THE NEW PYTHAGOREAN BROTHERHOOD

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ABSTRACT

An important role for overcoming the formal methods and the old paradigm could be played by introducing new approaches to Mathematics like development of mathematical intuition and eidetics. Mathematics for young learners, Mathematics competitions, initiation of more students to high mathematical achievements, special work with gifted students - all these should become common and widespread.

People have been communicating with distant countries and ages since the invention of letters. When they discovered figures, they started constructing a language "to talk to God". All divine ideas mankind has proposed for the last few centuries are due to a combination of the discreet nature of signs and time-space continuum. Descartes and Leibniz had the premonition of powerful-to-be Mathematics, i.e. Mathesis Universalis. Owing to Mathematics, people have penetrated the nuclei of atoms, of living cells and stars. Mathematics dealing with order principles has begun investigating the order of its own structure and development. Hence, traditional education finds it difficult to encompass so much. To continue the attack of the Unknown, we need a new approach to Mathematics on a different level. According to astronomer Carl Sagan, science originated on the southeastern part of Europe in Ancient times to combine numerical methods with experimental ones in a sole system. Ancient people assisted and contributed to science which in return paid back all invested money and expanded the might of the country. Sagan suggests that if the process had continued, mankind would have reached stardom. Unfortunately, for centuries on end people were contemplating The Colosseum, the Acropolis and the Cheops Pyramid without being able to understand how all these wonders had been built or what knowledge the ancient builders had possessed. A new "science explosion" was evident during the Renaissance. Chinese scientists explained it with the establishment of universities in the big European cities. Contrary to Eastern traditions, sacred and valuable among a close circle of successors, European universities turned into centers for new ideas. R. Oppenheimer wrote, however, in the middle of the last century that " science has become the property of a few well-known specialists who read and try to understand it but its general understanding seems to be elusive ". Provided it had been true for Physics, Chemistry and Technologies, it would have been more valid for Mathematical sciences.

At present, new wonders in science and technologies seem to come up every single year. That is evident from the numerous websites which have turned into a universal self-updating encyclopedia. Undoubtedly, the Web has become the nervous system of our civilization, it has penetrated all aspects of our lives and mind to build a modern noosphere. At the same time, multimedia games and interactivities offered by digital society totally change new generations' motivation and goals. It is essential and it is possible to make science activities more interesting, more attractive and most of all, more accessible. Classical pedagogical paradigm relies on strict axiomatic rules and laws, consequences and sequences obtained from theorems and theories dating back to Euclid. In accordance with the rules of the same paradigm, young people acquire theoretical background to solve problems. Scientists who created theorems and theory, however, had been solving a wide array of problems to reach a solution. Consequently, that concentrate of knowledge had been *extracted little by little*, which is known as theory today. The accumulation of so many concentrates nowadays has become a huge amount and the teachers 'drown' their students in it, as Einstein used to say. Similarly, Ukava, the Nobel prize winner in Physics, hinted he was not up to the university textbooks. The alternative to the classical approach is not to discover science but to find the proper solution to that strategic problem. Therefore, students are supposed to be confronted with a great variety of problems to solve and to come up with small 'rations' in theory. Thus, they can understand and apply each quantum of theory and the process altogether. The same approach can be seen in Jay Orear's textbooks in Physics. Being a student of Enrico Fermi, he uses the same method there.

Contrary, the monologue presentation of complete chapters of theory is considered to be anachronism. Learning by rote rules and theoretical conclusions, regarded as foundation of classical education, has low efficiency coefficient and cannot lead to independent thinking.

'New phenomena', Maxwell said, 'requires new thinking models'. For the last few decades, there has been a new paradigm in the air aiming at the development of new thinking processes in the wide arrays of experiments, operations, calculations by means of short rules and instructions. Scientists will begin to understand in a short while that theory deductions and proofs are also a task for the students but for the advanced ones.

The educational ideas presented in this paper are enticing for technical and natural sciences, indeed. Unfortunately, Mathematics needs more time to adopt this

approach. At the beginning of 20th century, Hilbert formulated the idea that Mathematics could be self generated by its axiomatic origin. Based on that, Poincare wrote the following:
“The logical point of view alone appears to interest Hilbert. Being given a sequence of propositions, he finds that all follow logically from the first. With the foundations of this first proposition, with its psychological origin, he does not concern himself.”

Poincare regarded that fundamental problem in a different way. According to him, sub-consciousness is much more powerful and creative than the system of conscious logical moves of the brain. 'It is by logic we prove, it is by intuition that we invent’, he states in “Mathematical Definitions in Education”. Later, he wrote, “Logic, therefore, remains barren unless fertilized by intuition”. Surprisingly, the well-known Gödel's Incompleteness Theorem showed that Poincare was right. However, a few teachers regard this rule as a very important one for mathematical education and education in general.
The work of the ‘giant machinery’ of sub-consciousness presents conscious results. A sequence of logical operations which being used for a long time accelerate, diminish and contract in our sub-consciousness. Thus, they are transformed into a new tool (of higher-order) of the latent work of sub-consciousness. In this respect, we should point out that language as an instrument of knowledge does not serve to execute formal logical operations. It is a much more powerful code, used in the operational memory of our intellect, to store data for conditions, purposes and results. In the process of constant search for intermediate solutions we extract by this code sensory-motor ideas while conclusions are recoded in verbal shape to collate results with goals and sub-goals.
A lot of teachers understand that the acquisition of verbal knowledge is inefficient without the parallel expansion of personal experience. The implicit information acquired by experience has an irrevocable part in formulating, understanding and using each new regularity. Therefore, the educational process should follow the logics of science development: from experience to theory, not the other way round, as it is the case with the traditional pedagogical paradigm – from theory to practice.
For mathematicians and mathematical thinking, a specific characteristic feature is the equal interaction of both verbal and non-verbal. Performances of both language and visual abilities and inclinations are well observed in renowned mathematicians like Newton, Leibnitz, Euler, Gauss, etc. With typical physicists like Einstein and Bohr, the image component of thinking dominates over the language one. We would like to point out that in both cases without the foundation of sensory-motor spatial ideas, language tools would be helpless, useless and without independent functions. The latest neuropsychology and neurolinguistic experimental studies show the same results in the last decades. These outcomes are significant for the change of Mathematical education. It is still common for traditional Mathematical education the emphasis to be put on formalism as if the teenage intellect were built on the same principle as of the computer itself. To present knowledge data verbally

is considered to be enough and as a result, student's logics will 'process' the database automatically. As far as 2500 years ago, Democritus said, 'We should strive not to comprehensive knowledge but to comprehensive understanding'. While Galois, a mathematician, who invented extraordinary things in his short life, wrote: 'I have been walking to clarity all my life'. What Socrates really meant in his words 'to help truth to be born' was developed by Leonardo da Vinci in his finishing touches of a picture with hinted contours. By careful selections of hinted solutions and adequately difficult intermediate tasks, students could reach that level which the great artist and constructor used to call 'Saper vedere!' – to know to see! Then perception becomes deeper. 'The picture', wrote Leonardo, 'becomes 'free' and we can change it in our mind and make whatever we want with it in our imagination.

Both Socrates and Leonardo preferred to use an example about thinking instead of an explanation when talking about the development of thinking. Newton used to say that the example was of the same importance as theory itself. If we could paraphrase the great scientist, we would say that in education the example has much higher significance than theory. The example leads to theory, which is checked in other examples and serves to solve new examples in practice. Differential calculation was disseminated in Europe due to l'Hôpital's book. It contained examples and problems most of which solved by using the new Leibnitz and Bernoulli method, initially known from their theoretical publications in 'Acta eroditorum'.

The abundance of examples gradually develops the ability all problems to be solved 'in the head'- without writing or drawing. Mathematical eidetics, the clarity of visual images we operate with, their dynamics is perhaps the ultimate goal human spirit strives for. Mental mathematical objects, after systematic trainings, guarantee freedom of operation, while those on paper are difficult to change or to experiment with. Euler, being completely blind at the end of his life, dictated his geometrical and symbolic visions. Pontryagin, also blind since his early childhood, could see further than those with an excellent eyesight in his ability to operate with spatial ideas. Pontryagin foresaw the future development of mathematical education insisting systematically on the prevalence of examples, operations performing and problem-solving as the most important tool for the development of mathematical thinking.

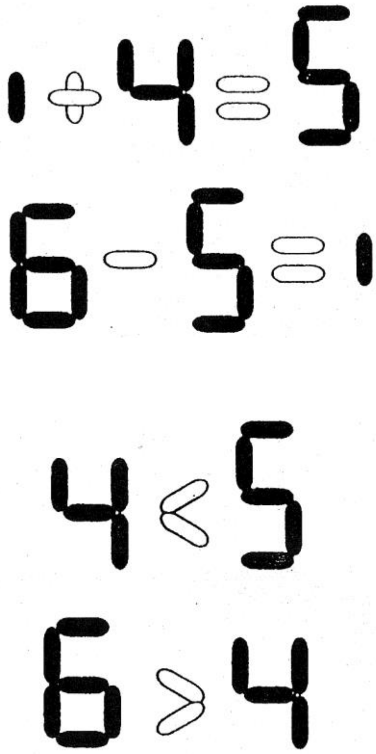

Fig. 1

Nowadays computers provide the greatest opportunities for the development of mathematical eidetics using virtual geometrical 2D and 3D objects. The author of the present paper experimented and patented a mathematical pre-computer game in World Intellectual Property Organization in 2000. (WO 00/76607 AI). The game represents the digits made of magnetic elements – the image of each digit contains as many elements as the digit itself. In the two-digit figures the digits from the higher order are represented volumetric – a set of the corresponding number of blocks containing ten elements each. (Fig. 1, Fig. 2) The elements make geometrical figures, areas and volumes. Some mathematic operations are mastered intuitively: calculations of fractions, geometrical dependences and algebra elements. The child is coached to use the computer keyboard both in a tactile and in a visual way and to transfer the magnetic game on the screen.

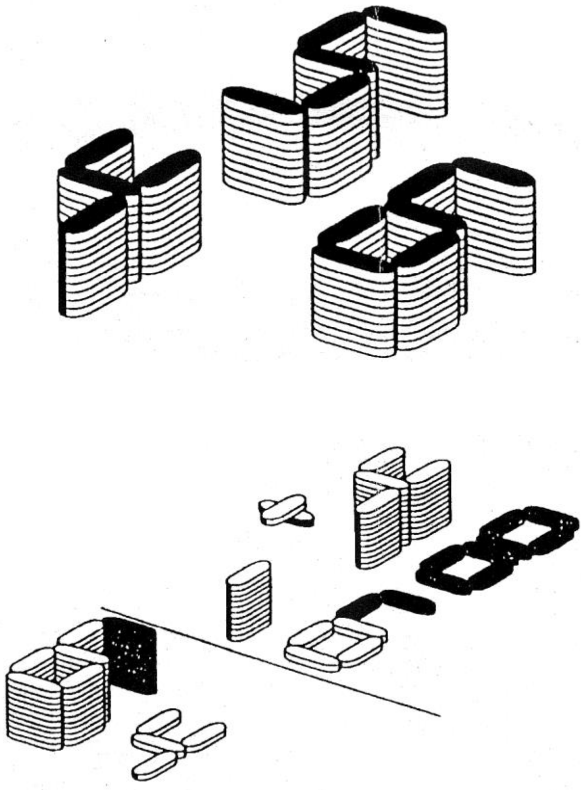

Fig. 2

Pedagogical-psychological experiments in the USA show that 10% of the ten-years-old children possess a well-expressed inclination to eidetic abilities, i.e. the ability to reproduce visual images and to operate with them in their head. The same experiments show that the same children at the age of 16 do not have the same intellectual ability: perhaps due to unsystematic development and practice.

The development of mathematical eidetism is of critical importance for the expansion of the semantics and motivation factor in mathematical education. The variety of sensory-motor ideas connected with premonitions, hints, insights later leads scientists to formulation of conclusions.

Since ancient times, Archimedes' 'Eureka' has been heard everywhere. The loss of emotional, visual and experimental component in Mathematical education is a worrying symptom and violation of the spirituality of the future generations. The haughty demonstration of endless forma evidence designated for the 'enlighted ones' is a dead-end street. In our new Pythagoras Brotherhood there should reign eidetics empathy, mutual understanding and worship to the seeking human spirit whose mission we have been chosen to carry out.

REFERENCES

1. Bruner, J., On Learning Mathematics, New York, 1966.
2. Grozdev, S., For High Achievements in Mathematics, Sofia, 2007.
3. Lalov, B., Extrapolation Theory of Learning, Proc.: IV World Conference "Computers in Education", North-Holland, 1985.
4. Poincare, J. H., Science et Methode, Paris, 1908.