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Cognitive dynamics of primary school students in interactive psycho-pedagogical

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Abstract

In the context of the digital transformation of education and the transition to interactive forms of learning, the development of the cognitive functions of primary school students is of particular importance. This article presents the concept of cognitive dynamics as a purposeful pedagogical process of developing thinking through the integration of interactive cases and cognitive activity maps. A method for constructing such maps reflecting changes in key cognitive functions is proposed: attention, memory, speech, logic, imagination, and metacognition. Examples and map schemes are given, and their types and methods of analysis are classified. Emphasis is placed on the Kazakhstani educational context, including the capabilities of the Kundelik, BilimLand platforms, and AR technologies. The cognitive activity map becomes a bridge between learning and thinking, allowing the teacher to track and guide the individual cognitive growth of students.

Keywords: Cognitive activity map, Cognitive dynamics, Critical thinking, Developmental pedagogy, Interactive learning, Primary school students.

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1. Introduction

Educational paradigms based on the mechanical perception of knowledge no longer work in the modern world. Modern information storage systems are more advanced than the mnemonic memory of an individual or a student.

Therefore, the main factor in training today is not the development of mnemonic abilities but the development of the dyad "analysis-synthesis" as a reflection of the mental activity of students' abilities. The development of cognitive skills is especially relevant in parallel with new technologies in education. In particular, interactive technologies are the most effective.

Therefore, we can say that the most effective learning paradigm is interpreted through the "cognition-interaction" dyad.

This approach is the basis of the educational process, in which the guiding and controlling vector of learning is cognitive dynamics.

By cognitive dynamics, we mean the educational process aimed exclusively at the formation, development and actualization of students' cognitive functions. This process involves gradual complications and improvements in basic cognitive functions. This applies to cognitive functions such as creative (creative) thinking, critical thinking, lateral (nonstandard) thinking, locus of attention (concentration) and emotional intelligence.

Notably, emotional intelligence is the most important and demanding cognitive function and should be developed predominantly during the learning process. Emotional intelligence for a student is the pathway to the future. Most professions in the future will be associated with the presence and degree of development of emotional intelligence. Therefore, in the learning process at the junior high school level, it is important not only to activate the student's cognition but also to actualize the student's emotions and emotional state in the classroom.

In classical education, emotions are given almost no attention. However, in fact, it is the emotional state that determines not only the student's ability to learn but also his or her ability to develop cognitive functions.

In this sense, cognitive dynamics should be aimed at suppressing egocentrism and increasing emotions such as the joy of learning or a pronounced interest in learning.

In this list of components of cognitive dynamics, we have not forgotten an important and classic characteristic—memory development. We believe that the development of basic cognitive functions accelerates the development of students' mnemonic abilities. Memory retains more of the knowledge that has become understandable and not that which was memorized purely mechanically. That is, cognitive dynamics develop the ability to understand the educational subject, and this automatically leads to a greater ability to remember it.

Cognitive dynamics is not the fastest process. The development of cognitive skills should take place throughout the entire learning stage. A sequential chain of events that form cognitive skills gradually and step-by-step—from class to class.

Therefore, in junior classes, it is impossible for students to demand pronounced cognitive ability. At this stage, it is only motivated, and they begin to lead to it. With the expectation of a positive effect at the following, older, stages and steps of training.

Junior grades represent the initial period of development of cognitive functions. Logical and structured thinking at this stage is just beginning to form. At this stage, the student is just beginning to understand what cause-and-effect relationships are and to make the first attempts at comparative analysis at a simple level.

Let us add that, as it seems to us, junior grades are the most important stage in cognition. At this stage, specific logical thinking, inductive reasoning and other cognitive parameters of personality are formed. Depending on how effectively and efficiently they are formed, success in further studies and even in periods of future social activity will depend on this.

The main task of modern education is the development of mental structures aimed at the development and self-education of the student.

The passive role of the student should be replaced by his proactivity in the context of cognitive interest. The student is no longer interested in simply memorizing something. He is interested in self-expression through his interest in educational processing. The desire not to memorize but to learn something new this archetype is increasingly fixed in the behavioral structures of the student.

Here, the role of the teacher is especially important in the context of feedback with the student. If the teacher requires memorization as a sign of better academic performance, then the student will strive for mechanical memorization without the need to show interest in the subject or in learning in general. If the teacher does not require memorization but rather cognitive activity in the lesson, then this requirement is interpreted accordingly on the active development of cognitive abilities, competencies and interest in the educational subject. This moment is especially important in the context of the relationship between the teacher and the student.

Interest in knowledge is the foundation of intellectual education, and the degree of interest should serve as both a formal and informal criterion for the quality of educational processes.

However, the real process of cognition is determined by the presence of reflection and self-reflection in educational processing.

It should not just remember knowledge; the student should show interest in knowledge. However, the most important thing is that the student should interpret knowledge. That is, the key point in the modern education system should be not only in active cognitive interest in learning knowledge but also in how the student relates to the acquired knowledge and how he or she relates to knowledge in general. This, in fact, is educational reflection. That is, the student should not only have an interest in learning but also be critical of the knowledge already acquired.

Here, he must himself or, with the help of a teacher, come to a new paradigm, to a new stage of his educational development. In this paradigm, the teacher must not only show interest in knowledge but also be engaged in the selection of knowledge for its assimilation. That is, the student must learn to independently answer the following question: what is this knowledge? Do I need it? Is this knowledge unnecessary, false or useless?

This selective attitude toward knowledge in the context of critical thinking is especially relevant in the era of the modern world of hyper-information.

Therefore, simply showing interest in knowledge is not enough. It is necessary for this knowledge to undergo selection through critical thinking in the student. Notably, critical thinking is not limited to the selection of knowledge. Critical thinking is not just a filter for the process of cognition. A deeper purpose of critical thinking is the analysis and synthesis of already selected and assimilated knowledge.

If the process of acquiring knowledge is realized through interest in learning, then the process of actual cognition, as an expansion of the boundaries of knowledge, is realized through critical thinking in the context of cognitive dynamics.

The most effective tool and method for implementing cognitive dynamics is undoubtedly interactivity (Figure 1).

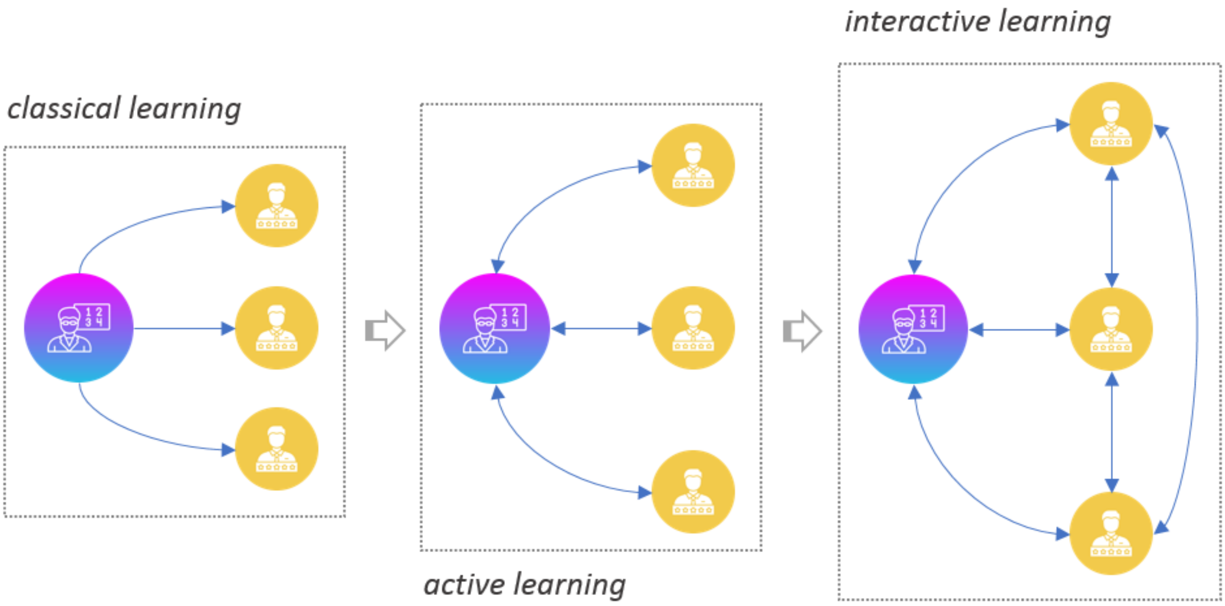

Figure 1.
Comparison of classical, active and interactive methods and practices of education.

By interactive learning, we mean not a one-way connection between the teacher and the student but multicomponent positive feedback between all the participants in the educational process.

Classical learning is monologic learning. Active learning is dialogic learning. We interpret interactive learning as polyphonic learning. Interactivity evokes emotion, feedback, confidence, significance, and reflection.

These findings indicate that interactive technologies have not only a didactic effect but also an important psychological impact they creating a comfortable environment where the student is not afraid to make a mistake and is willing to engage in cognitive activity.

In general, interactive methods in primary school are a means to make learning personally oriented and developmental. They help to connect new material with the children's own experience and teach through action and cooperation.

In junior classes, it is quite difficult for students to maintain one-point attention only for the teacher. Therefore, interactive communication with other students without compromising the pedagogical hierarchy gives students the opportunity to switch to new sources of information or opinions. This undoubtedly effectively contributes to maintaining motivation and developing critical thinking.

Maintaining voluntary attention in the classroom is directly related to learning success. Students with better-developed attention perform better in various subjects.

We believe that if, in modern education, we connect cognition and interactivity into one methodological system, this will allow us to solve the main problem of education achieving maximum indicators of students' competencies. Starting from the junior grades

Accordingly, in this paper, we consider the educational dyad Cognition-Interactivity in terms of theoretical and practical aspects. With an emphasis on cognitive activity maps in the context of applied cases.

2. Literature Review

In modern learning paradigms, it has become evident that cognitive dynamics lead to the formation of dynamically reliable learning outcomes [1, 2]. In this sense, cognitive dynamics in education can be thought of as a class of general cognitive dynamic systems [3, 4] which require detailed analysis and research. This concerns not only the dynamic aspects of cognitive development and learning but also the scope and limitations of certain procedures that are used to transform these processes of cognitive change into limited objects of empirical research [5, 6].

In this case, cognitive dynamics are particularly relevant in the context of interactive forms and methods of teaching and training [7]. With respect to primary grades, cognitive dynamics in teaching can significantly improve the social-cognitive abilities of children from different social contexts and become a driving force for creating conditions of equal opportunities and gaining learning advantages for all their students [8]. Here, the role of dynamics in the formation and improvement of executive functions in primary school children should be especially emphasized [9]. The principles of cognitive dynamics are now beginning to be used not only in elementary grades but also in special education within higher education [2].

Naturally, teachers themselves must be prepared to use cognitive dynamics in teaching and must be guided by programs to strengthen their cognitive and social-emotional skills [10].

Of particular interest are approaches to assessing and metric the use of cognitive learning [11]. This is especially relevant in the context of our work, which considers cognitive activity maps for assessing cognitive dynamics in interactive learning.

3. Methodology

The aim of this study is to identify and visualize the cognitive dynamics of primary school students when interactive cases are used through the construction of cognitive activity maps.

Study subjects:

- Primary school students (6-10 years old) in the context of introducing interactive forms of education.

4. Methods

- Literature analysis (modern cognitive dynamics);
- Observation and pedagogical mapping;
- Collection of data on key cognitive functions (attention, logic, imagination, memory, speech, emotions) before and after the use of interactive cases;

Visualization via cognitive maps (point, dynamic, differential, or thermal);

Interpretation of results according to individual cognitive profiles of students.

Tools:

Tracking cognitive changes on a scale of 1–5, marked ↑ → ↓.

The methodology is adapted to the realities of primary education in Kazakhstan, uses local digital tools (BilimLand, Kundelik), and takes into account the bilingual environment as well as the psychological and pedagogical specifics of the region.

5. Results

Based on the above, we can formulate the fundamental points of cognitive dynamics in the context of the symbiosis of cognitive activity maps and interactive learning

5.1. Principles Of Information Mapping in Interactive Learning

A cognitive activity map is not just a table or a graph reflecting the development of cognitive skills but rather a whole ontological projection of the development of thinking in the learning space. It is a way of visualizing the student's inner world his growing connections, movements, surges, delays.

In fact, the cognitive map is built on a philosophical premise that we can formulate as follows: "*Every thought, every learning is a trajectory of movement in cognitive space.*"

This space is invisible to the eye, but it can be reconstructed through the behavioral, speech, written and digital patterns of the student. In this sense, the cognitive map is a kind of attempt to "see thinking" as a process and not only as a result (assessment, correctness of the answer) [12]. This is the philosophy of the dynamics of cognition, in contrast to the static pedagogy of the result.

It also continues the traditions of intentional phenomenology, according to which thinking is usually interpreted as always being "*directed toward something*." A map in this regard is a recording of the vectors of these directions occurring in time. That is, a map is *similar to a "trace of cognitive life and learning."*

Thus, the cognitive activity map is a multidimensional space. Indicators of the key cognitive functions of the learner (memory, attention, speech, thinking, imagination, metacognition) are recorded. In addition, they change over time and under the influence of educational influences.

That is, it connects

- *vector thinking (development of functions),*
- *network topology (interconnections of cognitive nodes),*
- *dynamic modeling (changing the trajectory of thinking).*

At the same time, the art provides not only a "snapshot" of the student's condition but also a trajectory of his development, a prediction of the possible course of learning, growth zones and "cognitive hunger", resonant zones of activity where motivation and learning coincide.

Each student is a unique system of cognitive circuits. In this sense, the cognitive map provides a way to respect and study individuality. This is accomplished not through labels but through the analysis of natural cognitive patterns. It rejects unification in principle. Here, two students with the same grade can have radically different cognitive trajectories.

In addition, the cognitive map does not fix the child in a framework. It shows where he was, where he is going and where he can develop. That is, this is already a movement pedagogy and not a "diagnosis".

Much in education remains elusive. For example, why can a student not concentrate? Why is he or she weak in expressing himself or herself? Why " *knows but cannot explain* "?

The cognitive map brings these invisible cognitive processes to the surface so that they can be used pedagogically, methodically, or individually.

In general, the art shows the student's cognitive profile and his strengths and difficulties. This automatically makes it possible to adapt tasks, offer personalized cases, and direct them to the zone of proximal cognitive development.

For example, if a student consistently shows growth in imagination but decreases attention, then tasks are selected with a focus on maintaining attention in conditions of creative freedom.

At the same time, the teacher receives tools for the early detection of cognitive risk, such as memory loss, emotional burnout, and overload. Here, cognitive development trajectories can be built: how will the student grow in such and such cases?

In particular, signal zones are actualized here. If a sharp shift appears in the map, you can ask the following question: Did something external happen? In addition, accordingly, they intervene in time.

The students themselves can also see their map (in a simplified form) and understand how they are growing, where their strengths are, and what qualities require training.

That is, this is already the beginning of the pedagogy of self-reflection from a young age.

A cognitive activity map can be built before and after a certain technology is used (e.g., storytelling, AR, games). In this case, it is clear which functions are used. This allows you to move from the assessment "everything works" to the effect "*This case activated creativity and attention, but did not improve logical thinking.*"

If group maps are constructed, the teacher has the opportunity to see how students interact cognitively, who strengthens others and who is isolated, who is an "emotional driver" and who is a "logical stabilizer".

Thus, cognitive maps allow us to move toward group pedagogy in terms of activity rather than assessment.

Additionally, the cognitive map can be represented as a field, where each vector is a direction of development, each node is an active cognitive element, and the intensity is the strength of involvement.

It is similar to a magnetic field of thought. It is not visible, but it forms the trajectory of movement of thoughts, knowledge, and interests. Such a field can be modeled, visualized, and studied in time.

Therefore, the cognitive activity map in our interpretation is a bridge between the student's thinking and pedagogical action. It makes possible a scientific, humane and dynamic understanding of cognition in school. We interpret it as an instrument of new pedagogy the pedagogy of cognitive resonance, development, dialogue, and foresight.

5.2. Cognitive Activity Maps in the Pedagogical Practice of Case Assignments

Thus, in the learning process, it is very important to know the nature and dynamics of cognitive skills when performing educational cases. It is especially important to analyze the activation of different mental zones of the student when solving cases and to study the cognitive load (cognitive load) during case assignments.

To solve these educational problems and use them in practice, during a lesson, cognitive activity maps can be built, which provide real neuroscientific significance to the learning process.

Accordingly, we create cognitive activity maps for primary school students as a tool for visualizing and analyzing cognitive dynamics in interactive cases.

Let us recall that by cognitive activity maps, we mean a certain multidimensional visual space. Each student is displayed as a point (or trajectory), and the map axes correspond to key cognitive functions. Such a map allows for tracking the level and development of cognitive indicators over time and under the influence of different cases.

Let us look at the structure of the cognitive map.

Let us define the C cards in the following form:

X - logical-analytical thinking (L)

Y - creative imagination (V)

Z (color of the dot) - level of voluntary attention (A)

point size - volume of active working memory (M)

dot shape - type of cognitive style (for example, logician, creative, communicator)

outline/frame of the point - emotional tone/involvement (E)

Each student can then be interpreted by a cognitive profile vector in the following form:

$$C = [Logic, Imagination, Attention, Memory, Emotion, Speech]$$

where the values are normalized from 0 to 1 or on a scale of 0–10 (depending on the methodology).

We can construct a static map at time t and a dynamic map the movement of points (students) for the periods before and after the series of cases.

This makes it possible to track an individual's cognitive trajectory.

Let us present a hypothetical example of a trajectory in the form of the following graph (Figure 2):

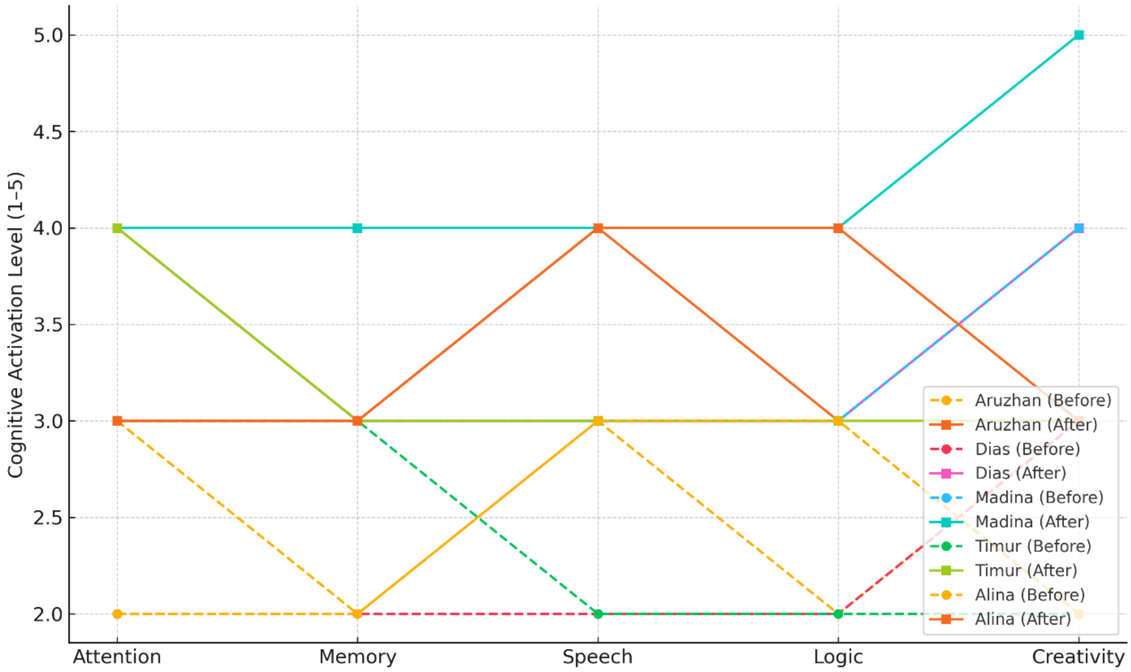

Figure 2.
Trajectories of the cognitive activity maps of the five students.

The graph shows an example of a cognitive activity map before and after the use of an interactive case (for example, a thematic project with an AR component) for five elementary school students.

Here, we see an overall increase. All the students showed an increase in cognitive activity in all the functions, which indicates a positive impact of the case.

Let us highlight the differentiated effects for each student:

- Madina achieves maximum scores in 4 out of 5 functions. This indicates a high potential or strong resonance of the form with her style of thinking,
- Dias and Alina show significant growth in logic and speech; perhaps they engage better when there are structured tasks.
- Timur has increased his attention, speech and logic, but his creativity is growing slowly. That is, it is worth including more creative components.
- Aruzhan shows balanced growth. He is a typical student who activates everything little by little.
  Most active zones on the map:
- Speech and logic achieved the greatest gains. The case may have involved discussion, debate, or problem solving.
- Creativity also increased, but was less pronounced for some.
- So the map allows you to see:
- Which cognitive zones were activated in each student?
- How effective was the interactive form?
- Which areas require additional support?
- Individual style of thinking (for example, Madina's is systemic and creative, and Timur's is analytical and closed).

On the basis of this map, we can assume that such a visual approach will help primary school teachers

- Building personalized educational trajectories,
- Understand what works and for whom,

Use data, not just intuition, when assessing learning.
Another example can be given in tabular form (Table 1):

Table 1.
Examples of individual cognitive trajectories.

Student	Thinking (L)	Imagination (V)	Attention (A)	Memory (M)	Emotions (E)	Speech (R)
Ainur	0.6	0.9	0.4	0.5	0.8	0.7
Sayan	0.9	0.5	0.7	0.6	0.4	0.6
Leila	0.4	0.7	0.6	0.7	0.9	0.9

Table 1 shows the distribution of types: logicians, empaths, visualizers, etc.
Cards can be of different types. Let us present these types in different formats (Table 2).

Table 2.
Types of cognitive maps.

Card type	Purpose
Static map	Comparison of students by functions at 1 moment
Dynamic	Tracking progress
Differential	Difference before/after the case for each function
Network card	Cognitive relationships between students
Heatmap	“Where is the most activity happening?”

Thus, cognitive activity maps are not just visualizations but tools for making pedagogical decisions.
These cards allow

- *Fine-tune training,*
- *Track the dynamics of thinking,*
- *See the "case effect" in real cognitive units.*

Overall, cognitive activity maps are innovative, scientifically proven and pedagogically valuable tools for visualizing, measuring and guiding the development of thinking in primary school students.

In the context of the active introduction of interactive technologies into primary education in Kazakhstan from digital platforms to cases, AR and gamification cognitive maps are becoming a bridge between practice and reflection, data and meaning, and learning and development.

6. Discussion

Let us consider the correlation between interactive forms of learning and cognitive activity maps. This will allow us to focus on cognitive dynamics as a modern educational system in the context of cognition-interactivity.

Therefore, interactive learning activates various areas and zones of the student's thinking. In particular, such

- *Attention,*
- *Memory,*
- *Speech,*
- *Imagination,*
- *Logical Thinking,*
- *Emotional Regulation,*
- *Cooperation.*

Each of these functions can be documented in a cognitive activity map (Figure 3).

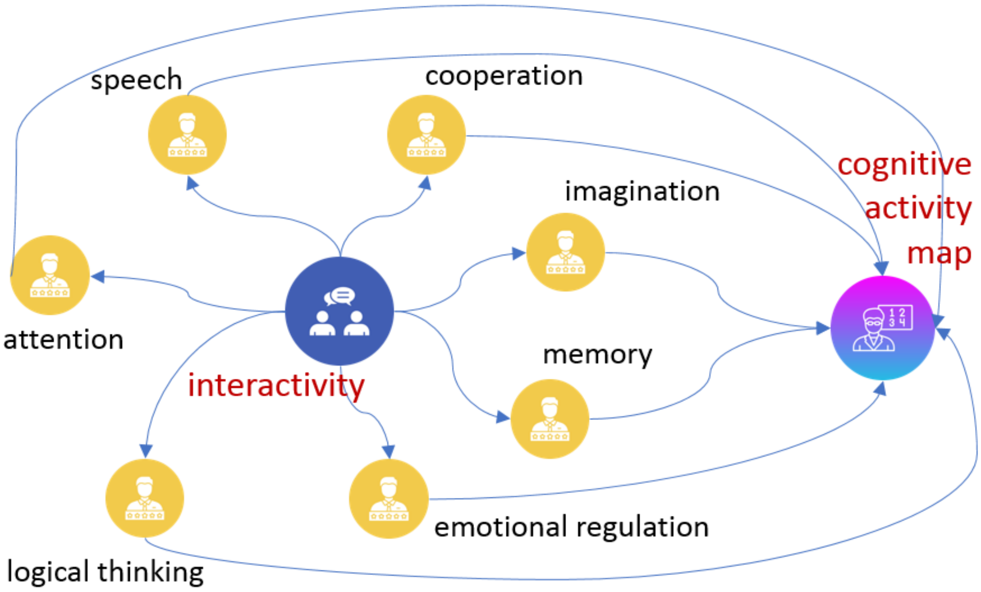

Figure 3.
Translation of the effective components of interactivity into the structure of the cognitive activity map.

How to translate the components is the prerogative of the teacher himself. This depends on how actively he uses cognitive maps in his educational processing.

As an example, we can take the role-playing case “choosing a hero,” which shows growth in the areas of speech activity (discussion), moral imagination and cause-and-effect analysis.

The interactive format triggers these cognitive processes, and the cognitive activity map allows them to be seen, recorded and measured.

Naturally, each interactive technology forms its own specific set of cognitive functions in the student [13]. Therefore, it is logical to classify these differences in the form of a table for clarity (Table 3).

Table 3.
Correspondence of the interactive form to the cognitive profile.

Interactive technology	Activated cognitive functions
Game-based learning (gamification)	attention, reaction, motivation, strategy
Case method	logic, argumentation, ethics, judgment
Project activities	planning, cooperation, self-regulation
Storytelling	memory, emotional thinking, causality
AR/VR	imagination, spatial thinking, involvement
AI tutor	individual trajectory of thinking, self-reflection

We can demonstrate the practical application of this table via the following example.

Let us say that a teacher wants to motivate students to know the Kazakh alphabet by heart. According to the table, the best pedagogical strategy and effective motivator for successful knowledge of the alphabet on the part of students will be the choice of a game form (gamification) of learning and motivation.

Thus, the cognitive activity map reflects the specificity of the activation effect of the interactive form of learning. However, it should be taken into account that the interactive method can be innovative but not always useful. In some cases, it can lead to a surge of cognition in some students, but others may experience cognitive overload (fatigue).

We believe that the role of cognitive activity maps in this process is constructive. Owing to the maps, the teacher can see the real impact of the interactive methodology used in the lesson on the cognitive functions of the students. He will be able to compare the results of the impact before and after the case/lesson/technology. In addition, we identify which technology works better for the formation of a particular cognitive function.

Let us present another practical example.

Let us assume that a cognitive activity map shows that, as a result of using interactive AR technologies in a lesson to study wildlife (at the primary school level), approximately 60% of the students improved their spatial thinking but, at the same time, somewhat reduced their concentration (that is, they experienced overstimulation).

On the basis of the map data, the teacher adjusts his/her similar lessons. For example, he/she reduces the visual flow of information about representatives of the animal world or builds in certain pauses in the interactive presentation.

In this context, interactive forms of learning provide the most valuable and visual information for analyzing cognitive activity maps.

Notably, a classic task on a piece of paper does not provide complete and representative data on how long the student thought, what mistakes he made and how he corrected them, how carried away he was by the lesson or the subject itself, and at what point he lost the thread of educational processing.

Interactive teaching methods create directed flows of content data containing semantic information. Interpretation of this flow with the help of cognitive activity maps allows the teacher to obtain quantitative and qualitative information about how long the student kept paying attention to the topic or lesson, how he or she moved along the iterative steps of solution or understanding, how often he or she made recursion (returns to one or another moment) and what cognitive functions were involved in the process of transitive transition from not understanding or ignorance to understanding and knowledge.

Thus, interactivity in learning in the context of cognitive activity maps is not only a form of learning but also a way of diagnosing the student's thinking. This is a new meaning of pedagogy and learning.

In this process, the sequence is quite simple yet effective. The teacher conducts an interactive lesson, observes the cognitive map of the activity, and makes a logical conclusion. For example, regarding which student did not cope with a certain function, which of the students needs to be given additional tasks, where it is worth repeating the topic in another form, what the cognitive load on the student was, and whether he or she withstood the interactive activity.

Thus, within the framework of educational processing, the cognitive activity map is transformed into a tool for managing learning at the meta-level. That is, not only at the level of checking and monitoring knowledge but also at the level of checking the development of types of thinking and managing the acquisition of knowledge.

Thus, both interactive forms of learning and cognitive activity maps are in a direct and symbiotic relationship. Here, interactivity activates, saturates and directs cognitive development. The activity map becomes a tool for navigation, registration, visualization, analysis and pedagogical management of this mental development.

Together, they form a new pedagogy of cognitive dynamics. A pedagogy where thinking is not evaluated but rather developed and monitored as a living and dynamic process.

7. Conclusion

On the basis of the above, we can make a practical contribution to the new system of interactive education and develop a conceptual methodological guide in the context of the cognition-interactivity paradigm in the notation of cognitive activity maps.

Therefore, let us create a working methodology for primary school teachers that will allow them to develop students' thinking through interactive forms and track cognitive growth via activity maps.

Let us define a cognitive activity map as a graphic-analytical scheme reflecting the change in and development of a student’s key cognitive functions (attention, memory, speech, logic, imagination, self-regulation) over time, depending on the interactive teaching methods used.

his definition follows, either explicitly or implicitly, from the analysis of cultural-historical theories (for example, the zone of proximal development), the theory of cognitive development and modern digital pedagogy.

Let us define and interpret the key cognitive functions in the form of a table (Table 4).

Table 4.
Key cognitive functions.

Function	What is being tracked	Examples of activity
Attention	Stability, switch ability	AR games, math quests
Memory	Volume, longevity	Storytelling, association tasks
Speech	Oral activity, building judgments	Discussions, debates, "thinking hats"
Logics	Inferences, causality	Case analysis, games with rules
Imagination	Creative solutions	Projects, fairy tale therapy, design thinking
Metacognition	Self-assessment, planning, reflection	Mind maps, assessing your steps

We define interactive forms and methods of teaching and associate them with the cognitive effects of learning dynamics in the following tabular form (Table 5).

Table 5.
Interactive methods and their cognitive effects.

Method	What activates
Gamification	Attention, strategy, quick reaction
Case study	Logic, argumentation, ethics
AR/VR	Imagination, spatial thinking
AI tutors (BilimLand, chatbots)	Individual cognitive trajectory
Storytelling	Emotions, logic, speech, memory
Group projects	Communication, self-regulation, metacognition

On the basis of the tables, we can determine the key characteristics of the relationship Interactivity - Cognitive Map - Development of Thinking in the following form:

- And interactive methods activate cognitive functions.

- Cognitive maps record and visualize these processes,
- The teacher, seeing the map, sets up the learning, promoting meaningful growth of thinking.

Let us show how to create a cognitive activity map via an example.
We make a table in which we localize the minimum set of trackers from five functions in the following form (Table 6):

Table 6.
Assessment of the student's cognitive ability.

Student	Attention	Memory	Speech	Logics	Imagination
Aigerim	4↑	3→	4↑	2↓	5↑

In the map, we use the following notations:
↑ growth, → stable, ↓ decrease (on a 5-point scale).
Or in graphic format

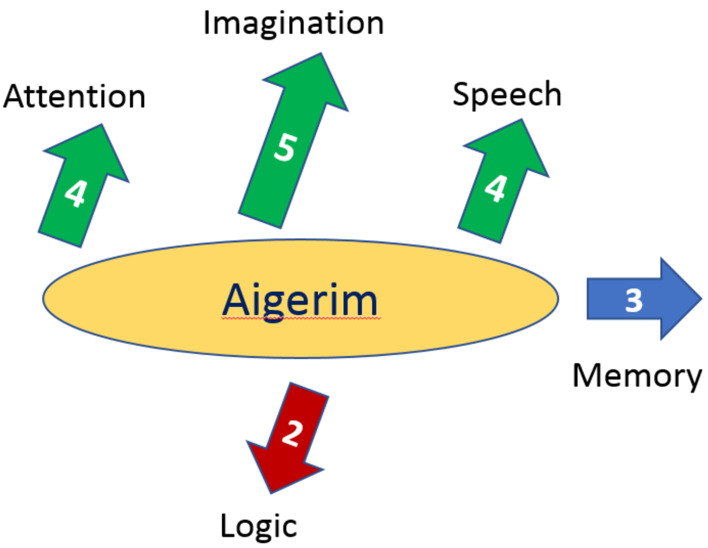

Figure 4.
Assessment of key components of Aigerim's thinking.

In the map, these parameters need to be marked after each interactive case or block. After 4--6 lessons, the actual diagram cognitive activity can be built.

The resulting diagram of cognitive activity allows us to differentiate tasks (which need to strengthen what), identify "resonance points" (which methods give a surge), support individual cognitive growth, provide parents (and the student himself) with dynamics and justify the effectiveness of lessons on the basis of the data obtained and interpreted.

However, when creating and using a cognitive activity map, a few simple rules need to be followed:

- Do not overload the map. One active form per lesson is sufficient;
- Do not evaluate the map in terms of "good/bad". Importantly, the map is a diagnostic of cognitive growth and the effectiveness of interactive methods, not a label or a sentence.
- In general, the map should be used positively. That is, for support, and not as a basis for putting pressure on the student.
- If technical capabilities allow, the map can be integrated into the Kundelik system or into the student's portfolio.

We provide expanded methodological rules for compiling and handling a cognitive activity map.

Rule 1: Start simple: one function - one card

- At the beginning, do not track all functions at once. Start, for example, with attention or logical thinking and build a map only for them.

After each interactive exercise (for example, an AR game or a case study), briefly record the following:

- Level of involvement (1–5),
- With stability (whether it was switched),
- Maintaining the mission objective.

And after 5–7 lessons, you can already see the established pattern.

Rule 2: Associating each task type with a specific cognitive goal

Do not just run a game or a case study - consciously define what function you want to develop. Examples:
Storytelling, speech, imagination, memory
Case "What to do if...", logic, ethics, self-reflection
AR animation, attention, and spatial thinking
My Family Project, Speech, Information Organization, Creativity

All this will allow us to build a functionally sound map and not a random tracker.

Rule 3. Color and graphic markers were used

To encourage children to participate in making their own map, they are given a visual scale:

- *High Activity*
- *Average*
- *Low*

Or build a simple "activity feed".

This promotes the development of reflection in the students themselves. They see how their thinking works and changes. This will increase their self-motivation for the subject or lesson.

Rule 4: Make the cognitive map part of the student's portfolio

Add a "How I Think " section to a student's portfolio that records their progress not by subject but by thinking functions. This makes thinking visible and meaningful as part of self-development.

Rule 5: Build mini-maps after key interactive cases

After a major task (project, research, case study), each student (or teacher) evaluates 2–3 functions that were used.

For example, a simple form:

What did I do?

As I thought,

What I did best (from the functions)

Where it was difficult.

This is, in fact, the basis of the mini-activity map.

Rule 6. Use a "group cognitive map".

Sometimes it is useful to make a general map of the class, which functions were activated in most children.

How it helps:

- *Identify strengths/weaknesses by class,*
- *Set up subsequent tasks,*
- *Find "cognitive leaders" (children who show growth and engagement),*
- *Offer mutual assistance in groups (one child is better at logic, another at imagination).*

Rule 7. Involve your parents

Show parents the child's activity map not as an assessment but as a dynamic of thinking development.

For example:

"In February, Askar's attention increased by 2 points – she began to focus longer on interactive tasks."

This creates a positive and supportive atmosphere at home.

Rule 8. Changes in cognitive style were recorded

A cognitive map may show that a student is changing his or her thinking style:

- *First, I relied more on intuition,*
- *Later, became logical or analytical.*

This can be tracked by the type of solutions he offers. Accordingly, include the following labels in the map: "Intuitive approach" - "Analytical approach".

Rule 9. Using a "pedagogical navigator" based on a map

Let the map guide you through the lessons:

- *What to include more often (game? debates? cases?)*
- *What functions require support,*
- *These forms are best suited to a particular class or student.*

Rule 10: Watch for phase jumps

Sometimes, a student makes a qualitative leap in thinking. For example, he begins to formulate judgments that he had not made before.

In a cognitive map, this can be recorded as:

- *"Growth point"*
- *"Resonance with form X (AR, case, project)",*
- *"The beginning of metacognition (reflection)."*

That is, it is very important to support these phases so that thinking does not "roll back".

Thus, the cognition-interactivity paradigm (both interactive learning and cognitive activity maps) is an inseparable and synergetic pair of modern cognitive-interactive education.

The first one activates and develops thinking,

The second one captures, visualizes and directs.

The systematic use of cognitive activity maps actually makes the teacher not just a "knowledge teacher" but also a thinking mentor. Here, the teacher is transformed from a knowledge relay into a scaffolder (tutor) of the student's cognitive development.

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