "Non-verbal Communication and Charisma": The Art of Wordless Influence // Fractal Academy. - 2026. - Issue 5. - Art. 8. https://fractal-academy.com/articles/article-5-8/
35. Kleymenov A. Mental Mechanism "Information Search and Analysis": Navigation in the Ocean of Data // Fractal Academy. - 2026. - Issue 5. - Art. 9. https://fractal-academy.com/articles/article-5-9/
36. Kleymenov A. Mental Mechanism "Spatial Imagination and 3D Visualization": The Cognitive Foundation of Creativity and Understanding // Fractal Academy. - 2026. - Issue 5. - Art. 10. https://fractal-academy.com/articles/article-5-10/
37. Kleymenov A. Mental Mechanism "Forecasting and Strategic Thinking": The Art of Looking Beyond the Horizon // Fractal Academy. - 2026. - Issue 5. - Art. 11. https://fractal-academy.com/articles/article-5-11/
38. Kleymenov A. Communicative-Cognitive Framework of Personality: Economic and Evolutionary Necessity of Change // Fractal Academy. - 2026. - Issue 5. - Art. 12. https://fractal-academy.com/articles/article-5-12/
39. Kleymenov A. Comparative Analysis of Mental Mechanisms "Socratic Dialogue" and "Constructive Debate": Similarities, Differences, and Rationale for Separation // Fractal Academy. - 2026. - Issue 5. - Art. 13. https://fractal-academy.com/articles/article-5-13/

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.

Disclaimer
The opinions, points of view, and data contained in Fractal Academy publications belong exclusively to the author(s) and do not necessarily reflect the position of the publisher or the editorial board. Fractal Academy and the editorial board bear no responsibility for any damage arising from the use of ideas, methods, instructions, or materials mentioned in the publications. Responsibility for compliance with copyright, accuracy of citation, and reliability of facts lies with the author(s) of the publication.