(E-)Mind Thinking with E-um

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ABSTRACT

Modern technology has opened up many new possibilities in learning. Unfortunately, technology's uncritical use can also be damaging. In promoting productive and comprehensive IT learning the essential issue lies within the capability of the teacher and IT material to use computer to promote the basic cognitive aspects of learning and not only to manipulate the learner to remain motivated. Motivation is productive only if used with a focus towards knowledge and understanding. Especially in mathematics the concepts, we try to teach, are simple and logical, but often abstract. Smart use of computers can motivate this abstract concepts through intuitive simulations and animations as well as provide a sophisticated but simple insight into the causality of mathematical thinking. Thus, we argue that preparation of good e-Learning materials requires an almost contemplative focus on what we want to communicate in order not to overwhelm the student with too many effects that the technology offers.

The concept and the vision of E-um project has been based on the above premises with a comprehensive system of simple technical, mathematical and didactical guidelines, together with a dynamic and creative system of permanent self evaluation and control.

To support those premises new software package based on the Exe open source system has been developed. In order to provide an adequate technical framework for our conceptual ideas new emerging technologies with an emphasis on writing mathematical texts had been used.

Keywords: Education, Mathematics, Technology, Computer, E-learning, Quality.

1. INTRODUCTION

We present the vision of a constructive use of technology, which was adopted in our E-um project and we also expose some dangers of inappropriate use of technology in education.

More and more often the technology is used on all the levels of education. Its use is also aggressively promoted by contemporary educational policies. Commonly, the use of technology is considered progressive even then, when it contributes little or nothing to the quality of learning. Namely, it is quite easy to motivate with the use of modern technology, but the essential question is whether this motivation enhances comprehension and enriches knowledge or does it only remain on the surface and possibly even overwhelms the student with too many information and visual effects, which make understanding even harder. On the other side, a smart use of computers offers immense possibilities for simulation and presentation of intuitive images of otherwise difficult and abstract concepts. Especially in mathematics education a computer can offer a deep insight into the comprehension of causality, which is the core of understanding and critical knowledge.

E-um has been an extensive research and practical project with its main goal of producing a comprehensive e-Learning material for primary and high school mathematics education (6-18 years of age).

2. MODERN SCHOOLING

Seldom in the history of mankind the need of knowledge was so profound and omnipresent as in contemporary times. But also, an average man has probably never been so unwilling and so unprepared for the true effort, which is needed, to acquire this knowledge.

Knowledge consists of understanding and skill. Learning is a comprehensive mental procedure, where practice deepens the traces of comprehension and leaves the permanent knowledge in human memory. Acquiring of a new knowledge is often based on the provocation of the old concepts. A challenge opens up a cognitive curiosity,

which can only be fulfilled by new understanding and extended knowledge. As nicely put by modern German neurologist Manfred Spitzer [5], *deeper the understanding more permanent is the knowledge*. In other words, we can only paraphrase the ancient reply of Euclid to Ptolemy, which modern neuroscience confirms, that *there is no easy way to knowledge*.

Once, (self)discipline was taken for granted and thus, learning (at least partially) functioned even without (inner) motivation. In contemporary popular theories of learning the motivation plays the most important and initial role. Unfortunately too often even without a clear definition of what we mean by motivation. It is interesting already to observe the etymology of the word *motive – motivation*, which today basically means something that is interesting, attractive, friendly, … while the original meaning of *motive* is much wider and basically means the reason, the power to move, to change. Discipline and hard work is not something that people look forward to even when motivated by the need for knowledge. Western market economy has adapted to this new standards and popular knowledge marketplace offers easy knowledge in all kinds of forms. Modern and poorly understood technology plays an important and often negative role in popular easy-knowledge marketing. Of course, it is all a farce, which is no better than the old anecdote of the Nuremberg funnel, which could supposedly be used to easily pour knowledge and wisdom into somebody's head. Unfortunately, knowledge is a sophisticated 'market product' of which the quality could hardly be measured by trivial market standards. How could otherwise one explain the naivety of people, who pay for 'learn-foreign-language-in-two-weeks' programs. Such marketing promises could hardly be made without the aura of the unknown that the technology offers. It is not like buying a car, with which you can take a test ride. It is often a product of which corrupted quality is protected by buyer's own frustration. It is like Woody Allen's *War and Peace*, which he read in 30 minutes … and it's about Russia.

By the use of modern computers and computer games, young people and children are exposed to new concepts of learning, which is based on dynamic and often non predictive action rather than on the motivation focused on understanding. Computer can be a 'blind' motivation, which only motivates with its action and change. Such a motivation is short lived and similar to the motivation that a sophisticated but of poor quality toy offers to a young child. One can follow different educational research findings, which argue that a concentration and motivation for computer learning can hardly exceed 20-30 minutes. Different negative influences of a computer supposedly account for these reasons [1]. We believe, such finding only prove that in such cases, computer is used as a toy of a poor quality and the charm of a new 'noisy and flashy toy' evaporates after 20-30 minutes. We argue and have proved in many experiments with young children, that when a computer is used smartly as a tool to explore and provoke the inborn child's curiosity, the motivation is long lasting and essentially unlimited.

It is paradoxical, that the use of computer technology as a learning tool often diminishes the understanding of basic logical and consequential principles. It might be so as a contemporary man sees learning too much as a way to bypass the problems, rather than as a tool to solve them. As J.H. Mason puts it [4] the essence of learning and especially the learning of mathematics is the nurturing of the ability to face and solve problems.

3. THE E-UM VISION

In the planning of our E-um project the clearly stated vision and consistent principles that abide with its main principles, were essential. With its main practical goal of producing a comprehensive e-Learning material for primary and high school mathematics education (6-18 years of age), the core principle was based on a decision, to use technology to enhance critical thinking. The computer should be used to deepen the understanding and promote critical thinking as a prerequisite of any good education. From ancient Greek tradition and as one of the most respected mathematics educator *Hans Freudenthal* [2] puts it, the ability of mathematical and logical thinking is a precondition for scientific and critical thought. Computer technology is nothing but an 'electronic realization' of the main mathematics principle, that is *Modus Ponens*. In other words, all the sophisticated computer technology is based on the simple and strict consideration of the relation between the cause and its reason. Thus, also the computer should mainly be used to enhance the comprehension of *causality* in thinking. It should simplify and emphasize the logical steps that teachers and students are obliged to take in order to get natural insight into the ideas we want to learn and comprehend. Popular computer use, especially in numerous computer games and in all kinds of commercialized IT (Information Technology) endeavors maintains the users attention by interesting but superficial visual animations and by unexpected effects. Contrary to that, we want to build up and use computer for motivation that is based on the challenge and beauty of understanding.

Modern technology and ever more accessible computers offer an incredible and absorbed view into the essence of causality, which is the core of mathematics and any other thorough education. Abstract concepts and for young students often difficult logical relations can, by the use of computer animations, be given attractive intuitive forms. Modern technology is too often used and abused to motivate 'the presence' and to make virtual 'the new'. This should not be the goal of learning. The development of technology has started thousands of years ago on the premises of understanding of the core natural and logical principles. And that is why and how the technology should be used in modern schools: To motivate and attract young people into the deepness of understanding of mathematics, nature and relationships that mankind struggles to understand and control. We are well aware

that understanding is a privilege and that gifts of young people are quite different. But we also believe, that with the right approach any understanding can be deepened. Addressing a young student, we want to start on a gentle slope, with ease, but armed with challenge and never underestimating the young. Namely, we strongly believe, that more barriers to understanding lay within apathy than within abilities.

In learning, we should never accept dogmatic principles and answers to *whys* should be found between the dialog of wisdom and practical experience. Thus, educational principles should avoid formality and be directed towards the content. Rather than checked by theoretical directives, educational work should be checked up by appropriate informal users. We are sure this is the vision which directs us towards the essence of a good learning and away from *bullshiting in education*, which young people learnt to dismissively call *whatever*. We believe that good old learning ideas are totally compatible with modern educational principles and even with the use of technology. Computer could and should be used exactly as Comenius wrote in his **The Great Didactic, 1649**: *There is in the world no rock or tower of such a height that it cannot be scaled by any man (provided he lack not feet) if ladders are placed in the proper position or steps are cut in the rock, made in the right place, and furnished with railings against the danger of falling over. If we examine ourselves, we see that our faculties grow in such a manner that what goes before paves the way for what comes after.*

4. THE E-UM TEAM

Teaching by means of modern technology and progressive standards is no easy task. Constant political pressure for educational reforms and explicit directives how modern teaching should be done, is no better than the illusion of the Nuremberg funnel. Good teaching can use modern technology, but modern technology is by no means a guarantee for good teaching. Teaching is an ingenious task, which requires a superb professional subject knowledge, emotional stability, social skill and to use the technology, besides all the mentioned, the teacher should have an adequate comprehension and confidence in computer use. By smart e-learning material a teacher can be aided and motivated to enhance some, many or all of the necessary competences. In our E-um team, we joined forces and ideas of people, who look at schooling and mathematics learning as subject professionals, as teachers and parents at the same time. We want to join our experience, theoretical knowledge, critical thinking and bold creativity. We want to frame our teaching within the classically proven methods and revitalize the ancient Greek admiration for understanding with the use of sophisticated technology. Thus, we want to use technology to promote, deepen, provoke and acquire new knowledge. To the young, who are often more skilled with computers then their teachers, we want to offer accessible knowledge and adequate challenge. Within our team we equally value superb subject knowledge, didactical skills and technical fluency, which only all joined together can provide for a well balanced and quality e-learning materials. The critical interplay of this three cornerstones leaves no space for dogmatic rules and requires an evolving system of self control, self evaluation and improvements. In order to achieve our basic principles with regard to the above three aspects of our work, we decided to

- build up a sophisticated and thorough system of reviewing,
- perform a nationwide seminars to inform, promote and expose our work to objective critique,
- base our technology use on freeware programs.

We hope to be able to tell more about this logistically very demanding project, which, by our opinion, succeeded to bind together the content and modern technology within a truly working cybernetics system.

5. THE E-UM PLAN

To realize such an ambitious plan, many operational questions had to be resolved and many conceptual decisions taken. Formal content questions regarding almost permanent syllabus change were put aside, as were considered unimportant all formal directives about the use of modern teaching methods. By our opinion the spirit of a many school reforms and promoted technology use is well described by the quote of B. MacDonald [3] from CARE (the Centre for Applied Research in Education of the University of East Anglia), that says: *Political control has yielded a compulsory school curriculum of mind numbing sterility, devoid of educational imagination or intelligence, and enforced by a crude technology. We need a curriculum for skepticism, a 'show me, don't tell me' curriculum.*

Basically, all school reforms and directives ever again in one or another form only reiterate almost 400 years old thoughts of Comenius: *The proper education of the young does not consist in stuffing their heads with a mass of words, sentences, and ideas dragged together out of various authors, but in opening up their understanding to the outer world, so that a living stream may flow from their own minds, just as leaves, flowers, and fruit spring from the bud on a tree.*

Regarding the official school syllabus we decided for as a flexible and wide interpretation as possible, offering a broad view on the content and encouraging supplementing regular topics with a variety of related ones. On some chapters (for example in *Theory of Numbers*) we decided for a conceptually new approach, which better fits our intuitive and inductive approach. We chose a simple and unified style, of which the main task is clarity and understanding. In modern Slovenian education history, our project presents the first unified approach to the whole primary and secondary

mathematics education, covering 13 years of mathematics schooling. Of course, there was a long way to go from theoretical and philosophical principles to the practical realization. Due to our devotion to use modern technology, we chose to set on a path of solving many technical problems related to our content goals. But at the same time, research into the technical dilemmas has also proven to be a productive way of deepening many content questions and widening the possibilities for in context mathematics understanding. Work on the communication between content and technical issues has dearly enhanced both, members of the editorial as well as members of the technical management teams. Later the division between content and technical issues was turning to be ever more artificial and the exchange of ideas rising from technical possibilities or content challenges were ever more inspiring for both.

6. THE E-UM GOAL

Our goal is very simple. Namely, to prepare some high quality e-learning materials and establish a unified and working e-learning framework for the subject of primary and secondary school mathematics. With that we hope to set out the path for further quality work and soon to extend the existing framework to all other subjects. By default, the system is not set as a final one but as one that allows and requires evolution and development on the basis of critical evaluation. Our final goal is thus very ambitious and noble. We want to challenge the teachers and the students to raise, not the formal, but practical standards and achievements of mathematics learning and in later stages, also of other subjects.

At the same time we want to help teachers also by just giving them new opportunities and ideas for better work. Namely, we strongly believe that regardless of immense technological achievements and new learning opportunities, the teacher remains the key to good education. The comprehensiveness of education remains defined only through teacher's capabilities and integrity. No formal or technical evaluation but only the teacher's human judgment can coordinate between core understanding of concepts, that we want to teach and its placements within the wider context of human values. So the use of a computer should by no means be an educational revolution or a surrogate for a teacher. A computer can only be a very useful instrument in teacher's noble work.

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5. REFERENCES

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