

# ON X-SCIENCE STUDY IN MATHEMATICS INSTRUCTION

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## ABSTRACT

*This article introduces a new paradigm, referred to as the “X-paradigm”, which combines various sciences in view of the priority development of the so-called cognitive<sup>1</sup> thinking – Co.E. in the mathematics instruction.*

*In this context, a conceptual model is introduced concerning the organisation and self-organisation functions for development and self-development of the individual and a technological model of the ‘Trainer – Trainee’ system in view of the X-paradigm realisation.*

**Key words:**

*X-paradigm, eidetic, reflexion, synectics, synergetics, cognitive thinking*

## INTRODUCTION

In the latest years, with a view to the methodical reality, priority has been given to the cognitive thinking – Co.E., which is a space and time related art (see [5]). The integration processes in all scientific fields require more or less the development of the cognitive thinking – Co.E. ability with a developed individuality. In this relation there is a certain necessity of special training in cognitive thinking – Co.E..

What type of paradigm would solve this problem?

Already in 2000, Edgar Morin defined in [11] the development of thinking as one of the most important moments in the reconstruction of the education and in this connection he is a champion of the 7 leading principles, which correspond to a

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<sup>1</sup> *Cognitive<sup>1</sup> thinking – Co.E. has the following meaning: cognitive thinking, but with inner interaction one and the same trend of thinking of the individuals.  
The addition – Co.E. belongs to the author of the paper.*

certain extent, as it becomes clear in the article, to the forthcoming origination of the so called X-paradigm in the mathematics instruction (see [3], page 249-255).

A reasoning in this direction naturally leads to the conclusion that there is needed a strategy that can offer a scenario for a future quality training based on untraditional and constructive methodology that will answer the following two questions (see [3], page 249):

- What type of education would turn the trainee into a subject?
- Which is the most appropriate educational conceptual model that will lead to the so-called cognitive thinking – *Co.E.*?

In this connection the eidetic skills, reflexion, synectics and synergetics, organized in a goal-orientated X-science with established principles and technologies, will help to clarify the various aspects of the genesis of the mind.

### **THE NEW PARADIGM OF THE ‘X-SCIENCE’ IN A METHODOLOGICAL CONTEXT**

The conceptual model (see Fig. 1) which has been experimented for 3 years (2005 – 2008) takes effect and confirms the assertion (see [4]) that the production of mental acts in the context of cognitive thinking – *Co.E.* brings reliable results and leads to the establishment of a cognitive hierarchical structure of understanding, and boosts the self-development of the individual.

It is the self-development that leads to the mastering of a system of orientations for acquiring valuable information, i.e. how to acquire knowledge from the modern encyclopedias or the Internet and to convert it into strategies for solving various problems, i.e. to transform it in one’s own know-how.

Before pointing out the objective, the set of terms and the principles of the suggested X-paradigm, it will be helpful to draw the attention to the following three notions (see [8], page 6): interdisciplinarity, multidisciplinarity and transdisciplinarity, which characterize quite often the scientific approaches in the context of the non-linear dynamics of the complex systems to which the ‘Trainer – Trainee’ system belongs to:

- Interdisciplinarity refers to combining multiple scientific fields (in this case eidetic, reflexion, synectic, and synergetic) in a concept which makes a step towards the synergy of mind and sense and allows for the complement of the rational and the emotional, i.e. the synectic, and subsequently will lead to solving a number of didactic problems;
- Multidisciplinarity refers to researches where certain phenomena are studied simultaneously by several scientific disciplines but from different points of view;
- Transdisciplinarity is connected with phenomena which go beyond the boundaries of the specific disciplines.

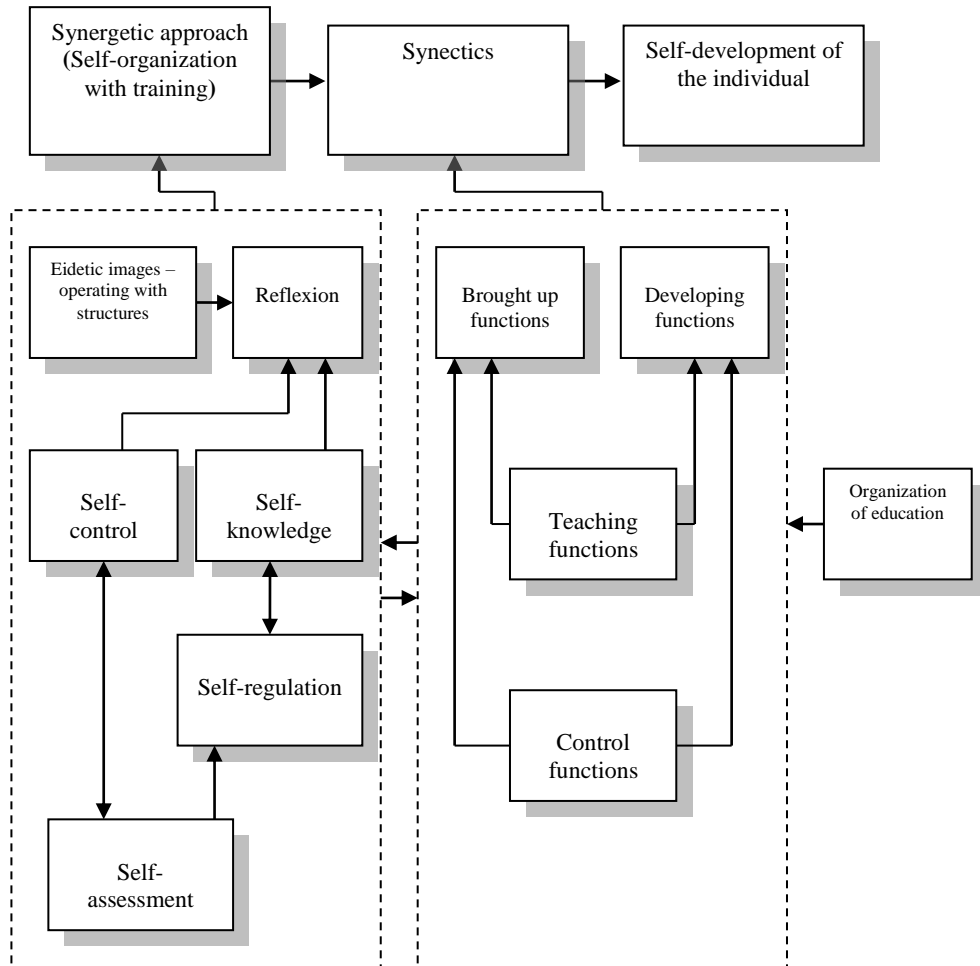


Fig.1 A conceptual model of the organisation and self-organisation functions for development and self-development of the individual

Taking into account the above, these three terms fit perfectly into the so-called X-science, which needs to create its own metalanguage in order to exist as a science in the intellectual space. The objective of the science in question, as it was already stated hereinbefore, is the self-development of the individual. The main notions at this stage of its development are:

- eidetic<sup>2</sup>
- reflexion<sup>3</sup>
- synectics<sup>4</sup>
- synergetics<sup>5</sup>

### ESTABLISHED PRINCIPLES

The X-science, subject matter of this study, is based primarily on the eidetics, which can be regarded as a theory and practice of the subjective images. Therefore, the principles of forming the genesis of the mind (and the cognitive thinking – *Co.E.* in particular) for solution of complex problems which every person and in particular every individual is confronted with in this globalizing society, require on the first place to have **the support principle** (see [10]) included because during the initial stage of training, especially in mathematics, the student needs to operate with outer, real objects and to accumulate sensomotor relations in order to reach an eidetic status (clear inner mental images). This has been already corroborated in a number of studies. For example, Boyan Lalov (see [10]) deems that through dominating the outer morphodynamics the student may use as a basis for acquiring certain knowledge the immediate perception of the object as ‘the image of that object takes the central place in the consciousness while the psychological projections of one’s own cognitive speculative manipulations in relation to the object and its elements remain at the background’. In order there to be reached the so-called inner morphodynamics so that the student will acquire greater level of independence, there shall be present **the variation principle**, by means of which wholesome learning of new relations between new and old objects is achieved. ‘Studying the various aspects of the subject (see [10]), placing it under different circumstances, exercising the various influences on it, leads to acquiring of a variety of sensomotor anticipative relations’ and hence it provides the basis for forming of anticipative mechanisms for the changes which could have taken place

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<sup>2</sup> Combines various ways for development of the anticipative sensomotor resources of the intellect with clear and vivid visual ideas.

<sup>3</sup> A major phenomenon of the inner activity of the human – a complex psychological and personal new creation

<sup>4</sup> A science about the optimal correlation between the rational and the emotional origins of every human activity.

<sup>5</sup> Studies the coaction of the multiple systems with a stress on their intrinsic properties as a source of self-development resulting into the occurrence of a new functioning system with a new structure.

with the object (the problem) during the transformation of certain structures. This of course will require from the student to perform a comparative analysis of the expected and the real in order to make an adequate decision with regard to a given problem.

Having in mind that mathematics is based mainly on operational ideas, among the principles of the X-science that shall be included also the following ones:

- \* **activity and consciousness principle** in the education, inclusive of the emotional activity which underlies the synectics.
- \* **reflectivity principle** which ‘is different from the reflexion (as a mental process), but can be connected to reflexion manifestations in activity, communication, or self-knowledge’ (see [2], page 83).  
On the other hand reflexion necessitates the introduction of
- \* the **tolerance principle**, which is quite an indispensable one especially when it comes to dialogue reflexion which underlies the mathematics instruction.

With relation to the synergic aspect of the X-paradigm the following principles are also of great importance:

- \* the **genesis principle (homeostaticity principle** – maintenance of the system within certain boundaries which allow it to follow its objective) and the **hierarchy principle**, which refers to ‘the compound nature of the superior levels in relation to the inferior ones, i.e. what at an inferior level is regarded as a structure, an order, at a superior level is only a structureless element of the chaos’ (see [1], page 51).
- \* **forming principle**;

In the reference materials (see [1]) there are considered normally 5 principles: non-linearity, non-stability, non-closeness, dynamic hierarchy and observability. The first three refer to the establishing of the system.

The meaning of the other two principles refers to the following:

- \* the **dynamic hierarchy principle** describes the horizontal transition of the system to a new quality, i.e. the slow change of the guiding parameters at meta level (see [1]) leads to bifurcation<sup>6</sup> – instability of the system at macro level and its restructuring.
- \* The **observability principle** makes the system of the synergetic principles open to being completed with various interpretations. In connection with the creation of one’s own educational product as a result of the self-development of the individual, it is of use for the sake of the X-science to take into consideration the **recursivity principle**, too.

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<sup>6</sup> An interval during which there occurs a quality change in the system properties (where this system moves into a stable state)

## CONCLUSION

The already mentioned combination of principles (which we consider still open for the so-called X-science) enables the individual self-development of the students in the mathematics instruction through fluctuation at micro level – responsible for the choice of the necessary way of evolution occurring after the points of bifurcation. This is best illustrated in the empirical studies of the different education technologies, and especially with the project related synoptic learning activities (see [4]).

### THE X-PARADIGM IN THE MATHEMATICS INSTRUCTION

The conceptual idea hidden in concepts rich of content in their dynamic nature, is represented with the help of a technological model of the ‘Trainer-Trainee’ system.

To implement this idea, methodological tools for teaching project activities in applied mathematics were developed [4], taking into consideration the following priorities (see [13]):

- \* accumulation of sensomotor relations;
- \* non-stop transition from sensomotor relations to the so-called inner morphodynamics;
- \* creation of subjective images and operating with them;
- \* increasing the emotional activity;
- \* emerging of a need of knowledge;
- \* development of the basic structure of the cognitive thinking – *Co.E.* ;
- \* development of reflexive abilities;
- \* self-organization of the system after upsetting the balance and reaching the determined chaos according to the guiding objectives – attractors<sup>7</sup>;
- \* decision making.

## CONCLUSION

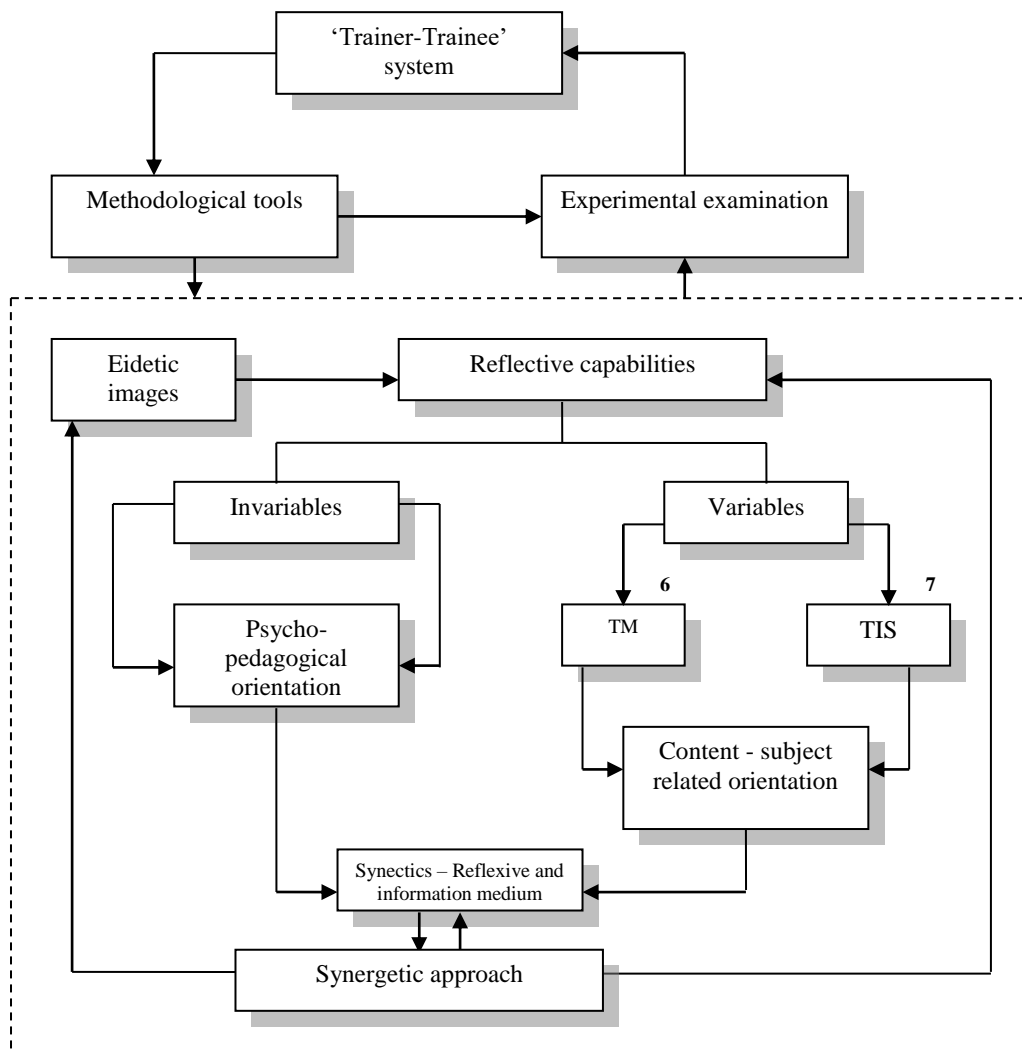
Within the boundaries of the X-paradigm through the training of mathematics the attention is drawn to the following:

- \* The development of cognitive mechanisms shall follow from immediate experience to generalization.
- \* The needs of the student shall be provoked through increasing motivation and emotional intensity.
- \* The transformation of structures shall precede the decision making.
- \* The creation of inner predictive mechanisms shall be the major motive power for the development of the cognitive thinking – *Co.E.* as the

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<sup>7</sup> An area in the space of possible conditions where the system can move without being disconnected from them.

cognitive processes cannot be linear, and the educational environment appears to convey for the student various forms of a future organization, or to represent an opportunity for the possible paths of evolution. Besides, the future in a certain sense exists in the present, i.e. the structure-attractors as future conditions are predetermined by the properties of the environment in question (see [8]).



<sup>6</sup> TM – Technical means

<sup>7</sup> TIS – Training intelligent system

Fig. 2 A Technological model of the 'Trainer-Trainee' system in the context of the X-paradigm

## DEDUCTIONS

Through the modelling which is realized in the complex 'Trainer-Trainee' system, in mathematics education we aim at essentially pointing out the possible ways of development of cognitive thinking – *Co.E.* so that by means of smaller, but correctly structured resonant impacts (which has been empirically proven), to arrive at an optimistic method to master the mathematical knowledge via an intrinsic and favourable for the subject way of self-development.

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