THREE PROBLEM AREAS OF THE EDUCATIONAL ENVIRONMENT

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Introduction

In this short note we are going to share our view on some questions concerning the evolution of math education in the near future. The inspirations for our speculations are Sharygin's conclusions in [1] but the base for them is the author's own observation on Bulgarian and European mathematics education. Our starting point is the next short list of events that play significant role in the math education during the last decade:

- the computers - widely spread, compact and powerful as hardware;
- the computer software, which becomes more and more sophisticated and powerful;
- the social demand of qualified staff with considerable competence in computers and deduction;
- the diminishing abilities of the largest part of the school students in learning abstract matter;
- the low prestige of the teachers' job and as a result the strong tendency to occupation math-teachers' positions by low qualified persons.

What kind of processes is provoked by the resulting force having the above components? In Bulgaria so called educational reform looks mostly like chaotic (Brownian) motion towards nowhere. This is because of lack of analysis of the global processes and as a result the misunderstanding among decision makers what is happening now. And what is happening is a growing pollution of the educational environment. Which are the main sources of such pollution?

First of all is the scale of values of the consumer society: *I want it all, and I want it now!* - this is the motto of the greatest part of young generation. And the most of the young people identify living and working with gambling where one can made it only (or mainly) by chance. Further we refer to this as the **gambling manner**.

The second main source of pollution is the substitution of the knowledge by non-verified and unstructured information. The easy access to any data tempts the young soul to cry to the teacher *Don't preach! I know it!* An immediate result is the lack of respect to the educational institutions and the educators. When a young individual finds some gaps in his knowledge he does not worry because any information he might need is 'one click apart' from him. Further we refer to this as the **all-know syndrome**.

The third source of pollution is the speculations with the so called common sense.
Here the danger comes from the extreme positions that the education should guarantee the basic survival skills and any cultivation of mind abilities is regarded as a collateral product. Further we refer to this as the **common-sense extremism**.

Perhaps the above list of pollution sources is not complete. But even so it gives enough reasons to discuss what kind of strategy should be accepted to diminish the negative consequences of the educational pollution and, if possible, to turn it working for educational purposes.

Two kinds of teaching and learning mathematics

Two educational profiles are adopted in the Bulgarian secondary school math curriculum: basic and extended [5]. The higher education succeeds these two profiles in the two types of studying mathematics: general math course for non-mathematicians and mathematics and informatics courses for professional mathematicians (or for subjects closely related to mathematics). Briefly we can speak about two poles of education-related-mathematics: basic (B-pole) and extended (X-pole). Roughly we can think for B-polers as the consumers of math results and we associate X-polers as the math developers. Since there are fundamental ideological and technical differences between these two types in math education any conclusion should be specified for which of them it has been done.

But there is also a large spectrum of subjects in-between the poles. We advocate the thesis that tending to the X-pole, the math teachers are actually B-polers. Such location of the math-teachers' job sets its mark on the teacher training process. As a result there should be a delicate balance between the fundamental math courses, didactics and applied psychology in any teachers' training curriculum. In such a curriculum the two poles should be considered at a kind of meta-level: the stress could be put on teaching teachers either for B-pole or for X-pole students. Here we point that the way of differentiation of the programs for each of the profiles can vary from optional courses to education at separate departments.

The specifics of teaching basic and extended mathematics do not overlap. For instance, the basic curriculum in some of the Bulgarian mathematics e-courses has been presented with no proofs of statements at all. Assessment in such a course is organized mainly by multiple-choice tests that call teachers ability to 'read' the results of the test from a 'statistical angle', i.e. to be familiar with the basic statistical results concerning tests. On the contrary, the extended curricula put the stress on the proofs which expects teachers' deeper abilities in deduction. The common courses prepare teachers for any kind of teaching, hence the profiles in postgraduate curricula that take into account these specifics should be designed.

Credence clear studying revival

The ecology of the global educational environment stands on agenda. Below we propose ideas for a recycling technology for the most significant factors of pollution.

The gambling manner actually is a powerful source of energy for the educational engine and it comes for free. The human beings are supposedly Homo ludens and the educational strategy *play to learn* is widespread in the early education. Unfortunately further math education in its classical form requires a long-term activity and effort in learning, which are not compatible with the gambling manner.
We see the exodus from the situation for B-pole in fragmentation of the curriculum into relatively independent modules (*islands*) and a lot of *computer corners*, *e-exercise bases* etc. where the routine work is replaced by application of program packages in standard problems and direct application of algorithms [2,4].
On the contrary, for the X-pole students the application of the computers should be oriented to the examining different configurations and problem situations directed to generating hypothesis, checking properties, designing algorithms. All the time X-pole students should be protected from the gambling, but to be encouraged to play the game called mathematics.

The all-know syndrome is the natural consequence from the global information environment. Fortunately, in math education we are a little bit protected from the informational hurricane by the nature of the mathematical knowledge. Indeed, the most of the math results are non-trivial and as a rule they need special conceptual and symbolical base to be formulated and performed. However, the teacher is forced to leave the comfortable and prestigious pedestal of the only knowledge keeper and to take the role of the tutor. In an appropriate didactical technology such a teacher's transition could bring more benefits than wastes for the educational process. In the first place is the freedom from the total knowledge chains. The winning teacher's strategy in a complex situation provoked by all-know-students could be *I do not know this particular thing but let us see together what could be done*. Here can help also the change of style from instructional to discussional one. In any case the attempt to stand ground the pedestal is extremely energy consuming even for the most prepared teachers.
But these specifics of math learning provide also a large area for performance of all-knowers. They can explore more and more math results. If they are given the opportunity to share what they have learned in some cases their activity could be followed by a chain-reaction in small group students or even in a class. The big difference between other subjects and mathematics in retranslating facts from a source to some receiver is the mentioned above conceptual and symbolical base of math knowledge which requires an understanding in deeper scale. This is why the recycling of all-know syndrome is possible only for X-pole for the purposes of math learning. However, beyond the math curriculum a target group (large enough) of B-polers can be involved in the educational process by the so called project-design-learning [5].

The common-sense apologists in education are widespread mainly among the B-polers. Perhaps it should be so. One can see the soft form of the brutal utilitarism in the opinion that math education should provide a general numeracy that (eventually) could be upgraded to abilities in dealing with computer programs. Even in the last few years the European view on aims of the math education changes from the basic-skills-oriented to building key-competences where the stress is on the methods instead of techniques [7]. To respond these two external forces on math education we can propose a didactical technology for B-pole learning based on **education by syntax**. In fact, to operate with a computer software one should be familiar with its syntax. It occurs that learning syntax is deeper than it looks like and contains a big potential a real math education to be done in this way.
The modern computer programs have quite similar interface which gives additional advantage to organize teachers' education in applying program packages independent on a particular software. Starting with syntax education one can go further with the **visualization** of some math objects and their properties. Trying to analyze the answers given by the program the student is forced to go further in the understanding of the process. When the math education can provide such a spectrum of competences, its mission is accomplished for the B-polers. In fact, X-pole has its own interest in such an organization of the math education which can be the point of additional discussion.

Concluding remarks

Finding a general solution of the raised above questions seems implausible. An attempt in this direction is the project-design organized education [5]. Despite that it has a lot of advantages the project-design cannot be a replica of the in-class learning. But to put all main components of the project-design education as ingredients of the teacher-training programs is important and urgent. The math teachers having a kind of *synthetic competence* [7], build as a result of a complex training, are not only a necessary condition for social-considerable multiplication of the synthetic-competence-owners. Such kind of staff will be welcome in many hi-tech

branches which will give immediate response on the prestige of the teachers' job and put the Ministry of Education in a competitive position with the private business.

Parallel to the teacher-training programs it should be developed adequate didactical technologies that protect educational environment. The Bulgarian experience from the last 3 years shows that solving equipment problem separately from the teaching technologies does not give positive effect. Moreover, the sufficient quantity of computers in the schools occasionally brings higher pollution, because of lack of vision how they can be applied. As a result students play on them (or as minimum surf in the web) even during the lessons.

Introduction of recycling technologies in the educational environment should take into account the “ecology clean products”. Such a “product” is the Euclidean geometry [1]. But no one subject can stay untouched in the dynamic process of changes. The computer technology's invasion leaves its mark also on Euclidean geometry [8]. This is why a kind of protected areas should be declared as soon as possible.

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The paper is based on the talk given on 3rd November 2007 in
Belgrade during the Meeting of the TEMPUS Project **N° CD_JEP-41110-2006 (RS)**