TEACHING TO LEARN BY DOING *AND* THINKING: TOWARDS THE PROPAEDEUTIC TECHNOLOGY FOR PRIMARY SCHOOL OF INFORMATION ERA

OR

INFORMAL MUTUAL EDUCATION INVIRTUAL WORKSHOP

Re: DRAFT MEMORY NOTE of RESEARCH SEMINAR
"TEACHER TRAINING FOR INFORMATION SOCIETY"
21-22 July 2000,IITE, Moscow

A TRIBUTE TO ALEXEY L.SEMENOV
on the occasion of his 50-th Birthday Anniversary

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PREFACE

In the Spring of 1986, at the age of 55, I came across an enthusiastic group of amazingly talented and devoted young Russian mathematicians and scientists eager to subvert and transform totalitarian system of Soviet children schooling by means of infiltrating and infusing it with modern information-&-communication technologies.

That pioneering group, operating under legitimate umbrella of Academy of Science and being officially presided by the second top figure in its hierarchy, was actually masterminded, organized and lead by the Dr. Alexei L. Semenov. Among his innumerable gifts was an incomparable capacity to lure and seduce innocent people into the most adventurous educational enterprises. He invited me to join their ranks quite casually, I agreed without bothering of the consequences, and never had a chance so far to regret about the choice made then (later the group transformed itself into the Institute of New Technologies of Education).

My contribution to the common deal was very modest. In case the group, or its leader had to wrestle with some controversial issues of computers in education, and there were no expert(s) at hand able to consult or pass an authoritative judgment, ALS used to ask *me* what *I* would think of it. Needles to say, he wanted me to supply not a concrete information or knowledge but any suggestions, analogies, homologies, assumptions, or working metaphors, however weird and bizarre, to strike a tiny spark and ignite the huge mental engine of his own. At times (not always) I had managed to perform that feat by letting my stream of consciousness go and produce (orally and/or in written form) the long chains of free associations out of which ALS could pick captiously one or two as a seed idea, or as a target of his vitriolic criticism that eventually did help him to corroborate logically sound and practically acceptable solution(s).

Recently I got a request for similar help in assessing the outcomes and possible repercussions of UNESCO Seminar "TEACHER TRAINING FOR INFORMATION SOCIETY" (Moscow, Summer 2000) where ALS had presented the Recommendations on Informatics for Primary Education of which he was a Chair of authoring and editorial team. While responding to that request in my usual irresponsible way I became imperceptibly involved once again in (this time entirely virtual) conversation with ALS on nearly all those themes and topics he had ever called to challenge my poor ideational faculties during the last fifteen years. By this reason it seemed to me not out of place to make it public — at least available for some concerned members of educational community.

By sheer coincidence (or a sympathetic trick of fate) I have my writing finalized barely a week before the approaching 50-th Birthday Anniversary of Alexei Lvovich Semenov; hence it's only natural to consider this text as a small but candid tribute to his outstanding intellectual wit and provocative ingenuity.

H E A D I N G S

FOREWORD

What's this all about

The Research Seminar "TEACHER TRAINING FOR INFORMATION SOCIETY" held in Moscow, Russia, 21-22 July 2000 at IITE (Institute of Information Technologies in Education) of UNESCO, has summed up its proceeding with a DRAFT MEMORY NOTE of extraordinary validity. The latter is centered on proposal "for training Teachers of Teachers", and "Methodologists" along the lines of "the IITE <yet to be designed> educational programme of modular character, aimed both at the tuition educators in computer literacy, and wider — In New Literacy for Information Society and at teaching them to apply ICT in educational process".

A document poses a number of challenging (one might say — tormenting) questions before any group of experts commissioned to design such a program. It's hard for me to stop pondering upon some of related topics — partly out of the idle curiosity, partly in performance of official duty. I'm a staff member of the Institute of New Technologies of Education, Moscow, obliged to supply heuristic assistance to other colleagues whenever they happen to stumble upon ill-defined problem(s) [see Chapter POINTS OF DEPARTURE, PART I, DIVISION I] in the course of their professional activities. It seems to me that those experts and specialists who are about to design the above mentioned educational program will, most probably, face many situations of similar kind.

What follows below is just a *bricolage* of assorted thoughts provoked and/or revived by what I have heard and read in this connection during the IITE Seminar. Hurry to assure you that I'm by no means inclined to prove (or disproof) any theses, or doctrines, or hypotheses; or insisting on the indisputable superiority of one theory above the other.

My *metier* is conceptual provocation, that is, prompting (and helping) people to give voice to those creative and potentially fruitful seed-ideas, or *logoi spermatikoi*. which they prefer to keep inside silent, inarticulate and undeveloped, mostly out of diffidence, but also because they consider them too vague, too insubstantial, or too unorthodox to be pronounced before the audience, or even to be told honestly to themselves.

The general path, indeed, is archetypal:

a. lure a person out of the established mode of apprehending and interpreting things by asking paradoxical questions;

b. bring in sufficient amount of playful images, or metaphors to be used as working materials and tools for building and expressing new semantic associations, meanings and value judgments;

c. secure some guidelines for adapting and assimilating newly found transformative discoveries of him/herself, and of the world around within an individual's history and culture.

Not always but at times it enhances my clients' inventiveness and makes them more resourceful in coping with their professional and/or personal problems alike.

Practicing (under different disguises and in different milieus) such trixter-like subversive in-, or con-spirational activities for more than four decades I've accumulated a number of tricks-of-the trade which I'd be happy to share with you to the benefit (hopefully) of our common endeavour.

Once again: I'm not an expert in any field of knowledge, art or craft, — just a mediator and conceptual mid-wife; although sometimes I feel like being that anecdotal rabbi who pesters everybody begging for at least one really hard-core question because he has so many brilliant answers in store. A problem of educational usage of ICT will undoubtedly provide me with a wide variety of nuts hard enough to quench my thirst.

There is no intention on my side to foist unbidden help, nor producing anything systemic: themes and motives do appear (and disappear) rather haphazardly, though being loosely interconnected and, so to say, somehow auto-correlated due to many recursions and reiterations. In fact, the chapters of this text could be read in almost any order.

However, central for me, more concrete than the others, and closer to practical issues is the cluster of topics which begins with chapter TO TEACH A TEACHER (Part I, Division II), and goes all through Part II down to the end of Division I of Part III. What comes before and after this cluster belongs predominantly to contemplative rather then operational considerations.

I'll be happy to hear if any of these scattered notes and remarks would elicit any critical and/or (hopefully) collaborative response.

PART I. TEACHERS' LEARNING

DIVISION I. FACING ILL-DEFINED PROBLEMS

POINTS OF DEPARTURE

When problem is ill-defined

"Ill-defined" means there are no formal rules, or procedures allowing us to assert with a proof whether or not we have reached a desired solution for a given problem. It happens when the latter is unparalleled, urgent and pressing but rather "felt" than properly "understood" and articulated. In such cases we are compelled to resort mostly to heuristic approach because it is futile to ask for any known "algorithms" or precisely defined "scientific" methods to attack a problem in purely rationalistic manner. The majority of educational problems mentioned in a Draft Memory Note (above all — "training Teachers of Teachers") obviously falls into this category.

Indeed, so far nobody on earth knew how to train teachers (moreover, teachers of teachers!) in what is in itself liable to incessant and dramatic changes at ever increasing speed. Does anyone know for sure how to teach it to children either? Is it possible — if only in theory and/or methodology — to separate operationally the first task from the second and the third? In sum, how to teach pupils, teachers, and teacher's teachers to deal with something that does not yet exist, or just starts coming into being and will come to full existence only tomorrow?

It's also hard to refrain from yet one utterly naive question: if someone has decided to train teachers of teachers can one manage such enterprise without hiring immediately the teachers of the third order, and so on *ad infinitum (*or *absurd)*?

Honestly, I see no other option than prompting a group of enthusiastic teachers, children and aspiring teachers' trainers (including ourselves) to explore, design, discover, and invent together the things they are knowing they don't know, and learn it experientially along the way. It's quite probable that at the certain stage of their endeavor they would decide to re-invent education — not to subvert and overthrow established institutions, indeed, but to stimulate their creative imagination.

Heuristic search

For the sake of simplicity let's put aside for a while the issue of training teachers of teachers and try marking some (more or less) fixed points from which such group could proceed.

Here's a couple of helpful hints to lighten them (us) a heavy burden of the first step(s).

The chances are that some valuable findings of theirs (ours) will in fact be consisted out of the re-discovered and re-invented items from our common cultural heritage. The history shows us so many cases when treasures of the old wisdom known for millennia, had been undeservedly rejected, neglected, and went into oblivion to be unearthed centuries later by a flash of insight, or a fit of serendipity coming from the archaic depths of mythology and folklore, collective unconsciousness, or genetic memory (you name it). It's good to recapitulate this cultural-historic stages, or phases quite consciously and willingly, as a kind of educational exercises and role-playing games.

More to it, there are many evidences that this approach is applicable and justified also conformably to child's integrated bodily-mental development. The fact that the human embryo is going through the biological phylogenetic stages during the first six month of fetal growth is well known. Recent researches show very convincingly that the infant is going through similar evolutionary ladder on a plane of his behavioral patterns during the first three years of life. Normal psycho-development of a human individual appears to be linked to the full expression of these developmental stages.

One way or another, the path of deliberate recapitulation, rediscovery and reinvention had been successfully tested many times as very efficient heuristic tool, and we're about to use it quite frequently. I say "us" and "we" because it's more productive for our discourse to identify ourselves mentally with those who are obliged to perform this work not in *virtual* (as I do now) but in actual, or genuine reality.

Imaginary experiential learning

Being pressed by the ill-defined problem situations we are usually inclined to take a risky road of trial-&-error, but if the risk is so high that a wrong try may lead to a huge loss, an irreparable damage, or even total disaster, it is much wiser to probe this road mentally beforehand. In other words, to make various imaginary tries in a series of thought-experiments with some conceptual models in order to sift out the most destructive steps, and then trying to make "physically" just those that seem safe and promising enough.

There are some special heuristic techniques and skills usable in such mental experimentation, or *conceptual design,* resulting in what we might call an *imaginary experiential learning*. I'm about to exercise this approach throughout my writing with no intention of "teaching" it to anybody but out of sheer necessity. Perhaps I can strengthen my position by referring (among a number of trustworthy sources) to the so called "Imaginal Education"— an approach practiced by Canada's Institute of Cultural Affairs (both for children and adults) during several decades in more than 50 nations. Next follow some highlights from Ronnie Seagren's "Imaginal Education. A model that goes beyond 'schooling'" [In Context, No.18, Winter 1988]:

Process and content are equally important

The imaginal approach rests on Kenneth Boulding's understanding of images:
1) Everyone operates out of images;
2) Images govern behavior;
3) Images are created by messages that can be designed and communicated;
4) Images can change; and
5) Changed images lead to changed behavior.

A person's images are supported by a screen of values based on past experience through which new messages must pass. As any teacher can attest, it is not possible to change student's fundamental images for them. However, it is possible to send provocative and inspiring messages that enable people to become more aware of their own images and to make their own decisions.

In imaginal education, process and content are equally important. It is an ever-expanding spiral, with material taught in an appropriate way for the age and learning-stage of the learner.

Spiraling journey

The spiral journey of imaginal learning is carried on in several ways:

1) Expanding the context beyond the self as primary frame of reference. A perceived connection to the broadest possible perspective of time, space and relationships enables the learner to operate out of hope for the future rather than the fear.

2) Stimulating imagination by encouraging the learner to view a situation from the variety of opinions and perspectives, and to "see" reality not yet created.

3) Beckoning participation by creating opportunities for active involvement. When ideas are connected with people's real life questions, meaning and motivation are awakened.

4) Encouraging critical thinking by guiding the learner to relate information to inner resolve, will and values. Ethical reasoning empowers an individual to operate responsibly.

5) Touching the deep in order to build self-esteem and release human potential. As Jean Houston had put it, "We're living in the attic of ourselves. We don't use the first three floors, and the basement is locked, until it wells up in an explosion." Imaginal education gives tools to unlock the basement and relate inner and outer space.

Tools for doing what was listed above include imagery, metaphorical thinking, inclusive myth, specific learning techniques suited to various kinds of intelligence (Gardner's work on verbal, visual, body, musical, logical inter- & intrapersonal intelligences). And, of course, this kind of education can (and must) get rid of mass-manufacturing factory- (or jail-) like organizational framework typical for legitimate school.

Innovative intellectual technology

Among the numerous proposals, aimed at revitalization of general education, the method of *learning projects*, advocated and corroborated in this century by John Dewey, Jean Piaget, Jerom Bruner, Seymour Papert, and many others proved to be the one of the most promising. The trouble is that it can not be introduced to an existing school practice as a ready-made set of precisely defined tasks and/or particular objectives, operations and procedures given in advance — these have to be found, discovered, invented, or *designed* in the course of the ongoing learning events.

To benefit from the above-mentioned method both teacher and pupil should acquire first some generic skills rarely taught, if any, in an ordinary school. Different authors call them the *design mode* of thinking and looking at things, *designer's approach* to a problem solving, *designerly ways of knowing*. Mastering and exercising those skills would eventually lead towards the formation of *The Design (or Third) Culture*, supposedly mediating the much-lamented rift between the "two cultures" of C.P. Snow — Techno-Scientific and Humanistic-Artistic.

To explain this issue further in a purely descriptive manner would be futile. Much better to invite a reader to take part in detecting, unearthing and cultivating the elements and principles of design in teaching and learning praxis proper. That is, to conceptualize its problem situations, generate options, making choices, conducting mental experiments, finding acceptable solutions and evaluate probable outcomes before actually implementing them. From this standpoint design could be seen as an innovative intellectual technology waiting to be converted into a powerful technology of education. For a start lets consider what makes, or might make the school learning really interesting, attractive and successful for the pupils and teachers alike.

Transformative re-working

For a long time it was taken for granted that an acquisition of any knowledge and/or skills is equal to a making in the learner's mind a photocopy of some predetermined and fixed knowledge, or "information". The latter has to be supplied by the teacher, who, in his/her turn, has received it in its entirety through the very same process from some higher source of wisdom and competence.

Nowadays we come to understand that a genuine teacher is doing something more than just transferring the information. Receiving any source-material he/she does make it a part of him/herself by re-exploring, re-interpreting, and re-constructing its form and content in the most personal way. While giving the classes such teacher is trying hard to persuade the pupils to treat in the like manner everything they hear or see in relation to a particular subject-matter.

Examining the phenomenon of "inner speech", L.S.Vigotsky had pointed out that "a child, assimilating certain notion, *re-works* it, and during the process of re-working he expresses in <assimilated> notion the *peculiar features of his own thought.*" V.S.Bibler, a

contemporary Russian philosopher and educator, adds that in inner speech an individual *transforms* the socialized and relatively static "images of culture" into a "culture of thought", dynamic and personal. Especially interesting is Bibler's remark that in such cases an inner speech becomes "*future oriented"* and serves as "the mould for *creating new, non-existent yet, but just possible* "images of culture".

We could say that a genuine teacher is acting as a designer of both the "images of subject-matter" to be presented in the class-room, and the tools to be used by the pupils in order to transform given images into a personal culture of thought, thus enabling the kids to develop further their own abilities to learn.

By initiating communication and interaction regarding the design of the learning process, a genuine teacher learns to no less extent, than the pupils, who, in fact, are teaching themselves and one another, and a teacher as well.

I hardly need to add that in this case the learning process turns out to be something like an adventurous journey through the wilderness where the one may often oneself completely disorientated, helpless, abandoned, lost in confusion and hesitation; so we have to take all our courage now.

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Conduit sine qua non

It wouldn't be an exaggeration to conclude that a deliberate ability to approach skillfully the ill-defined problems does consist an indispensable trait for anyone willing to live and work efficiently amidst the stream of ever-accelerating changes. This ability is very much required from people concerned with innovative education. It becomes *conditio sine qua non* when we enter the contemporary ICT realm which is changing more rapidly than anything else in the man-made world, thus amounting a lot of perplexity, confusion and misunderstanding.

At the same time an advent of modern ICT would bring us enormously powerful means to encounter ill-defined problems more intelligently and learn a lot substantially from such experiences. There is no doubt that sooner or later the ICT supported acquisition of corresponding competency will constitute an obligatory part of general education.

However, a sound conceptual base for this enterprise is still badly needs to be corroborated. To avoid unwarranted *qui pro quo*'s let us agree right now (if only within the scope of our discussion) to interpret the notion of information and communication technologies more broadly than it is usually adopted.

INDISPENSABLE CONSTITUENTS

A simple and fundamental fact

The just prepared UNESCO Recommendations on Informatics for Primary Education have solemnly declared:

> "The possibility of using ICT in education is based on the simple and fundamental fact that learning is to a very large extent based on information processing. Listening, speaking, reading, writing, solving mathematical problems, memorising verses, or state capitals – all are examples of without-computer information processing. <...>
>
> Historically, information processing and communication was the major activity in school since the inception of this institution, though it had to be done almost entirely inside the human mind with a very modest external support of pencil, paper and a chalk board.
>
> Now it is becoming the major activity in human life, practiced with a lot of very sophisticated instruments and media.
>
> Advanced educational methods are best introduced today through the extensive use of computers with versatile sensors, peripherals and extensions.
>
> Eventually, a computer is never autonomous, but connected to the growing number of various electronic digital devices, aggregations and networks for data and information acquisition, storage, processing, distribution and multimedia delivery; all these are assumed under the heading information and communication technologies, or ICT."

To paraphrase a bit more closer to our agenda: information processing and communication exchange are the indispensable constituents of all conscious (and pre-conscious) human activities, events, practices, and products they have brought to life. Until recently these constituents had been manifested almost entirely through the organic functions of our minds and body, only slightly (save writing) supported externally by rather primitive tools and techniques (e.g. abacus in ancient Rome). Today we have a wide variety of computer-centered ICT functioning as instrumental extension and amplification of our capacity for computational operations, logical reasoning, heuristic search and grasping of coherence and hidden interconnectedness in a medley of seemingly chaotic signals and disparate data.

Team of artificial agents

A computer and the peripherals are often likened to an organism able to interact purposefully with its surrounding realities which are being perceived and modified through various receptors and effectors. This view is justifiable when it comes to explaining the principles of industrial robots, guided missiles, and similar automata, but such likening leaves aside many other no less important applications of ICT.

More wisely would be to understand these complex hard/software system aggregations and networked configurations as a set of "smart tools" or, rather, as a team of highly disciplined, indefatigable, semi-self-governing artificial agents ready to execute strictly

defined tasks. By commanding, controlling, and managing the work of those tools/agents we can increase the sensitivity of our senses; the amount of data, information, and symbolic expressions that can be formally analyzed in split second according to our intuitive decisions made on substantial basis of tacit knowledge; and the efficiency, accuracy and precision of physical manipulations with outer material objects.

Perennial ICT

In my discourse I take the liberty to treat the information and communication technologies as being perennial and inherent to all educational practices and methods, old or new. At the same time I shall discern between their dual manifestations, or counterparts: internal, "natural organic", traditional means versus external "artificially instrumentalized" ones, implying mostly the modern, contemporary, newest and latest brands of ICT proper.

One sentence in already cited passage from Recommendations is especially symptomatic and worth to be repeated in this respect: "Advanced educational methods are best introduced today through the extensive use of computers..." We can rightly deduce that these methods were (and, probably, will be) invented and developed without any direct intervention of digital devices either.

A convincing proof is given also in a book distributed among the participants of the Moscow IITE Seminar [EDUCATIONAL MULTIMEDIA. What teachers need to know to carry through the social construction of information technology. Bent B.Andresen (Ed.), Royal Danish School of Educational Studies, 1999]. An opening paragraph reads: "Pedagogical innovations are a constant theme. Currently, pedagogical innovations are often made possible (i.e. implementable) by the application of educational multimedia into the classrooms". More then one third of a total volume is allocated exclusively to a very dense and concise disclosure of that constant theme [Key Concepts of problem- and project-based Learning: How to practice Student-centered and Self-paced Project Work, by Signe Holm-Larsen]. And what we see there? Throughout the whole chapter the words "photo", "video" and "AV-equipment" were used couple of times in passing; "ICT" — just once (on next to last page as a suitable addition to a school library); the sacramental "computer" and "multimedia" (seems to me) — none. I believe this is very symptomatic.

Walking Multimedia

Among the motives of my present writing is a strong desire and a modest hope to interconnect a bit closer the conceptual strains of the middle and two other parts of the above mentioned book.

A-propos "Multimedia". This term was coined in early sixties to denote the new "synthetic" genre of avant-guard artistic stage performances comprising action-painting, music, declamation, pantomime, slide-projections and dynamic color lights effects. In the seventies it became the trade slang expression applied to the joint enterprises in designing, producing, promoting and marketing a best-selling book bundled with a hit-movie of the same plot accompanied by the film's music soundtrack LP record.

The computer industry have picked up this coinage in mid-eighties to hype-advertise the machine and software configurations able to run alphanumeric, graphic and sound processing sub-routines simultaneously.

As for our particular issue it was Dr.Bengt Bengtson of Sweden, an internationally known proponent of ICT in education, who had been heard saying in 1994: "After all, a teacher is non other than the Walking Multimedia Presentation System!".

From information processing to educational process

Taking into account what was said so far we would do better by draw a bit more clear distinctions between three main topics, or areas of our concern, namely:

- Computer Literacy (CL);
- New Literacy for Information Society (NL), and
- Application of ICT in Educational Process — shortly Educational ICT (EDICT) — to be able to think and talk about each one more productively.

Computer literacy usually implies some competence in collecting, storing, retrieving, and processing information by means of electronic digital devices. It is assumed that computer-literate person has some (though not very deep) understanding of how to operate various types of contemporary ICT for controlling artificial systems and for creating/sending /receiving various types of multi- and/or hypermedia messages. CL constitutes a first step towards New Literacy.

Meanwhile, it doesn't seem that CL *per se* has any lasting educational value. I share Seymour Papert's view that much more important is the (inclusive) notion of technological fluency inseparable in its essence from the learning fluency.

New Literacy implies a competence in exercising basic linguistic, logico-computational and communicative skills allowing a person to extract some knowledge from the information s/he is processing. It includes the acquaintance with definite materials, mental/manual tools, operations and procedures (i.e. both *internalized* and *externalized* technologies), mastered by children at the Primary school. NL enables the schoolchildren to continue and build up their communication and interaction with teacher(s) and experts in all the other subjects, disciplines and fields of knowledge; thus serves as a prime educational lever, or a latch-key to the doors of all consequent stages and realms of organized teaching-and-learning.

EDICT (Application of ICT in Educational Process) implies a competence in using ICT as a cross-curricular set of materials, cognitive tools, procedures, and working environments for performing various teaching and learning activities and functions, including

those aimed at gaining Computer literacy and New Literacy. Only at this stage the *newest* ICT would become a truly indispensable part of N e w (ICT supported and based) Technology of Education, representing, as a matter of fact, the highest level of technological fluency..

Educational Technology and Technological Education

Everybody agree that technology should become a subject obligatory to general education of the twenty first century. Opinions differ on its content and method, often revealing the inner value conflicts and culture clashes. Meanwhile, very strong arguments can be found in favour of making ICT a powerful agent in mediating and reconciling those opposing stands. The mindful usage of some peculiar features of ICT would give us extraordinary effective means to show that a school subject named "technology" may, and therefore must be first of all the technology for educating the pupils and the teachers alike.

Hence, it seems quite reasonable to lay down our EDICT topic as a corner-stone, and the reference frame for the consecutive efforts to design and corroborate IITE tuition program with all its methodological aspects, the changing roles of the teacher, work-shops, teacher training courses, modular curriculum, etc.

It is also justifiable to conceive EDICT from the Primary School level.

However, we should also take into account and respond to the serious doubts expressed by some participants of Moscow Seminar on the prospect of creating "universal" tutorial module compatible with deep cultural differences existing between educational cultures in different regions of the globe.

Because it is obviously beyond my strength to consider education *in toto* I shall concentrate on just one of its three principal domains — technological.

ANCIENT LEGACY AND MODERN TRENDS

Trinity of education

There's a venerable tradition (kept at least from Jan Amos Comenius in the XVII-th century up to Max Scheller in the XX-th) to subdivide the realm of general education (i.e., the entire culture) into three different but overlapped, interconnected, interdependent and interacting domains. This approach in its turn had stemmed from the old tripartite notion of a Human creature as consisted of:

The Body which needs to get food and shelter, physical comfort and fleshy pleasures as well as many other material goods and man-made things available only in (and through) the artificial environment;

The Soul, suffering from solitude and searching for another soul, longing for sympathy and understanding, wanting to give love and be loved in joyful communion with whole Universe;

The Spirit, striving to orient oneself towards the Initial Cause (Prime Mover, Life Source, Perennial Wisdom, Ultimate Truth, and Final Goals of Human's existence which transcends all temporal and spatial boundaries of the Cosmos.

The corresponding educational (i.e. cultural) domains had been designated by various words, more or less synonymous; after summarizing (very roughly) their essential meanings we might call them:

L a b o u r - t e c h n o l o g i c a l (extrapersonal) education, aimed at mastering arts and crafts, logic and mathematics, engineering, natural, social and behavior sciences, and other ways and means of instrumental activities enabling an individual to fulfill his/her needs and desires by efficiently processing, governing and controlling matter, energy and information in a world of objects and "objective" phenomena;

C o m m u n i t i v e (interpersonal) education, aimed at learning the ways and means of subjective-emotional relations and interactions between humans (and, to a degree, non-humans) through ethical and aesthetic teaching, playing the games, dancing, singing and story-telling; ritual and myth, folk-lore and philosophy, poetry and theater, music and fine arts;

S a l v i f i c (transpersonal) education, aimed at catechization and initiations of a neophyte into the creed, mysteries and sacraments of a particular religious confession or an ideological doctrine; helping an individual to pose a question of her/his relations to the Absolute, or just endowing a person with a sense of belonging to something infinitely greater and potent than s/he is.

From schism to convergence

The so much talked about education-&-culture crisis has resulted, to a large extent, from historical schism and ever growing divergence and estrangement of the three above mentioned domains. Since the mid-twentieth century we've been witnessing an ever increasing, nearly exclusive, obviously dangerous and threatening dominance of the technological one. The latter itself, by ironic twist of history, begins to suffer more and more significantly from cutting its vital connections with two other domains.

A time has come for their intentional and voluntary convergence.

We ought to envisage some measures and make (if only on modest local scale, just to show this is possible in principle) some practical steps toward the restoration of their lost balance and creative interconnectedness. This might be achieved by:

(a) re-sensitizing all three domains - making them more perceptive and responsive to the true nature, needs and aspirations of each other;

(b) reminding them of their common origin, and

(c) offering concrete options, ways, and means for their more consorted and reciprocal development.

We, the Technologists, are inviting the educators of Communitive and Salvific domains to collaborate along these lines.

Reassess underrated stature

I believe that with the help of ICT the first (technological) domain of education can gain enough momentum to show the lead in this direction; at least to provide some tentative suggestions concerning the corresponding features of the second and the third. Among other things it prompts us to eliminate (seemingly) impenetrable barriers between them, as well as to reassess the underrated stature of the so called technical vocational education (TVE). An idea is not new indeed.

One and a half century ago Cardinal Newman had said: "the only true vocational education is a liberal education". And Alfred North Whitehead's 1917 Presidential address to the Mathematical Association of England was entitled "Technical Education and Its Relation to Science and Literature". We may take more detailed look at this fascinating document later, now just one short quote:

"The antithesis between a technical and a liberal education is fallacious. There can be no adequate technical education which is not liberal, and no liberal education which is not technical: that is, no education which does not impart both technique and intellectual vision. <...> Geometry and mechanics, followed by workshop practice, gain that reality without which mathematics [as well as all "humanities", or "liberal" disciplines - LP] is verbiage."

In sixty-odd years these prophetic words had been irrefutably proved by the radical shifts in workshop practices co-related to the rocketing market value of such "intangible" entities as the mathematical and logical operations performed in gigantic volumes at enormous speed.

Mindcraft Economy

Nowadays a classical three-fold division of economy into agricultural, manufacturing and service areas needs to be complemented with booming "knowledge sector" — the one comprising the "knowledge workers" and rapidly replacing "handicraft" as the major form of contemporary labour.

In an increasingly "smart" automated environment the "mental work" moves inevitably from just crunching and tossing data to creating sensible amounts of information and knowledge communicated, exchanged and shared with fellow-workers. An ubiquitous computer surrounded by kindred ICT devices has become a main tool for such endevours.

At the same time it becomes clear that in reality the "knowledge work" is not yet another "sector" but a cross-section drive, a main carrier, a cutting edge of all the contemporary economic activities.

Many observers are talking about emerging "mindcraft economy" of the twenty first century — an economy that presupposes among its constituents the incessant learning within elaborate systems combining both individual and/or collective human agents and the intelligent ICT-based machines.

Stern challenge

Taken together all these trends put an unprecedented stern challenge to the established forms and norms of both general and techno-vocational education — its proclaimed mission, aims and goals, organizational schemes, subject-matters, methods and procedures. These have been ever more harshly criticized as utterly inadequate since the inception of the so-called scientific-technological revolution started in mid-'50s with the advent of the first computers and contagious ideas of cybernetics, semiotics, information theory and system engineering.

There's no intention on our side to reiterate any critique or enumerate again already posed problems. We are going to present some thought-provoking ideas, considerations, and conceivable solutions instead, partly successfully tested in practice, partly developed only theoretically so far, but deserving to be discussed as a possible response to the above-mentioned challenge.

DIVISION II. COMMUNITY OF EXPERT PRACTICE

PREVIOUSLY UNTHINKABLE OPTIONS

Hidden potential

Technological component in general education has a great hidden potential which has been blatantly neglected and scarcely tapped so far — mostly due to some time-honored but one-sided assumptions and wide-spread prejudices.

In the name of intellectual justice it would be quite appropriate to ask first if there is substantial ground to single out technical vocational education and regard it as something special which exists apart from, or even in opposition to general education?

We have many reasons to believe that the latest developments in information-&-communication technologies could provide many previously unthinkable options to bring them much closer to each other for the sufficient benefits of both.

Liberal *and* Vocational

There is a millennia-long split, yawning hiatus and flagrant contradiction between two long established modes of institutionalized education: "academic", concerned primarily with translation of *knowledge*, and "vocational", focused on occupational (mostly manual) *skills*.

Now the time has come to reconsider the mutual disposition of these two.

Until recently the first one has been seen as superior, nobler, and much more prestigious. It was proclaimed "liberal", non-utilitarian, and economically disinterested with its sublime fine arts and exact sciences as opposed to a rather "compulsory", overtly utilitarian and economically oriented vocational churning artisans and handicraftsmen.

The latter was not just socio-culturally inferior: it had a bad image of wood chops and welding classes as a result of sinister tradition of "tracking" (i.e. squeeze out) the academically disfavored youth into voc-ed ghettos that were rarely either vocational (because *vocation* means literally *called by God* to some particular *profession* which in turn means *declaration of believing* in, or *loyalty* to something sacred) or educational (because *education* means *leading on* somebody to something better, wider and higher than one's present state of mind).

It's worth watching a bit more closely what lies at the root of this lamentable cleavage and confusion.

How reality is made

Looking to Academic-Vocational asymmetrical dichotomy from methodological point of view we find a great rift in their ways and means of transmitting knowledge. Both expect the pupils to *understand* what they have received but differ profoundly on *the very nature* of presupposed understanding.

Academic education requires understanding based primarily on i n t e r p r e t a t i o n that is fully expressible in words, strictly observing explicit formal rule-following, and using name-object model for mental predicates. The rules in question can be postulated as a set of axiomatic statements (where nouns predominate), or agreed upon as certain convention. It epitomizes itself in a classical lecture form.

Interpretation is something that involves conscious and reflexive intellectual activity.

It is *interpretative understanding* of how the reality is made, how its objects are interconnected and interacting, etc.

How to make the reality

Vocational education requires understanding primarily based on, and expressed in a c t i n g — grasping of a rule that is not pronounced but directly exhibited and followed in the customary way. Spoken words are also used (at times) but only practical actions would give them their meaning.

And this *experiential understanding* is not about reality which is already made and does exist by itself.

It is understanding of h o w t o m a k e r e a l i t y — if only in a tiny part of one's immediate surrounding — through some skillful doing (hence the dominant words — when they appear — are not nouns but verbs).

The only way to obtain corresponding experience at a truly profound level is to become an apprentice to a master and to learn by practice.

Tacit knowledge — could it be articulated?

In these circumstances the rule following can not be taken as an isolated or chance happening. Skills can be adequately and fully grasped only as being practiced, and the knowledge transmitted remains speechless, mute, or — as Ludwig Witgenstein, later Michael Polanyi called it — *tacit* knowledge.

Do we have any means to make this knowledge — if only to some extent — pronounceable and articulated?

All that was said before does not preclude the inquirious academicians from possibility of constructing elaborate theories of abstract models showing how human mind and body work together in acquiring general and/or particular skills. At times it can be of much help in organizing learning environments equipped with material and tools needed for better vocational education — especially if more attention will be paid to some new ICT-generated options available to both academic and vocational camps at the verge of the Third Millennium.

Learning the craft to help personal growth

The fact is that in the mindcraft economy where the great majority of work is knowledge work, the content of the knowledge filed under the umbrella of liberal arts-&-sciences has considerable economic utility. I mean not only explicit and verbalised, but also a tacit knowledge, as well as all those intuitive experiences which every good craftsman, technician and engineer must posses.

Should I add that this is intimately connected with two other educational realms, communitive and salvific? Writes R.E.Ornstein in (now almost classical) *The Psychology of Consciousness*:

Our usual Western concept of "metaphysical" or "spiritual" training involves abstrusive ideas and ritual, including secret initiatory rites and occult symbols. In fact, however, the education of these adepts has been far more concerned with such things as movement in space, visualization, and especially crafts... George Gurdjieff (a famous and very influential "mystic teacher" of the early twentieth century) studied "mundane" activities, craft for the most part, in addition to his breathing exercises and reading. He was taught to weave

carpets, to do calligraphy, to hammer copper, — all activities that we would not normally associate with "mysticism", until we consider that these activities each call on the tacit, intuitive mode.

And, frankly speaking, even if we accept "self-actualisation" as a highest priority among the human needs, this ideal can be honestly attained only after daily bread, basic security and economic independence of an individual is provided by his ability to support himself. Jesus Christ was the carpenter in his earthly life, and St.Paul after his conversion from the academically educated Pharisee [rabbinical scholar] into Apostle had learned the craft of tanning to be free in his evangelic mission.

Mastering even the simplest craft is necessary pre-requisite in nurturing one's growing personality.

To overcome inertia of mechanical past

There are great many principles of effective learning which are well known but not widely applied — mainly due to the traditional inertia of vocational training rooted in its "metallurgical-mechanical" past, and the lack of will to probe the new, immensely rich opportunities offered by the latest ICT now available at the trade market.

As a result the large numbers of younger workers in the industrially advanced nations while given a lot of intensive but narrowly focused training are still receiving insufficient education and fundamental skills — those to enable them effectively to keep learning for the future as the economy shifts and they go through the inevitable changes in the years to come.

For older workers a massive effort to combat functional illiteracy and a work career with precious little learning and building skills is — and will be — even more vital.

Some far-sighted employers has already understood that pre-service human resource development, started as early as possible (preferably in the junior high) is the key to the future adaptation, flexibility, and even survival of the firm.

URGENT IMPERATIVES

Smart people for the smart machines

Three decisive points are indisputably clear now:

a. the main hope of to-morrow's post-industrial mindcraft economy and global society at large is not the smart machines (which are getting smarter every year indeed) but the smart work-force using high-end technologies with even greater competence, that is — having enough capacity for inner growth and means to unlock and exploit its own human intelligence;

b. training and skill enhancement is not an isolated event but a life-long learning process;

c. the adolescent schooling, the adult techno-vocational education and the work proper need to be better joined.

These assertions are valid for the technologically advanced societies and the Third World countries alike. Even the nations striving to go over from ancient to modern agrarian economies must be prepared to ever accelerating pace of serial changes in practically everything their youth ought to learn and master within the individual's working life span. Befriending ICT on the first stages of education would help a lot in coming to terms with what's laying ahead.

Unifying platform of human dimensions

Besides energy and matter, the information *per se* is coming out as a main constituent for the so called "materials", "tools" and "products" of work in literally all areas of contemporary life.

As an obligatory and indispensable part of general education a full-time usage of ICT provides a most suitable unifying platform for teaching and learning all the other technologies, disciplines and subject-matters. In this respect the efficiency of modern ICT is rooted in their unique ability to reflect and represent with utmost clarity the total Technology realm while being the crowning part of the latter.

The human dimensions of ICT would manifest itself in providing powerful means to open dialogue, fruitful interaction, and synergy between teacher and student or, rather, between the Master and his Apprentice, as well as among apprentices themselves — be it in a close contact or at the long distance.

Continuos improvement of performance.

Due to the permanent presence of ICT no one step of material working action in teaching and learning activities is left without audio-visual, graphic, and alphanumeric documentation, as well as without its mental reflection by the pupils, supported by their oral comments, drawings and written reports all recorded and kept electronically.

An instant access to these records would give each student an opportunity to discover that he/she could learn how to use newly acquired conceptual tools and theoretical faculties in order to control and improve his/her own work performance.

The earlier they would begin the better.

Propaedeutics

Consider an overall vision of what we might call a P r o p a e d e u t i c T e c h n o l o g y Courseware for Primary School of Information Era ((ProTech). It should be an appealing invitation to encounter plethora of goal-oriented activities, tools and procedures,

occupational perspectives, work-spaces, types of labour and specific skills they require, — those already existing and (supposedly) will be existing at the time when to-day's kindergartners and first-graders would come of age.

The children shall undoubtedly appreciate ProTech as a brilliant opportunity to deal with something incomparably closer to the realities of adult world (therefore, more emotionally rewarding in terms of granted responsibility and increased self-esteem) than anything else they can find inside an ordinary school.

From the employers' point of view our Pro-Tech vision may be perceived as an earliest pre-service human resource development.

It will be the most challenging and demanding for the teachers because the purpose of any propaedeutics is to implant the seeds of what has to be grown and cultivated further all through the period of systematic schooling. Embryonically ProTech contains some essential features of both content and methodology of general education in its entirety.

The only true education

We intend to raise and foster not only the work-force for the mindcraft economy, but the responsive and responsible members of the world community, who could envisage, conceive, design, construct and re-construct things and events first in their imagination, then in external modeling, and, finally, in real life practice.

Our aims goes far beyond the specialized training of craftsmen or factory workers. The only true education is the one where all arts, crafts, sciences, and technologies comprise an interactive network to facilitate mutual cognitive development, productive creativity, and personal growth of pupils. Needles to say that such ambitious scheme has no chance to be even conceived outside all pervading New Literacy. And even if brilliantly designed it could not see the light of the day unless being ICT supported and co-ordinated from bottom to top and from top to bottom, as well as staffed with teachers willing to face ill-defined problems and to be engaged in learning which has no end.

The question is where to find an educational framework capable to carry on a project of such proportions.

APPRENTICESHIP REHABILITATED

The key to high order skills

As Lewis J.Perelman had pointed out emphaticly in 1992, and Jules M.Pieters stressed two years later in relation to the ICT-based teacher development, the scientists who study learning increasingly recognize that apprenticeship is a powerful way of organizing learning-in-context for any purpose. In medieval times the craftsmen guilds which had institutionalized such practice were very prominent as vocational-training system. Young men acquired professional skills by interacting with real materials and tools used by masters of high expertise. The apprentices gradually became experts themselves through a process in which the control of the masters faded.

An advent of industrial revolution eventually had put an end to the very existence of guilds as the main productive/educational organizations, and at the verge of twentieth century the institute of apprenticeship seemingly disappeared from view. However, these days situation begins to change rather significantly. For example, it was realized that scientific research training (as was shown by the recent history of great schools in physics and biology) is a kind of apprenticeship, with the experienced researcher as a master. In contrast to the traditional view of academic learning as different from or even superior to vocational learning, educationists now speak of the "cognitive apprenticeship" as the key to acquiring high order thinking skills that, in turn, are increasingly needed for working and living in the knowledge age. So any kind of learning that aims to be relevant to the real world can benefit from the following characteristics that Jean Lave, Brigitte Jordan, A.Collins and other researchers have observed in traditional apprenticeships as opposed to academic teaching.

Focus on doing instead of just talking

Apprenticeship learning focuses on doing rather than just talking. Learning is provided by the master who teaches the novice learner by introducing him experiences and ideas in an environment that was almost (sometimes entirely) identical to the real context of performing the job.

Apprenticeship is concerned with the *ability to do* rather than the *ability to talk about doing something*. The apprenticing process arranges opportunities for *practice,* whereas school curricula — where the focus is typically on verbal and abstract information — tend to be a specification *of practice.*

Apprenticeship learning comes through the practice of skills. The master is less likely to talk than to guide by modeling, assigning tasks, overseeing, and critiquing. Indeed, it may be quite difficult to get craft masters and apprentices to articulate what it is they know how to do.

The division between academics and apprentices goes back to the classical age of ancient Greece, when the liberal arts curriculum was originally designed as vocational education for politics. The first and foremost goal of such instruction was apprenticeship in the skills of *rhetoric,* in preparation for the craft of political argumentation. So in early academia the ability to do and the ability to talk about were the same thing. But with the vast expansion of the academic institutions since the early XIX-th century, rhetoric as an *end* became mistaken for a *means* of teaching. As a result, the rhetoric methods of academic vocationalism have been increasingly misapplied to a whole range of nonpolitical crafts and skills which, to be learned effectively, need doing and talking about to be separated.

A way of life

Apprenticeship is a way of life. Apprenticeship happens in the course of daily life. In fact, apprentices seldom sense any separations between activities of daily living and learning "professional" skills. Rather, the apprentice is exposed to a certain environment, is socially engaged with the community that shares some common interest, participates in sets of activities, handles (plays with) certain tools, and is trained in the sphere of specialist work the same way a child is in the home environment.

Work is the driving force

Masters and apprentices engage in activities that are driven by the requirements of work to be accomplished: pots must be fired, a shawl woven, trousers manufactured. Whatever teaching or learning may happen is coincidental to the overriding concern of the work to be done. Consequently, the apprentice values progressive mastery of tasks not so much as a step toward a distant, symbolic goal (like a diploma), but for its immediate benefit. Apprentices are not practicing for the real thing — they are doing it.

Acquiring skills in a meaningful order

Apprentices acquire skills in a meaningful order. While on the surface apprenticeship may seem to impose a "walk before run" orderliness, in effective apprenticing the order derives from the organic structure of the work and its real context, rather than from an artificial model of cognitive difficulty. Apprentices commonly are directed to start with skills that are relatively easy, where mistakes are least costly.

For example, young tailor apprentices, rather than constructing a garment from start to finish, first experiment with parts of the production process that are least costly in terms of wasted materials, like sewing garments from pieces someone else has cut. Working from the "sidelines" of a complex task toward its center stands in contrast to the ways that knowledge is usually transferred in formal schooling. In formal classroom, things are usually learned in chronological or some other arbitrary order divorced from learning in context.

The components are treated as equally important, and it is assumed that they must be acquired in a linear way — one after another. But apprentices acquire skills in bunches or bundles that fit together to solve a practical problem. Much of the learning is "just in time" — immediately connected to a problem that has to be solved now for the work to proceed.

Evaluations embedded in the work environment

Performance and competence evaluations are implicit, embedded in the work environment. For an apprentice, expert execution of a task is obvious and easily observable — in the master's performance. Judgment about the apprentice's competence is likewise obvious and needs no commentary: it emerges naturally and continuously as work is accomplished, rather than occurring as a specially marked event, like a test. In fact, to a great extent, the person who judges the apprentice's performance *is* the apprentice. Having observed the work sequence many times, the apprentice knows what remains to be learned. Moving on to acquire the next skill is largely up to the apprentice, rather then under master's control. Apprenticeship is inherently individualized. The master promotes and assigns apprentices as their talents and limitations are demonstrated in practice.

Teachers and teaching are largely invisible

In apprenticeship learning — as well as informal on-the-job training in modern workplaces — it may look as if very little teaching is occurring. Whatever instruction the apprentice receives originates not from a "teacher" who is doing teaching but from another worker doing his or her work, which the apprentice observes.

In apprenticeship learning, the apprentice is being induced into a community of expert practice. The community is not limited to the local "studio" but extends across space and time, joined by a variety of professional associations and by formal history and informal folklore of the craft. Apprenticeship learning illustrates the distinction between doing and waiting it out, between an active and passive environment.

All learn from each other

Moreover, contrary to what may appear at first glance as an orthodox ritual, apprenticeship learning is neither static nor simply concerned with the one-way transmission of tried-and-true practices from masters to novices. In effective apprenticeship there is a healthy, dynamic friction between preservation and renovation of expertise. "Change is a fundamental property of communities-of-practice and their activities," Jean Lave and Etienne Wenger observe. And they note that "inexperience" is an asset to be exploited," not just a vacuum to be filled. Precocious and irreverent apprentices challenge and inspire masters as well as follow them. Members of community of practice all learn from each other.

Apprentice learning is becoming such an inherent feature of the mindcraft economy that in many cases more formal programs may be considered as optional and not obligatory

With expertise ever more embedded in networks and smart tools, rather than personal "masters", the features of apprentice learning are becoming almost universal in the HyperLearning environment. Many apprenticing now is going on almost invisibly through the use of expert systems like CAMS. Magic etc., through simulation and embedded training systems, and through collaborative relationship forged through communication network utilities such as electronic mail, Bulletin Board Systems, groupware, Personal Pages, Virtual Commons, and other World Wide Web facilities.

If seems that similar approach might be the most appropriate strategy for that still fuzzy enterprise of teaching the teachers.

DIVISION III. CONCEIVING VIRTUAL WORKSHOP

TO TEACH A TEACHER

Finding the Genuine Master

What is the best way to teach a teacher-novice to use ICT efficiently for educational purposes?

Obviously not by compelling her/him to read text-books and attend (or watch on TV) the lectures of eminent academics (pedagogical theoreticians, researchers, and methodologists) .

Much better are (both in- and out-of-service) training seminars and workshops conducted by those peculiarly knowledgeable and skillful though rather mysterious and still rare specialists — "teachers of teachers".

A (nearly) perfect solution is to find the Genuine Master-Teacher who not only knows how to use ICT in education, but is actually doing it daily in Primary School by running the *Generic Workshop* there, and who is ready to take a teacher-novice as an apprentice.

Teacher's masteries

I borrow the term (and notion) of Master Teacher from the UNESCO Recommendations on Informatics for Primary Education. Here's two excerpts to remind you the what we're talking about.

> "The master teacher is the one capable not only of instructing but also of constructing as a role model for his/her students. The master teacher continually looks for ways to construct something that is interesting and appealing to the pupils, something that might provoke and inspire them to attempt to construct it, or something similar, by themselves, in the hope of reaching the mastery and artistry of the teacher (and, perhaps challenge him/her in the future).
>
> The themes and topics may be as diverse as assembling and operating model cars and toy trains, building and decorating puppet homes, writing and printing prose and poetry via a word-processor and desktop-publishing, turning out pop tunes with a synthesizer, drawing simple animated cartoons, or cracking the codes of mediocre computer games in order to make them more challenging to play.
>
> The main issue of this construction should be, of course, the acquisition of knowledge and skills required by the curriculum plus the experience of being in the control of one's own process of collaborative teaching and learning. <...>
>
> The master teacher should be capable not only of instructing but also of constructing right in front of the class. Hence, to make wise choices and productive use of computers and other things technological, a teacher must be literate, fluent, and comfortable not only with ICT but with the new technology of education.
>
> The authority of a teacher can be re-established on the basis that s/he possesses three densely interconnected kinds of mastery:
>
> •Mastery of Doing – can do a lot, but not everything, and can do more in cooperation with students and humanity;
>
> •Mastery of Learning – is not the only source of information but can teach how to find alternative sources;
>
> •Mastery of Cooperation – can multiply results by joint work with students and other teachers.
>
> The primary school teacher is a key figure in the process of the introduction of ICT into schools. As was previously said, the advent of ICT brought many changes to the status and functional role of the teacher. The contemporary teacher does not know all the answers, neither is s/he a person who formulates all problems and ways to solve them. However, s/he is increasingly assuming the important roles of adviser and learning facilitator, and becoming a master teacher who can attract children by skillfully doing something interesting for them and helping them to do such things as well."

It's worth noting that the word *mastery* has double connotation of *power* to control the one's surrounding and the *wisdom* to use it appropriately. Mastery may be thought of as biological/evolutionary in its origins, but the use of crude tools and the invention of language changed the vehicle of mastery from natural selection to cultural/historical, i.e. technological development. In ancient times mastery was inseparable from the sacred prototecnologies (especially healing and metalworking) of shamanism and liturgical ceremonies, practiced by the truly wise men and women — masters in spiritual traditions. Unfortunately, as technological capabilities increased, this wisdom aspect of mastery weakened, and finally was forced out by purely economic or military considerations. Contemporary Master-Teachers are called to restore the dual meaning of mastery in its completeness.

Ideal model

Let's assume that we have found such Master — an embodiment of "smart skills" — whose practice exemplifies an ideal model of everything we could dream about.

He is both brilliant innovative educator and ICT wizard, having all kinds of modern hardware and software at his own and his pupils' disposal.

He is tracking (through local and telecommunication networks) the latest trends in general pedagogy while co-operating with fellow-teachers of various specialised disciplines on concrete joint learning projects as well as teaming with hi-tech industry scientists and engineers to form sort of action research collaboratives.

Inside his Generic Workshop he gathers a team of pupils-apprentices of different age-groups: senior apprentices, endowed to some degree with Master's authority, are helping him to co-ordinate, direct and consult the work of junior ones.

Each pupil performs his assignments and tasks in fully computerized and personally customized working-and-learning environment allowing him to progress at individualized pace; he can address, communicate and interact with the Master, the apprentices, and the fellow pupils via local network.

Double trouble

A teacher-novice could also be given access to that network first as observer, then as active participant starting in the role of junior pupil and ending in the rank of senior apprentice and Master's assistant. So far so good, the advantages of the education by apprenticeship are well known (see **APPRENTICESHIP REHABILITATED** chapter), but let's look now on its institutional limitations.

The double trouble is that the Genuine Master-Teachers in this world are scarce, and even the most benevolent and magnanimous ones are incapable to keep more than two or three (rarely 5-7) apprentices at a time. (Just think of outstanding clinical surgeon; a leading scientist engaged in a large research project; an ex-champion coach of a prize-winning football team; a famous symphony conductor or theatrical director, etc.)

The only hope to train millions of teachers in apprentice-like fashion is to rely on ICT exploited to its utmost.

Master-Teacher observed

In the first instance we could (if only theoretically) attach numerous video-cameras and other sensors to the genuine workshops of several Genuine Master-Teachers followed by diligent pupils/apprentices in order to register electronically (almost) everything related to their joint teaching/learning activities.

After collecting sufficient amount of such material we could select, edit, and deliver it via multimedia CD-ROMs, DVDs, and WWW to any number of teachers-novices applying for apprenticeship. Everyone of them would undoubtedly get a lot of the first-rate information (and some knowledge) of how each Master Teacher is using ICT in education. In a certain sense the novice would enjoy even more privileged positions than genuine apprentice due to a technical ability to watch any particular event over and over again, in "real", "compressed", "expanded", or even "reversed" tempo; shot from various angles, optically magnified to minutest details, etc.

The sad fact is that our novice-applicant would get no *experience of being accepted and treated* as the Master's apprentice. Watching this Multimedia (Observing Only) Excursion s/he would inevitably remain a passive spectator of, not an active participant in the on-going teaching-&-learning events. And it's simply couldn't be otherwise because this genre of Observing Only software makes no provision for any interaction between Apprentice and Master. We have

Let's consider some ideas on how to provide such interaction, first in principle, then (even if to a small extent) in practice of computer-generated virtual reality.

Virtual reality in learning environment

Back in the early nineties David Zeltzer, then Moshel and Hughes had described three attributes of virtual reality which are especially important for those who are going to use a computerized learning environment.

•Presence — a sense of believe in one's real existence in the simulation.

•Interaction — the ability to change features of the simulated world in a consistent, natural, and organic fashion.

•Autonomy — the objects presented have inherent behaviors and can be trusted to automatically exhibit them when simulated. In other words, if the virtual universe will "play its part", the user's mind is freed to do creative work of designing and constructing his/her own projects.

A situation gets aggravated when a student moves from the solitary activity in the closed virtual micro-world to the networked Cyberspace of global scale. For example, there are collaborative games providing lessons about building complex worlds with hundreds and thousands of players. It was found that in similar situations no amount of central planning on the part of teachers will suffice. Any major efforts involving the "top-down' design of virtual worlds may be counterproductive. It is better to populate a roughly pre-fabricated environment with users, to observe their needs, to provide them with tools as required, and then let them build the world(s) they want.

Master Teacher simulated

Suppose a group of Master-Teachers and computer-scientists have created The Virtual Workshop for Teacher Training — an educational course(soft/hard)ware which allows the novice not only see and hear, but "encounter" the (virtual) Master and "interact" with him productively in a learning-collaborative mode. (I feel badly ashamed but it's a sheer typing convenience and not a male chauvinism that makes me cling again to a reprehensible old habit of applying masculine pronoun to all teachers, pupils, students, masters, and apprentices.)

Appearing on screen v-Master leads an *experiential excursion* through the v-Workshop showing and explaining various working activities, every time prompting the Novice to take part in each of these by assigning him simple tasks, and evaluating the output.

Each task demands that the Novice should do something with some materials, tools and environments visible on the screen (and to some extent given to him as a Laboratory-&-Construction Kit — a set of tangible three-dimensional manipulatives) to produce desired effects, or achieve assigned results, rather then responding with the right (or wrong) answer picked from the offered list.

The multiple choice options are reserved for opposite purpose: the Novice can ask the v-Master to answer a wide range of pre-compiled questions related to the specifics of a particular task and/or to other features of what's going-on in a Workshop. Master's responses may be given in a form of direct demonstration of some way of action, an additional assignment aimed at acquisition of some peculiar skill; a graphical description of a tool or process; a reference to some external source of information stored at the same CD-ROM or accessible through the Internet.

All this characterizes the apprenticeship style of teaching-&-learning where one is gaining knowledgeable experience by watching, imitating, practicing, and having conversations and discussions with the Master (if only virtual).

Let's imagine tutorial expert system conceived and built after the long-time creative experience of the true master-teacher.

TUTORIAL EXPERT SYSTEM

Three connected sub-systems

The principle (but evidently not the practical designing and building!) of an expert system is simple, consisting of three connected sub-systems:

1. A knowledge base, comprising facts, assumptions, beliefs, heuristics ("expertise"), and methods of dealing with date base to achieve desired results, such as diagnosis or an interpretation or an effectual solution to a particular problem.
2. A data-base, a collection of data about objects and events on which the knowledge base will work to achieve desired results.
3. An inference engine, which permits inferences to be drawn from the interaction between the knowledge and data bases.

When user presents his problem by means of picking corresponding entries in the pre-formulated list of questions the system evokes data from the questioner, and eventually offers advice toward the solution. It can be questioned in natural human language (typed texts) or visual iconic images and system's responses can be given either in verbal or pictorial, even animated forms, which makes it fine instructional and tutorial device for novices.

In our case the knowledge base will comprise the description of the multitude of problems that the teacher used to face and solve more or less successfully in his practice with the tools and procedures at hand; whereas the data base will comprise the description of the multitude of possible concrete situations (including human characters) in which those problems could arise.

Functional types

There are at least three functional types of expert systems (the order of listing is roughly corresponds of their structural complexity):

1. to assist a specialist who is seeking to have the decision process checked in the interests of accuracy and consistency. All advisory systems fall into this category: e.g. medical (on the operation of a clinic, the analysis of X-rays, etc.) legal (consulting on complicated cases in civic or financial law), or construction engineering (building materials, safety requirements, environmental norms).
2. to be used by the person with limited or non-existent knowledge in the domain but who needs information and advice while doing his/her routine job; e.g. working on a factory production lines, fault-finding in complex equipment etc.
3. designed for the people wanting to learn how to operate skillfully some new tool, device or apparatus in order to get some particular results; the ultimate case is an expert system for the trainers, or teachers of such operators.

The last type is potentially the most complex one because there may be several levels of knowledge which must be interrelated and the system must provide a very flexible user interface to cater for various styles of learning (e.g. verbal linguistic, logical symbolic, spatial visual, or bodily kinesthetic dependent).

The hottest issues

The development of expert systems in education immediately brings to mind the ethical considerations implicit in relaying on machine decisions in a highly personal and at times emotional situations. The machine should be used to advise and prompt decisions, and, because it can do this more rapidly and consistently, there should be a benefit to both the teacher and the pupils. If the system is well designed then those matters of ethics and responsibility have been taken into account implicitly. As _Seymour Papert has put it in mid-'90s, "*A principal connection between the computer and the moral development comes via computer's ability to provide a context in which knowledge is seen as having the understandable purpose and meaning, thus removing the need to lie about it."*

Lying to pupils (especially children) is the worst mortal sin of a teacher, indeed. It worth noting that nobody else but Papert had laid the (one is tempted to say, *moral*) foundation of such educational usage of computer twenty years ago when he showed with his Logo Turtle that the computer microworld can given concrete form to previously abstract ideas, allowing the pupil to experiment with the former, to explore alternatives to established orthodoxy, and explain them to others.

Similar philosophy was followed later by J.Briggs, R.Ennals, and others developers of expert systems tools for naive users. The hottest points are to support different styles of thinking and learning with a simple menu-driven interface, and to demonstrate initial examples drawn from the educational practice of pupils and teachers alike. No less important is to address issues of cultural differences and social disadvantage aided by mediating representations of problems, made available at little or no cost to those whose access to power and technology has traditionally been restricted.

Web of human connections

A search for adequate metaphors should become one of the top priorities. The use of aural, visual and tactile representations is very promising but all such metaphors should have the same meaning to all participants of the teaching and learning process. And you can't overemphasize the point that all the powerful ideas implicit to such metaphors can be fully expressed and exploited only in a dialogous interaction and free exchange of direct face-to-face experience. Among other things it brings us to the conclusion that our projected tutorial expert system must not to be confined to the closed microworld(s) — we need to keep it open and made accessible to all the others similar systems through the web of inter-human connections. Some brief considerations shall be given later in a chapter on Cyberspace Support Systems.

In the meantime I'm not in the position to plunge further into any technicalities of the supposed Virtual Workshop. It's necessary to take a glance beforehand on what the Genuine Master Teachers are doing daily in their Genuine Workshops irrespective to training any teachers-novices. Let's imagine the (composite) exemplar, or Generic Primary School Workshop run by the (composite) Genuine Master-Teacher, and have laid it down as a bedrock and a home-base for The Teacher Training Virtual Workshop we are intending to design.

PART II. GENERIC WORKSHOP. FACETS

APPROACHING NEW LITERACY

Dual purpose

Beyond its immediate duties (delivering required primary education to the children attending compulsory school) the Generic Workshop is pursuing the goals of researching, designing and practically testing advanced educational technologies. This dual purpose may be considered a norm for any paedogogical institution of Information Society.

Everything (every bit of knowledge, skills and experience) that should be taught and learned in ordinary Primary School is being introduced and represented in Generic Workshop as some form of productive instrumental activity practiced by the Master and his apprentices. The same is true for the output of their research and design efforts.

Needless to repeat that all kinds of activities in question — whatsoever their material specificity — are, by definition, information loaded and communication intensive. However they could be initially performed without any interventions of computers and other brand-new hi-end ICT. The latter (for the sake of didactics) will be introduced in due time gradually to support, enhance, and develop what had been done and achieved firstly with, figuratively speaking, bare hands and quite primitive materials and external tools. (Saying "primitive" here and further in this context I mean rather primeval, fundamental, genuine and generic, "closer to the original source", than being somehow simplified, abridged, derivative and superficial.)

Here is a possible scenario for initial development of writing, thinking and communicative abilities. This might be justly called Zero Package of our Propaedeutic Technology Courseware (ProTec).

The Trail of Culture Hero

When the yesterday's pre-schoolers (still pre-literate), enter Generic Workshop they are told by the Master that he has a mission to conceive a Propaedeutic Technology Courseware for the Primary School of Information Era. An amount of work is enormous and he needs helpers whom he's hoping to find among the newcomers. Anyone can contribute to this long-term project and they could start it right away.

The Master would tell the kids a thrilling myth of Culture Hero — a Great Teacher-Inventor (e.g. Prometheus, Krishna, or some other) who had taught the humans how make a decent living on Earth — and enact the plot in a puppet show (functioning simultaneously as a narrator and a puppeteer). When everybody gets excited the Master would stop and offer the audience to join him in doing it together.

The chidden would start studying assigned roles and manufacturing puppets and props out of clay, wood, cardboard and other materials at hand. After finishing these tasks and rehearsing the play under the guidance of the Master they would perform it joyfully to their own delight and, no less important, to entertain some guest-spectators. The kids always try to do their best whenever there's an opportunity to demonstrate the resulting achievements to some other people.

Authoring the first book

Now the Master informs the kids that their successful performance could be saved for posterity in a form of a book similar to those already written about famous heroes. They may author it by themselves. Even pre-literate ones are capable to convey the overall sense of the story-play by drawing a sequence as well as Gestahlt representation of scenic events. First-graders would eagerly produce such sort of a comic-strips and/or iconic maps resulting in nothing but pictorial texts they are always glad to supplement with oral comments and sonic effects.

At the peak of the joint excitement the pupils are requested to write down a name of the hero, and later to add a word or two describing some of his peculiar features, dramatic actions and characteristic states by using letters that the Master demonstrates them while pronouncing the corresponding sounds.

Nomination

Giving names is really fascinating; it is by its very nature congeneric to the elementary act of cognition through discovery, as well as to gaining control over what has been nominated. During the process of nomination the letters are not necessarily should be "written" in calligraphy; they might as well we handled as pre-fabricated units and just posted beside, above, or underneath the drawn image(s). Conformably the children are encouraged to "read" their (couldn't we say *para-multimedial* and *proto-hyper*?) texts in both sequential and non-linear "omnidirectional" manner, thus receiving a necessary propaedeutics for mastering New Literacy.

As soon as the kids start having it done the writing ceases to be something non-situational and isolated "thing in itself", taught compulsory and out of context (the much lamented plague of so many elementary grammar classes).

From this moment on the writing (combined with pictorial components) does become a story telling, a re-enacting the plot of a play, a thought made visible, and a communication of created meaning to the others — a bunch of activities already familiar and pleasant for all children. The itch for reading aloud of what has been written amidst this enthusiastic exchange occurs immediately, providing powerful motivation to continue this joint joyful learning by doing.

Prewrighting, Writing, Postwriting

After a while the Master tells the kids they can use the newly acquired writing ability to compose a more detailed story of Hero's adventures. The best way of doing this is to sub-divide the work into three distinctive but interrelated phases: prewriting, writing, and postwriting.

Prewriting includes deciding the subject of the composition: brainstorming on one or several subjects, reminiscing and selecting the most impressive of Hero's deeds; gathering and organizing thoughts about how the writing is to be structured.

Writing is the creation and the "on-line" reading and editing of a text just arising, and after it is done it can be improved during postwriting.

Postwriting comprises checking the spelling, correcting the syntax, revisioning and changing the word sequences as well as doing any other editorial and publishing work down to physical manufacturing the book with stitching, sizing and binding. Children write better when they have real audience for their compositions and the Master would offer them convenient channels and mechanisms to reach the wider circles of reading public.

Diaries and portfolios

An absolutely prerequisite for a solid success and sustainable progress in mastering writing and learning (as well as any discipline and subject-matter) is keeping chronicles (diaries) of every relevant event of teaching and learning practice, and portfolios of texts, drawings and other artifacts produced by the pupils in the course of their workshop practices.

The diaries and portfolios — as encompassing and detailed as practicable — are being kept by both Master and the pupils.

I'm intentionally passing over almost everything that might be (and already had been) said about the beneficial usage of ICT in relation to this case. The gains and benefits are numerous: from pictogram- and letter-processing to making hard copies while producing collaborative animated multimedial presentation via the networked authorware in between to enlight a burden of auxiliary physical efforts, stimulate creative impulses, and individualise learning.

Because the implementation of all innovative paedagogical proposals is always restrained by the lack of time the crucial advantage here is the possibility to spare a great amount of time which should have been spent otherwise on various repetitive, monotonous, boring and labour-consuming routine operations.

The fact of extraordinary relevance for us now is that ICT would allow Master and his pupils to achieve their particular educational objectives within the limits of standard school schedule, or even faster.

However, an introduction to New Literacy can be done in computerless environment as well. I dare say that even ABC of computer science (or "literacy") could be taught and learned not only theoretically on pen-&-paper basis but (to a degree) in a truly experiential hands-on fashion (see Chapter ...)

Archetypal pattern

The recursive three-partite pattern of the composition process described above is on no account confines to a fiction literature. It is archetypal for all kinds of activities related to design and implementation of any project — be it erecting a skyscraper, establishing a bank, or writing and debugging a computer's program. Above all it is one of the most powerful conceptual tool for a truly efficient perception, thinking, cognition, and learning. By its very essence — especially within our Generic Workshop — it implies discovering, inventing and creating meaning which can be expressed, presented and embodied in fleeting spoken words, in corporal movements, gestures, and postures; in graphic symbols, in hand-made article, or in heavy-duty mechanical contraption.

While acquiring basic writing, reading, and communication skills the kids are getting accustomed with various ways and means of getting, transferring, and using information and knowledge needed to achieve concrete goals set by the Master. His mission, let us not forget, is to conceive ProTec (Propaedeutic Technology Course for the Primary School of Information Era) called to compensate the very well known weaknesses and shortcomings of "standard" curriculum.

PRODUCING TO LEARN

Neglected subjects

There are two disciplines, or subjects that dwell at the opposite ends of Primary curriculum, being the most desolate and neglected step-sons (or step-daughters) of today's compulsory education.

One is so called "manual work", "handicraft", "labor practice", "training dextral skills" etc.; the other — "fine arts", "aesthetic fostering", "development of good taste", etc.

For a layman-outsider and the majority of parents, even for the colleagues schoolteachers of other subjects, both disciplines look equally vague and fuzzy, though clouded by very different sentiments.

The first is seen as down to earth, raw and rough, loaded with hard muscular efforts, dealing with heavy-duty hardware and making one's hands dirty.

The second is perceived as sublime, purified, spiritual, non-material, aloof from the realities of daily life.

Paradoxically these two opposites meet, — not only in lacking serious attention to their utterly unsatisfactory state and shaky position within the curriculum, but also on a more profound and fertile ground, which gives us a hope to improve their lot by way of collaboration and mutual support.

Strategic questioning

Let's consider some strategic questions.

• How to deal with "labour" and "aesthetics" in order to increase:

a. their cognitive, productive and cultural significance;

b. a quality of teaching;

c. a social prestige and intellectual/emotional appeal of those subjects to the schoolchildren?

• How to join and connect these kinds of "material" and "spiritual" activity, so diverse, remote, and seemingly antagonistic?

• How to turn "labour" and "aesthetics" into the corner stones of the advanced education based upon the new information technology?

To run a few steps ahead let me say that the very neighboring of these two notions — *information* and *technology* — presupposes the third, synthetic, or integrative path leading toward our ambitious goal. But right now there comes the next bunch of questions of more concrete kind.

• How to arrange a marriage of an informatics, where you manipulate digits and logical symbols, and a "labour", where one deals with solid bodies and their mechanical motion and transformation?

•How to match informatics and "aesthetics", when the latter is so densely intertwined with the art and based predominantly on tacit knowledge and intuition, thus defying any qualitative measurements, operational description, and formalized representation?

•How to make those children, who have already deeply biased against algebra, geometry, and physics, not to be afraid of that new mysterious thing called informatics? And how to convince them that this very subject could help them to overcome their deadly fears of math and science?

Rig up common platform

At this point we inevitably stumbles upon the famous Snow-Lewis Controversy, which brings to a forefront the great historical schism of "two cultures" — scientific-technological and humanistic.

Apropos, the similar, though not so explicit and much talked about chiatus is also lurking among the natural sciences and the technology. Contrary to popular beliefs, these must not be taken as substantially one and the same because there are peculiar differences in their initial intentions and approaches toward the outer reality.

How to interconnect these two — or even three — within the Primary curriculum?

The list of questions seems endless so it's better to take the bull by the horns and ask ourselves once again: is it conceivable, if only potentially, to design a Propaedeutic technology course (ProTec) with a special purpose to bring closer, to reconcile, and to resolve these contradictions and collisions? Is it possible to build bridges across dividing rifts, to insert coupling links, to rig up common platform(s), to establish new channels of communication, to encourage productive exchange, dialog and synergy?

O*pen* course

A very old term *synergy*, which literally means *collaboration*, and requires communication in its utmost, is the key-word for us because it is labor that laid both material and spiritual foundation of our project.

Needles to say, we do not confine the notion of labour to the rough menial tasks; it is a category that encompasses all kinds of activities aimed at producing of something that have a definite shape, a structure, the functional characteristics, and may (sometimes even demands) to be evaluated by the judgment of a good taste.

Meanwhile, in an educational context even the simplest handy-work is considered worthy of theoretical reflection supported by the most sophisticated system of conceptual and instrumental representation. This is where the informatics enters the scene because it is a technology *par excellence,* a universal technology which enables us to approach the realm of labour both from its *hard* and the *soft* sides either simultaneously, or moving back and forth smoothly between them.

By the same token ProTec will not, and must not be seen as anything that we have to design in its entirety up to the minutest details before putting it into implementation. It is essentially *open course* and an idea of CAD-CAM — a continuous design-while-manufacturing — seems more appropriate metaphor, though in our case we should complement it with a continuous Research-&-Development.

Cellular multi-valent packages

To corroborate this metaphor let us say that each of our "end-product" would appear as some multi-valent "package" of teaching-&-learning events, or holistic units. Being compressed tightly inside the package those units would allow the wide variety of internal re-groupings and re-configurations of their outer connections. Depending on the circumstances each package could be "unpacked" and interconnected with other packages in many different ways. Hence various content units could be given to each pupil in many different fashions according to his individual cognitive profile and learning situation. The credits for this advantages must go first of all to the very nature and formative principles of ICT.

In other words, the course would emerge as a cellular network; its instant structure results from its past history, planned future, and general dynamics of interconnections between packages which is governed, to a degree, by the Master. That is, the design, research and development, as well as implementation and modernization of ProTec will go on in parallel with its assimilation by the pupils and by the whole educational community.

Planting seeds

Now I'm going to sketch very briefly a few propaedeutical "packages" as they might be presented to the elementary school-children on their first encounter with ProTec. The purpose of Propaedeutics is to implant the seeds of what has to be grown and cultivated further all through the period of systematic teaching and learning; therefore, it contains the essential features of our project as a whole. So let's enter the our make-belief (yet) Generic Workshop and see what happens, when M a s t e r Teacher and his/her pupils-apprentices could do after "unpacking" the contents in question. May be it's worth saying that in all four packages the educational events are centered around dealing with the simplest material available — the clay.

COSMISIZING CHAOS BAREHANDED

Palpable metaphor

P a c k a g e O n e . The Master invites the pupils to make with their bare hands out of moisten clay some simple things they like: "flat cakes", "sausages", or small balls. By doing this the kids would give habitual shapes to the amorphous material while the Master would help them to assimilate the first intuitive notions of creations, destruction and transformation of recognizable patterns. This is a tangible, verily palpable metaphor of cosmisizing the chaos.

Everything they do is video-recorded digitally and can be projected onto big screen both on- and off-line to be replayed, freeze-framed, zoomed, compared with previous frames, de- and re-constructed in order of being closely watched, analysed, evaluated and discussed.

Then goes a making crude decorative figurines and small "useful" things: toy-models of jugs, caps, pots, and other "organic" (as opposed to "geometric) forms. Only after they would have made a number of such objects the Master would display the exemplary prototypes and ask the pupils to compare former with the latter — directly and by using ICT representations for precise juxtaposition — and tell him what constitute the difference.

Experiential notions out of skillful actions

One of the most important steps in developing capacity for conceptual reflection and critical evaluation in the process of shaping the clay is the visual-tactile presentation and nomination — first verbal, then written and ICT-supported — of the *convex* and *concave*, and *outer* and *inner* respectively.

Keeping the same ICT environment the Master would show — and the pupils would imitate — the actions for continuous, or "analogous" patter-formation of a piece of clay. Its volume and integrity is retained in all the transformations of its shape — the kids will recollect this intuition years later when time is come to study the topology.

Then the pupils would sculpt by varying the volume and breaching the integrity of material in two ways: removing the redundant and adding what is lacked.

Consecutive cutting the volume into the ever smaller parts would help to bring forth the idea of atomicity.

Making the figurine "on the empty place" by joining together many small pieces of material taken from some other place would give the notion of the constructivity.

A visual-tactile comparison of two approaches for the shape-making out of a piece of material — with and without retaining of its integrity — would give the experiential notion of continuous and discrete.

A closing event of the first package is a "production" of identical three-dimensional shapes by pressing the wet clay with a mould, or matrix, as the kindergartners like to do in their sand-boxed playgrounds. This gives the pupils a concept of an artificial tool detached from organical human gesture and serving as its morphological substitute and mechanical extension. Or, to be more precise, as an external carrier of a particular program for semi-automated pattern-formation.

Earth, Water, Fire and Time

P a c k a g e t w o . After having formed a desired shape of an object made out of wet clay, the pupils under the supervision of the Master would give it a thermal treatment, or baking, resulting in molecular transformation of a material. This is the most ancient (prior to potter's wheel) technology of ceramics. And the next step on the path *from myrhos to logos* — acquiring conscious power over *elementa* and their formations.

It's easy to introduce the basic notions of temporal relations by using the hour-glass, then mechanical clock; as well as to get accustomed with pyrometer and thermometer in controlling and managing the corresponding procedures.

Every stage of this process, including the measurements of temperature and duration, then checking and testing the mechanical properties of an end product, is captured by the kids using digital cameras and sensors. All data collected will be analyzed and finally presented as multimedia progress report.

The content of the first two packages presupposes the *syncretic* activity, not yet divided into the realms of "technics", "science", and "art". Both packages can be used later for the specialized propaedeutics in all three of these areas.

Paragon of modularity

I n P a c k a g e T h r e e the educational events gravitate mainly to the technics and the natural sciences, starting with geometry. Under the Master's supervision the pupils would make the cube and the parallelepiped (a brick). This marks the transition from the oval, spherical and other "organic" shapes towards the bodies confined in orthogonal planes, i.e., to the elementary planimetric and stereometric representations.

Then, using the given amount of prefabricated wooden (plastic) blocs to erect the walls, toy-houses and castles, the kids are grasping the idea of modularity. The paragon of modularity is, of course, a brick — the first minimal constructive unit, as well as the first object of mass-production invented by the human race.

Constructive units and blueprints

By making more complicated construction out of building blocks, the pupils would solidify those initial geometrical intuitions they already have, and acquire the new ones.

The manipulation with discrete constructive units (blocs), assembling and disassembling them into larger and smaller wholes (compounds), would help to learn elementary arithmetic. It's easy to introduce the basic notions of constructing and dieconstructing objects comprised of different numbers of identical units.

By drawing their constructions on squared paper and comparing the images with material objects the pupils would assimilate the basic ideas of blueprints and spatial representations in Cartesian co-ordinates.

Technological Jacob's ladder

By imparting written names to those "bluerprinted" constructions, and later operationally describing their characteristic features in words supplemented with alphanemeric and other conventional signs, the children would eventually assimilate the idea of percepting and interpreting surrounding realities on different levels of reflection.

While practicing various workshop activities the pupils will learn how to ascend easily from palpable bodies, material instruments and physical events to more and more "disembodied" notions, up to the contemplating purely intelligible entities. At the same time they would be apt to descend from highly abstract categories and speculative considerations to pragmatic "down-to-earth" working procedures and materialisations of their concepts.

In a sense the whole action-learning environment of Generic Workshop can be seen as something like the propaedeutical Jacob's ladder for the kids eager to encounter the multilevel realms of Technology.

DIFFERENTIATING MASSA CONFUSA

Brick making seen scientifically

P a c k a g e F o u r . Here we are touching a predominantly *scientific* issues. The Master invites the pupils to take a look at the brick-making from the standpoint of a scientist equipped with modern ICT measuring and analytical devices. By moving along these two planes simultaneously the kids are probing new prospects of cognition and improvement of their work. The latter becomes for them not only empirical reality but a subject for theoretical reasoning; thus acquiring truly technological dimension.

I don't want to bother you with enumeration of many other packages, but let me to stay a bit longer at Package Four to highlight the most essential points of ProTec.

The craft of brick-making is millennia old. We start to learn it at the large box of viscous semi-liquid clay, facing the chaotic, unorganized and undifferentiated staff, or *massa confusa*, as the alchemists used to say.

Let's assume for a moment that we have an infinite amount of clay spread infinitely in all directions. Then it's permissible to talk about matter and energy evenly distributed in a four-dimensional continuum.

What kind of operation we should perform upon this staff to manufacture a brick, or, to simplify the task, a cube of a standard size?

First of all, to pick a finite amount of staff required for making of just one brick. How we might do it in a way which is the most convenient no only for the actual making but also for its conceptualization?

The necessary procedure goes like the following.

Starting dichotomy

Let's reduce an imaginary infinite *massa confusa* to the actual, i.e. finite, box of clay and count it for our initial amount of raw material which we would call a *monad.*

Let's divide the amount of clay (or, rather, the space it occupies) *in half* mentally, or graphically on paper; then put a board, or slab at the side of the box, and, by moving it with our hands, displace the viscous staff towards the opposite side stopping at the dividing line and leaving the empty space behind.

By starting this dichotomy action we would perform our initial binary choice, turning a monad into a dyad, making the first step towards the notion of a *system*. We would create the palpable measure of complexity, ordering, and organization which is obviously above zero-level.

Now may I remind you that we have some special instruments for *symbolic representation* of what is resulting from our actions.

In-formation displayed

There is an array of galvanic (or pressure) sensors installed on the inner surface of a clay-box sending a "yes/no" signals to a display — computerized, or just wired out of small electric bulbs and batteries. When the clay is distributed evenly in the box a display is all lit; when we have a clay displaced to the one halve of the box a display shows one of its halves lit and another halve dark.

A general path of later development is clear enough. What we used to call a shaping, or forming of clay, we can now re-interpret as an *in-formation* of the material that leading to the production of the brick (not baked yet).

It's worth to consider a bit more thoroughly the educational aspects of these events.

Discrete quantification

Performing the operations just mentioned the pupil does not just obey the instructions and imitate the Master. The latter does comment all the proceedings, explaining what's going on both at the empirical and symbolic-theoretical levels.

At the same time the pupils watch a schematic representation, or informational model of what the Master is making. Then the pupils repeat the same task without direct instruction, but having Master's informational model in front of them.

In the beginning the Master does put on display only qualitative analogous model. Then the Master and the pupils (perhaps, in a company of the teachers of Math and Sciences) would discuss a problem of its quantification. Going this way the kids would start to build a discrete quantitative model, and to come step by step to the idea and the scientific notion of information in Hartley's, Shannon's, or Kolmogorov's sense, and, finally, to deduce the corresponding formulae for calculating its volume.

Age level indeterminate

One may ask: at what age the school children would be able to acquire the sensory-motor skills, mental faculties and intellectual development needed for such an enterprise?

Dr.B.K.Passi has just reminded us an historic anecdote which I'm glade to cite here once again:

Albert Einstein asked Jean Piaget whether the children could understand his 'Theory of Relativity'. Piaget responded that he would take some time to answer this question. As a result of this query, Piaget simplified the 'Theory of Relativity' in terms of simple elements like mass, weight, distance, numbers, series, and so on.

Piaget decided to teach these concepts to young children. It took two years to develop the relevant Piagetian task. He found that children too could understand these concepts at appropriate stage of their cognitive development. In this way, Piaget responded to Einstein that the elements of 'The Theory of Relativity' could be explained to children. The important point is that complex matters too, can be taught, provided one has the ability to simplify. (B.K.Passi, Introducing Informatics at Primary Stage)

I can cite one more case throwing the light on yet another aspect of the problem, bringing us a bit closer to our concrete topic.

Decades ago Dr. Herman Bondi, a world-known expert in the relativistic physics, expressed a strong belief that if the high-powered cyclotron could be made portable and safe enough to be played with by the five-, six-, or seven years old, it would be quite natural to include the special theory of relativity into the curriculum of any elementary school.

Nowadays there's no difficulty to provide the first-graders with the desk-top simulated accelerators and nuclear reactors to conduct virtual experiments, discuss the results, and find suitable explanations.

In my own humble opinion, the basics of informatics, or cybernetics, could be made understandable at the same age, and maybe earlier. As a starter it is necessary that the pre-scholars, who are eager to make the cakes out of sand, bricks out of clay and toy-houses out of wooden blocks, should be given a correspondingly wired computer with a set of software and peripherals to play with, or, at least, a switch-board and relay circuit with flashing bulbs.

For example, why not to invite them to construct and operate in this way the "working" Turing Machine?

A right moment, perhaps, to insert a brief description of one more possible ProTec package of dual, or (literally) binary purpose: firstly — to deliver hands-on acquaintance with basics of information theory *and* praxis; secondly — to be used as a supporting "technical" tool in carrying out a number of other packages in a situation when there are no computers, or any other modern ICT available.

GRASS ROOT ANALOG/DIGITAL INTERFACE SUPPORT

Cheap do-it-yourself computer similitude of very low complexity

Referring to results of Moscow IITE Seminar in his message "Introducing Informatics at Primary Stage" Dr. B.K.Passi of India also reminded us about "the shortage of computers in developing countries. It was told that a large number of countries are short of funds for purchasing computers required for introducing Informatics. This point was substantiated by the fact that a large number of societies especially near Sahara desert have not yet used the telephone in their lives. Talking of computers in such societies is an impossible dream." He also noted some encouraging signs of circumventing the shortage of high technology by means of delivering corresponding theoretical knowledge and mental skills by using paper-and-pen teaching materials created at Russia's Institute of New Technologies of Education.

It's conceivable to complement those with a sparingly practical solution of that seemingly insoluble problem: to lay down if not a foundation, then, at least, a corner stone for the long awaited computer literacy and modern ICT culture in the presently computerless countries. The idea is to provide schools with the sufficient amount of extremely simple and affordably cheap modular units, — kind of DIY Component Kits, — out of which pupils could eventually assemble and construct with their own hands the computer similitude of very-very low complexity.

The low complexity computer similitude built out of a few modular units will comprise the elementary circuits, representing in the uttermost crude but fully palpable and clearly visible form, the basic structural and functional traits of a "real" computer.

Soft and Hard inseparable

The main distinction between "real thing" and its similitude (besides overwhelming differences in complexity of architecture, speed, and amount of memory) is that those fundamental schemata, characteristics and features are enormously enlarged and spread out in its spatial and temporal dimensions, thus revealed and "displayed" for comprehensive observation and direct manipulation.

The first lessons in programming this oversimplified computer model, i.e. the initial steps of software design, would be inseparable from, and based upon the immediate manual, visual and intellectual experience of designing and constructing hardware to execute the planned logical and computational operations and procedures. An accomplishment of both tasks should be started right from the zero level. The holistic view of, and personal involvement into that two-fold process will prevent the well known and lamentable split between the "hardware" and "software" mentalities, whereas in our case both sides will mutually stimulate and enrich each other's growth and scope. That's why it might be called GRASS ROOT ANALOG/DIGITAL INTERFACE SUPPORT for a propaedeutical studies both in computer literacy and computer science.

Unlimited extension

The minimal, or atomic modular unit for our computer similitude, i.e. the binary logic unit, is an embodiment of the concept of "bit" — a physical system with only two distinct alternative states (1/0, Yes/No, Light/Dark, True/False etc.), — a logical seed, or *Logos Spermaticos* of all the digital devices past, present and future, loaded with an infinite amount of meaning and unlimited teaching/learning potential.

This atomic modular unit has a capability for extension, bifurcation and development by way of "attracting" from its (physically and symbolically prefabricated) environment, and "assimilating" within its own "body" the increasing number of additional elements, interconnected on the successive levels of structural and functional complexity.

There are three "technically" distinct developmental stages within the curriculum and/or implementing period of this new approach to a computer literacy & computer culture in education: mechanical, electric (with sub-divisions) and electronic.

Mechanical to Electric

At its lowest level the atomic modular unit is being purely mechanical construction, directly (manually) operated and visually perceived in its two alternative states as the one two-fold indivisible whole. Nonetheless it is possible to arrange the rows, columns, or any other configurations of such units (coupled in the Lego-like fashion) for manipulating with, and displaying of various YES/NO combinations, thus creating "analog" visual patterns, characters and even short sentences out of these mechanical "bits".

At second level an electric toggle switch is added to allow it sending energy signal or no-signal through the wire for showing at the distance whether it is ON or OFF. Consequently this "atomic" unit would be divided in two: an "input manual switch" and an "output visual indicator" (small incandescent bulb or light-emitting diode).

Several IMS can be mounted together on the manual board, thus forming a prototype keyboard; and several OVI can be mounted in similar way as prototype display, allowing to create various geometrical patterns, characters, or primitive images.

Logic-&-memory board

At third level an electromagnetic relay is added to a switch to make it being remotely activated by coded signals of small energy.

Two units with switches-&-relays can be interconnected to form the simplest trigger circuit which, in turn, can be used as a building block (among the many) for ever more complicated trigger networks, thus creating prototype logic-&-memory board.

Secondary memory units can be attached separately to the primary IMS' on manual board to make each one being individually encoded with particular message (pattern or character). Then another SMU of the same type can be attached to the display board to make

it "downloaded" with some pre-formatted patterns or characters. Yet another memory boards can be constructed for the future use as the changeable RAM & ROM prototypes.

Timer

The next consecutive step is an introduction of a timer — first in a form of a toy clockwork mechanism with electrical contacts added; then a trigger fed through the R-C circuit. At this stage the pupils will come quite close to having an embryo-prototype or, rather, working archetype of a computer with all its essential functional blocs, made by their own hands from the ground level up to the top, completely "transparent", and tactile/visually traceable in all its structural elements and interconnections.

Using this archetype computer, however simplistic, poor and miserable in its architecture, speed and storage capacities, the students can perform the elementary computations, logic operations and visual pattern formations, thus acquiring the (literally) first-hand and "grass-root" knowledge of the most profound principles which both computer science and information technology are based upon.

Electronics

The next stage of technical development would be step by step replacement of the electro-mechanical elements, substituted with electronic ones: at first using simple transistors, then integrated circuits.

The cheap cassette recorders would be added for storing lengthy programs.

The first peripheral device might be introduced in the form of electromechanical typewriter (currently available in SU schools) with additional controller, designed and built by the students along the already familiar lines. The archetypal computer could hardly be used for practical word-processing, but there is a possibility to produce some large letterheads and/or elementary graphic images by treating typewriter as a very crude "one pin" dot matrix printer.

Advantages and prospects

The advantages of such an approach in the given situation are obvious.

The emphasis is on active "hands-on" learning rather than on teaching; hence the shortage of instructors is not so crucial, and the new breed of instructors might emerge very soon due to self-education.

The simplicity of mental and manual actions needed to proceed from the self-evident "analog" notions to their "digital" representations & vice versa, wouldn't frighten, and, on the contrary, would attract those who proclaim the "innate dislike for all things technical or mathematical".

It is easy to make it interesting to the young teachers of other subjects (besides informatics), because it might be used as an efficient supporting tool for teaching and learning language, biology, geography, etc., where new "hands on" methods of "cybernetic" modeling of corresponding realities are likely to emerge. In fact, the general educational potential of GRADIS is yet to be revealed.

Let's resume our Generic Workshop practicing in brick-making paired with elementary informatics, geometry, and physics.

EXPLORATIONS IN THE BOX OF CLAY

Behavior of viscous bodies

Having moved all the wet clay by means of the board to the one halve of the box we have made its surface elevated above the initial level. It's good to have a transparent box, — better a set of variously shaped boxes, vessels, or reservoirs — for direct observations of many interesting behavioral traits of viscous and fluid bodies, liquids and semi-liquids (e.g. their tendency to receive a shape of a container).

A clay is now unevenly distributed within the box volume and will remain in that state as long as we hold the board with our hands.

Now let's take our hands off the board and see what would happen. In fact, we've turn the moisten clay loose and let the viscous staff to creep back and to fill anew the empty part of the box. The clay will creep slowly when thick and dense, or faster when thin and watery. An hour-glass may be used for comparative measuring of the time needed in each particular case for the staff to restore its initial state of equilibrium and even distribution.

From properties of raw material to quality of product

It's worth to note that the degree of clay's thickness would predetermine to a large extent the qualitative features of an end product we are about to manufacture. An opportunity to prove it experimentally will appear later at the last phase of a technological cycle: we shall test both firmness and fragility of a baked brick by loading it with the objects of different mass and/or hitting it with the objects falling from different heights.

But at this moment our attention gets focused on something other.

Enthropic tendencies

While a semi-liquid staff creeps back and fills the empty part of the box, it changes not only the level of its upper surface (which goes down) but its shape as well. It's instructive to trace (and to draw on paper in a series of sketches) how after being flat at its highest level it becomes curved and than flat again at the lowest level. Reaching this position a moist clay looses its organized and ordered non-

equilibrium, finding its rest in unorganized and amorphous state where there is no distinctions and no grades. Here we have a vivid metaphor for chaos and entropy, that helps the small kids to build the appropriate intuitions and scientific notions.

Energy imparted, stored and released

Now take a look at what happens with the board left in the box at the dividing line after we have taken our hands off. A clay on its way back to equilibrium would push the board and move it across the box towards its initial position at the side of the box. What is the force that makes the board move? It was our own muscular force, or energy which we have given to the board, which made clay elevated and endowed with the same force, which was stored there for a while, but presently is set free again and moving another body in reverse direction.

All phases of these events are getting represented automatically on the display and plotted or printed out on the sheets of paper in a number of copies kept by each pupil in their personal files. The reason for doing it will be clear a bit further.

Empirical to theoretical

Since the loss of shape is caused by the viscosity and fluidity of a raw clay we should introduce the operations of drying and baking. Corresponding processes of physical and chemical transformations are getting immediately represented graphically, their numerical and symbolic expressions will come later.

No one step of material working action is left without automatic representation of such kind, as well as without its mental reflection by the pupils, supported by their oral comments, drawings and written reports. The kids are describing everything they do — at first in empirical terms, then in more and more abstract and theoretical. These abstractions are by no means given to the pupils in a ready-made form; they are being developed gradually as the conceptual tools for an organization of sensory data and practical experience.

Practicing with ideal objects

While learning the craft of brick making a child learns to describe, explain, and interpret not only direct work actions with materials and tools. He is learning also how to work with such impalpable entities as symbolic representations, or substitutes, that, in their turn, would become subjects to an informational processing. In other words, one does learn how to correlate those "ideal" objects of theory with empirical realities and have both met in one's personal working praxis. It gives the pupils a chance to discover the fact that they could learn how to use newly acquired conceptual tools and theoretical faculties in order to control and improve their own work performance.

Here we comes to the introduction of informational exemplar, or detached working standard which, in its turn, can be a subject to change and development.

GROWING SELF-DEPENDENCE

Master Otiosus

At certain moment he Master steps aside and ceases to show, instruct, and explain the pupils everything they should do. But the kids are given the graphic iconic and symbolic substitutes, or models, which represents the Master's exemplar working actions displayed side by side with theirs own. Each pupil could compare these two representations and learn how to detect, analyze, and correct his errors and deviations from the exemplar much faster and in a more refined way than by observing only "material-empirical" side of manual work. Now the pupils can trace its mental, or intellectual correlates displayed externally that opens unprecedentedly broad pedagogical vistas.

Given the powerful enough computer it's easy to envision the possibility of replacing the living Master by the artificial, or simulated one. This might be very useful, at times even necessary for many training purposes but it's obviously not a main rationale for using ICT in primary education. On the contrary, a deliberate Master's withdrawal and going away — a situation of *Master Otiosus* — can be extraordinary challenging to the pupils' creative efforts to overcome the arising obstacles on their own.

Working with representation of work

I have to clear up briefly the explorative and cognitive instrumental functions assigned to the computer in ProTec courseware.

The pupil would interrupt for a while his manual work with raw material (clay, wood, metal, plastic, etc.) and concentrates on its ICT-generated models — drawings, printouts and, above all, images and symbols on computer's screen. He starts to perform the analytical and synthetic manipulations with these graphic and symbolic substitutes which represent the transformations of physical objects as well as the s t r u c t u r e a n d d y n a m i c s o f t h e w o r k i n g a c t i v i t y i t s e l f . The child could never have done before anything close to it with his direct experience; manipulations of this kind is possible only due to the modeling by means of modern information and communication technology.

Model *of* and model *for*

The crucial moment comes when Master says to pupil: look, you have learned so far how to make tangible things first and then represent them in series of gradually disembodied iconic and symbolic models; in our case — the models *of* bricks and brick-making. Now let's try to do it the other way round: make first a model *for* a certain thing — say, a brick of unusual shape — which does not exist

yet, or, rather, exists only in your imagination as well as on paper or some other carrier until you have it actually made. And let's consider how to make it in the best possible way, by spending less time, materials and muscular efforts. Do it mentally as well as by drawing on paper and modeling on the computer screen.

Widening the content and methods

While so doing the pupil learns to use models not only as exemplar but also as a tool for heuristic search during the process of design. Here we enter the realm of creative thinking, strategic planning, and project development which implies both theoretical and practical approach to reaching particular goals. It gives us a good ground to introduce basic notions of semiotics (a science of sign-systems and languages) and human communications.

To sum up: any handy work is accompanied by ICT-based representation and reflection of corresponding physical and mental operations and events. As pupil's capacity to represent and reflect his own work does grow so grows his self-dependence in all educational endeavours. The content and methodology of teaching and learning activities that started with the craft of making bricks and simple utensils are getting wider with increasing number and complexity of products, materials, tools and technological procedures — up to the robotics.

Making programmable robots

All over the world millions of children are playing with LEGO blocs. At least half of them (mostly but not entirely, boys) are busy assembling different types of mechanical toys such as cars, locomotives, windmills, helicopters, etc. Thousands of schools conduct technology classes using special LEGO Kits which comprise electrical motors, relays, switchboards, pneumatic pistons, measuring gauges etc; whereas pupils are assigned to construct working simulations of cranes, power drills, forklifts, conveyor belts and other epitomes of industrial and post-industrial eras.

Since late '80-s LEGO kits often include optical sensors and interfaces for coupling them with computers serving as programmable controllers for any contraption with movable parts that children would be able to built and operate. The famous combination named LEGO/Logo (Logo is very powerful high-level programming language) allows eight years old kids to launch such serious projects as creation of tiny robot that can walk around finding and picking up sticks scattered on the floor.

Hands-on — look-at-the-screen

The Master introduced general ideas and principles of LEGO/Lego in hands-on — look-at-the-screen fashion. Performing their tasks the pupils do not just obey instructions and imitate Master. The latter does not teach either but rather reveal "the secrets of the trade" and comment all the proceedings, explaining what's going on both at the empirical-material and symbolic-theoretical levels.

The are, of course, other commercially available brands of hardware constructive sets and programming languages besides LEGO-Logo; I've brought the latter only as a well-known example illustrating the essence of approach considered.

A core of the matter is that the children would watch on computer's screen a schematic representation, or informational model of what the Master is making by manipulating tangible materials and tools. Then the pupils repeat the same task without receiving direct instruction but having Master's "virtual reality" model in front of them.

Hard/soft interplay in project management

In the beginning the Master does put on display only qualitative and analogous model of what should be created. Then the Master and the pupils (perhaps, in a company of the teachers of Math and Sciences) would discuss a problem of its quantification. When the solution is found the kids would start to build a discrete quantitative model simultaneously moving along in the interplay of its soft and hard dimensions.

All phases of these events are getting automatically registered and plotted or printed out on the sheets of paper in a number of copies kept by each pupil in their personal files (as well as on the hard disk of Master's computer).

As a result the children obtain certain general but very practical skills of *project management* as well as specific principles of design, system engineering, science and math.

It is an information and communication technology that provides a unifying platform for teaching and learning all the others "technologies", knowledge and skills to be mastered in Primary, Secondary, Junior and High school alike.

THE CHOICE IS THEIRS

At the crossroads

Time and again I have to stress that our aim is not the training of craftsmen or factory workers, but the general (first of all — primary) education where all the arts, crafts, sciences, and technologies are called to facilitate cognitive development, creativity, and personal growth. Neither all school-children are eager to become brick-makers, architects, or computer programmers, nor the society and employers wants the school to supplement predetermined types of work-force only.

We intend to raise and foster the thoughtful initiators of change, builders of better social institutions, connoisseurs of beauty and friends of Nature with solid scientific-technological background. That is, the responsive and responsible individuals, who could pursue personal and communal goals by constructing and re-constructing things and events first in their imagination, then in external modeling,

and, finally, in real life practice. They should be intelligent enough to decide which path to follow in order to fulfill their own wants, aspirations and expectations, whereas we must enable our graduates to make a conscious choice of their further specialized training, occupation, or future professional career.

While they are still standing at the crossroads we face an urgent problem of what might be designated as a forestalling professional orientation of students at the pre-graduate level according to one's personal predisposition and vocation. Strictly speaking, we have to expose the children to the very idea of diversity and multiformity of work and labour from the very beginning, thus allowing them to try and test any one all through the period of education.

An acceptable solution (at least, in principle) looks as follows.

Map of work-offers

Imagine the overall map of major vocational activities, occupations and professions in agriculture, mining, metallurgy, energetics, mechanical engineering, transportation, electronics, communications, applied and fundamental sciences, etc.

Consider each area as a multitude of vacant work-places, or work-stations — both of today and tomorrow — waiting for the trained operators to control a variety of technological systems and processes. Each vacancy is specified by a particular type of hard- and software equipment and operations to be performed at its work-station.

Paradigmatic installations

In our Generic Workshop we have the simulators of those work-stations designed for the training, testing, and diagnostic purposes. Each students has the opportunity to encounter every simulated vacancy and test his/her physical and/or mental fitness to it. There is no need to have a large number of separate work-stations. At the propaedeutical phase it's enough to use a few simplified and miniaturized paradigmatic installations with flexible re-adjustment to fit the different types of working activities and bodily parameters of the age groups.

Telling personal preferences

After finishing initial propedeutics and entering middle phase of systematic teaching and training the children would interact with the installations of a size augmented according to the pupils' age, in order to master more specialized skills. Having experiential acquaintance with several types and forms of labour and working environments, the school-children can tell their preferences for some particular directions of further studies.

Options for future (re-)orientation

The third phase, or *practicum*, brings the student up to the real working conditions in a chosen field which has a chance to encounter while visiting a particular job facility at industrial plant, servicing firm, etc. Being accustomed previously (if only briefly) with many other options the graduate becomes sufficiently oriented in a broad spectrum of occupations. Now each one does know his strong and weak points, predilections and capacities well enough to decide confidently which career to choose as the most promising in relation to pragmatic success, emotional reward, and personal growth. Whatever direction our pupil would have chosen now he will be prepared to meet future challenges open-minded and ready to make another try.

PART III. GENERIC WORKSHOP. FRAMES

AUXILIARY AGENDA

Gaps to fill

In previous chapters we have made a few sketches of educational activities — the short-term micro-projects practiced in our make-belief Generic Workshop — with no detailed technical specification of ICT proper because it had been done by numerous authors. (Quite recent publication EDUCATIONAL MULTIMEDIA....by B.B.Andresen et al., was already referred to earlier; in fact, my first impulse was to offer some link-ups and possible junctions of two main themes — paedagogical innovations and ICT proper — expounded there separately). In other words, in my narration I've been concentrated predominantly on those direct actions of both Master and pupils that could and should be ICT supported and enhanced in order to highten their teaching and learning efficiency.

Many issues of great importance remained entirely outside my scope and it's timely to try to fill up some of the yawning lacunae by shifting the focus from small particular facets to large conceptual frames. I have to name at least three of them right here.

Assessment and evaluation

Most urgent is the theme of assessment and evaluation. So far it didn't come up for obvious reason: we were dealing with ICT used as tools and environments necessary for performing concrete and strictly delineated work tasks — therefore not only Master but apprentices themselves would tell with certainty if it is done successfully or not. But to measure pupil's average progress and

achievements in some particular area of math, physics or linguistics after he has completed his week-, month-, or trimester-long project would be quite a serious and complicated problem.

Needles to say, assessment of learning in such cases should be based on quality of pupils' understanding, products and portfolios rather than multiple choice tests. It is possible only if very detailed records of all educational activities of each pupil are kept. Keeping of long term records, or "learning chronicles" is most practical in a networked environments. For obvious reasons assessment and evaluation should not be treated apart from an educational process proper. Amongst other things it is tightly intertwined not only with methods and content in general, but also with quite concrete planning and executing Master's actions aimed at providing the individualized help, auxiliary instruction, and correction to the pupils in need.

It easy to envisage (though it would require a lot of effort to implement) an ICT-based Cyberspace Support System which will serve the former and the latter goals alike.

Sustainable motivation

Somewhat more remote though equally crucial (and still far from being satisfactory tackled) problem — sustainable motivation. How to hold pupils' interests sufficiently cohered and oriented towards the genuine aims of education during the whole period of schooling? Honestly speaking, it's hard to imagine any successful attempts to improve the quality of education unless we would consider this issue as coming the first in our list of priorities.

There are strong grounds to believe that ICT-supported collaborative learning could become a major source of hope. It's conceivable to launch very long-term (practically infinite) project of Hypergame type which would encompass in holistic fashion all subject-matters and school-disciplines while being attractive to the all age-groups. An endeavour of such kind might also become a prospected leverage to counter-balance the third (Internet connected) point on our agenda.

Open networked education

An easy access to WWW — that inexhaustible fountain of (yet incomprehensible, disturbing and confusing to a small child) information, seducing advertisement and x-rated entertainment brings forth yet another concern for any conscientious educator. Equally worrying are dubious BBS, conferences and chat-rooms inviting kids to private communication and interaction with persons under nom-de-plumes whose true identity and intentions are unknown to both child and his parents.

On the other hand we can find convincing evidences that these threatening tendencies are not absolutely irresistible and fatal: they could also be fought back granted some ingenuity and persistence.

An idea of Open networked education on grand scale is getting more and more plausible. A bridge over troubled waters should be built by the joint efforts of Masters and pupils in the course of ICT motivated and enhanced creative learning.

All three themes mentioned are too complicated and bringing forth so much ill-defined *problematique* that I have to consider them in a rather broad cultural perspective before making any concrete design proposals. For the sake of didactic convenience let's start with the second — sustainable motivation.

DIVISION I. BUILDING COMMON MICROWORLD(S)

CREATE TO LEARN

The Microworld options

A powerful enough (e.g. Logo-based) MicroWorld package installed on any school computer having an access to WWW, provides the pupils around the globe with an unusually intelligent multimedia end-user interface of great learning and educational potential.

A world the pupil (even the first-grader) has to explore, to study, to describe, to explain, or to change through that interface is not something already existed and given to the child by somebody else. It is his own (micro) World(s) which the pupil must create, or construct first.

There can be as many different kinds and types of personal microworlds as the children would, and could build. For instance:

(1) MicroWorlds built with an intention to make a scholarly model of a real (i.e. natural, or socio-cultural) world as it is now, or used to be in the historical past.

(2) MicroWorlds built as an experimental model for some future human world to come,- be it a theoretical prognosis, an utopian wishful thinking, or a practical project to launch and implement by the kids themselves - if only on a very small scale - within the boundaries of their own classroom.

(3) Imaginary MicroWorlds of children's dreams and fantasies, of myths and fairy-tales, of art, music, poetry, or science fiction (i.e. the adventure of some modern Robinson Crusoe suffering a space-shipwreck on a far-off planet).

In any of those cases all the pupils everywhere would have and use the precisely identical sets of "raw materials", "tools", "shapes", "primitives", "blue-prints", "commands", "instructions", "procedures", "rules" and "operational expressions" for the "final products" of their individual and/or group activities.

Therefore, the main "technical" content of their multimedia telecommunication messages could be safely reduced to the rather short and simple alphanumeric sentences in the Logo programming language.

But that's quite another matter to decide what kind of intellectual, cultural and emotional content would be the most appropriate and should be chosen for the first encounter between the participants (both pupils and teachers) in our projected MicroWorlds Exchange.

Shifting paradigms

In the days of sweeping global changes and shifting paradigms no training for any particular skill or job is of lasting value unless it endows the trainee with an ability to be re-trained and self-retrained anew each time when a situation demands.

The shape of things and the things themselves are coming and going now incredibly fast. They are growing in numbers and in types. New events occur every day. Our senses are assaulted by the rising tide of utterly diverse and often contradictory messages. Our world - or rather, our world-picture - once quite definite, stable and clear, becomes more and more complicated, diffuse, diluted, unreliable, ever-changing.

There is no hope of dealing with it further in the century-old belief that we, "the teachers", have access to some body of the true (or scientific) knowledge. The knowledge which we must structure according to some theory of teaching-&-learning; to simplify and reduce to the predetermined level of cognitive ability of a corresponding age group; to serve cold and feed piecemeal to our pupils, and feel content after getting confirmation that they really have eaten and properly digested it.

This brings us to the crucial question of what comprises the basic assumption of our whole enterprise.

What our ultimate goals and objectives are; what guiding principles constitute the very foundation of our paedagogical endeavour?

From the depths

The INT has an experience of adapting and introducing Logo MicroWorlds to the Russian schools in close personal collaboration with its originators (Dr.Seymour Papert of MIT, LCSI of Canada et al) and of conducting teachers' development Logo courses on both domestic and international level for nearly a two decades.

On the other hands a contemporary situation of Russia in general and of Russian school education in particular has neither historical precedents, nor even remotest theoretical envisions.

Hence there is nobody professionally qualified to teach survival, adoption of universal values, and building the civic society amidst the economic, political and moral flotsam of totalitarianism. These are the top and immediate educational priorities of ours — sort of a rescue mission — and we are trying hard to respond somehow to that challenge and to find some plausible answers and solutions.

There is no hope of dealing with it while keeping a century-old belief that the so called teachers have an exclusive access to some body of permanent truth and immutable knowledge which could be served cold and fed piecemeal to their pupils.

Instead of instructional teaching we ought to motivate and facilitate constructional learning by exploring the unknown, thus creating new experience and discovering new order emerged from the depths of chaos.

Imparting an image

Perhaps it's suitable to recollect now that the English word EDUCATION has its root in the Latin *EDUCARE*, which literally means TO LEAD OUT. Generally it implies either to lead out and make visible something which has been previously unseen, hidden, kept in, or contained inside.

Or to lead out somebody - say, an individual who was born in a cave, raised and accustomed to dwell in the dark, a captive or merely ignorant of the very possibility of getting away from one's confinement to eternal night toward freedom and daylight, or even worse, having no idea at all that such a thing as daylight does really exist. In view of our eco-anthropological crisis and in search for its possible resolution, both implications of the word *EDUCARE* and EDUCATION are of immense importance.

But no less inspiring implications are recumbent inside a Russian word for "education" which is *OBRAZOVANIYE*.

The root of this word is *OBRAZ*, which means IMAGE.

So *OBRAZOVANIYE* - a Russian word for an education - might be translated into English as IMAGE-FORMATION, IMAGE-BUILDING, or THE GIVING, IMPARTING, and CONFERRING THE IMAGE.

And especially when related to the aims, goals, procedures, and processes of teaching and learning we could interpret its meaning as CREATION OF SOMEBODY IN THE IMAGE AND LIKENESS... well, do you suppose of whom?

More often than not, in the image and likeness of one's self, indeed.

But would you not agree with me if I say that no one of us would be quite content with creating someone in just MY OWN image and likeness.

In any case we'd prefer to "create" somebody in the image and the likeness of that person (The Person) whom we consider much better than ourselves (or *my*self).

Verily, we cannot create someone in the image and the likeness of God, because we are merely humans.

But we can IMAGINE deep inside our soul the presence of, or at least a reflection of a spark of a PERSON — not necessarily divine, but at least as infinitely wise, gentle, kind, beautiful, attentive, sensitive, responsive (and responsible) than *one*'s self. And we'd be willing to project THAT image into the soul (and the body, to a degree - through some body building exercises) of our pupil or pupils.

Search for New Hero

To fulfill our duty equated with that of the rescue mission, we must impart our pupils an image of a Person who would, presumably, be able to perform a two-fold task of truly heroic proportions.

The first part of our hero's adventure is to overcome internal inertia, a psychological risk-aversion and deeply rooted predisposition for going routinely along the well rolled trail. A very strong impulse is needed for us to get rid of the old fears and to make an initial step on the long road of experiential learning which is rather risky but the only way to learn how to navigate through chaos.

The second part is the task of erecting kind of emergency shelter for those whose job is to build the whole human habitat anew, restoring and re-creating both its cultural and natural dimensions.

Needless to say, such a task could not be performed by the sole effort of an individual, however talented, brave and powerful he or she may be. For anyone it would be possible only in collaboration through the appropriate networking with one's fellow countrymen. And with all good folks and creatures of the Earth, of course.

So, perhaps, our hero-image should be given yet another assignment. For this once - to learn the skill of dealing with other people and with Nature itself in a peaceful and collaborative, rather than an aggressive and competitive mode. In a sense it means that we must endow our hero with some initial aspiration and a striving for democracy along with its generic attributes and companions: indispensable human rights, social responsibility, and personal involvement into everything demanding his/her attention, courage, expertise, compassion, and love.

Learning by facing the unknown

Nobody believes that all this could be achieved nowadays within the established school system because that very system was born centuries ago out of completely different set of needs and has been devised for the different purposes. On the other hand I'm by no means preaching for its immediate replacement by some other "system", equally bulky and inefficient. But it is conceivable to make a move toward the realisation of the above mentioned goals and tasks by launching something which might be called "parallel", or "complementary" education, growing and evolving alongside the "legitimate" one without any intention to compete, even less to struggle with the latter.

Moreover, it could be done in the precincts of any ordinary school as extracurricular, non-obligatory activities having no slightest resemblance to the regular classes or lectures. And it must be done without any attempt of "teaching" - the main principle is the facilitation of learning. The reason is simple: our situation has neither historical precedents, nor theoretical envisions, and there is nobody professionally qualified to teach survival, adoption of universal values, and building the civic society amidst the economic, political and moral wreckage and flotsam of totalitarianism. The only solution is learning by facing the unknown and creating new experience.

Both "teachers" and "pupils" are equally unprepared for such ordeal; both facing now the very same life problems, both parties have to learn how to cope with contingency. Many have already decided to do that learning on the individual sink-or-swim basis. Others still hope there are less dangerous paths of schooling by modeling the unprecedented problem situations in order to find possible way-outs by developing and exercising sufficient problem-solving skills.

In any case we have to create in order to learn.

EDUCATIONAL TECHNOLOGY OF MIND

Continuous development of teachers and pupils

The most promising approach implies additional motivation of children's active participation in that endeavor through various kinds of educational plays and games — a tool well known in the West but completely alien to the old authoritarian school system.

The latter was always dead serious: no humor or irony, no playfulness, no jokes or fun was ever allowed to enter the classrooms. It made us spent much time and efforts to convince the skeptics but finally they were forced to recognize that the combination of the two above mentioned principles — inviting people to face the unknown and let them to cope with it by playing the exploratory game according to some clearly defined rules — would invariably yield brilliant results.

Joint Joyful Learning

We have been practicing that kind of joyful learning for several years with hundreds of elementary school kids and dozens of teachers, studying/teaching Three R's, ABC of natural history and visual imagery in experiential "hands-on" way.

In our teacher development sessions and workshops we try to re-create the learning environment of our "real" classes, inviting each teacher to assume the dual role of "innocent" school-kid and the pedagogue-researcher equipped with sophisticated mental technique for self-observation and analysis.

We have found that the best general procedure is the following:

(1) Give a group of students (be it children or adults) something to play with freely and cheerfully around the current theme of the curriculum by breaking the rules of the established class-room (or the university lecture) routine.

At this preliminary stage both children and adults get to learn that "a teacher" could be not only mentor, or instructor, but an elder (and fully responsible) playmate easy to communicate and to interact with.

(2) Introduce some simple and attractive "structured" game with strict, explicitly defined rules relevant to the topic under study, and invite the students to play it in order to win.

Now the "pupils" get to learn that "teacher" could initiate them into new kind(s) of competitive play(s) and game(s) enabling one to reveal his/her wit and mental adroitness.

(3) Make students being aware that their success in playing structured goal-oriented games depends directly upon their willingness and acquired ability to observe - not breaking! - the conventional rules they have voluntarily accepted by mutual agreement.

Then students get to learn how to turn the limitations and restrictions imposed by these rules into a springboard for reaching higher levels of their resourcefulness and ingenuity. They come to treat the teacher as a respected game-leader, whose mastery they are hoping to equal some day.

(4) Devise a series of increasingly complicated, project-oriented games related to the consequent themes, topics, and tasks in various subject-matters and implying collaborative rather than competitive approach to problem solving.

At this stage students would imperceptibly getting more and more involved into mutually supporting, intellectually and emotionally rewarding group work of exploration, research, design, and project development of their discoveries, inventions, and solutions together with teacher the partner.

Reshaping the content and procedures

This opens the way for re-shaping the content and procedures of any standard subject-matter according to individual predisposition, demands and requirements of both teachers and students of any given class. In this case the whole process of learning activity is subdivided into the following phases:

(a) Accepting and analyzing a problem situation.

(b) Making ourselves sure we have no ready-made solutions for it.

(c) Deciding to launch a project, setting the main goals and objectives, weighting our mental resources.

(d) Discovering the fact that we are not equipped enough to cope with it successfully.

(e) Seeing what specific knowledge, skills, and experience we must
obtain in order to seek and find good solution to our particular problem.

(f) Going through corresponding process of research-learning, training, drill-&-practice, etc.

(g) Designing a set of possible solutions (generating options, comparing alternatives, evaluating, etc.); choosing the one which seems suitable enough.

(h) Imagining what happens if our design is implemented: what changes of our immediate surrounding and of broader physical and socio-cultural environment it would bring about; what kind of consequences and side-effect might be caused by it, and how we could prevent, avoid, or repair it. Re-assessing the overall approach to tackling the problem.

(i) Reflecting upon what we've done: repeating mentally the road taken and actions made; describing the essentials; scheming about if, and how we could use our newly acquired knowledge, skills, and experience in case of facing some other problems.

Virtual School

That's what we would call the basic Educational Technology of Mind which INT is trying to develop and support with various soft/hard/courseware technologies of computer simulation, e-mail networks, interactive multi-media and other advanced information-processing and communication devices.

As for the specific games aimed at the development of teachers' ability to generate the ideas of their own the following scheme is proposed.

(a) imagine a VIRTUAL SCHOOL, populated by a small number of students, equipped with laboratories full of megacomputers, synchrophasotrons, radio telescopes, nuclear reactors; museums and libraries on a world scale, and all means of transportation (space rockets included); and staffed with any desirable number of the best professors, mentors, lecturers, workshop stewards, great scientists and other experts ready to exercise the most efficient teaching-&-learning approaches and methods.

(b) compose the curriculum utilizing all the resources given, set corresponding procedures, and let your educational dreams to flourish within a single HUMAN medium of personal encounter, direct face-to-face communication, friendly interaction, hands-on experiments, field observations, theoretical research, peripatetic discussions, high-spirited symposia, and intimate transactions between all the agents and participants involved.

(c) reflecting upon, and guided by that virtual experience of yours, do ask yourself how could you approximate (if to a small degree) this paradisical state of educational affairs while dealing with the real problems of an ordinary inner-city, Third World, or ex-soviet school and given the technology affordable.

Metaphoric scenery

There are quite plausible methodological and heuristic justifications for such a strategy when you have to make teacher start thinking about the possibility of changing his/her immediate school environment. As a rule it's good to start with the question of how much world reality (matter, energy, information, data, knowledge, etc.) should, and could be allowed to enter the school from the outside.

Or, stated differently, which elements, structures, relations, artifacts, events, and dramas of a turbulent, violent, and ungovernable real life (both socio-cultural and natural) which is going on beyond the heavily guarded school walls, are needed to initiate sustainable, controllable, and properly oriented learning process within its precincts.

In our case there is a question of selecting, channeling, taming and shaping these demonic forces by the use of the available technologies equipped with the interfaces able to re-create the conditions of that human educational encounter, interactions, and transactions.

The aim is to translate all those ill-defined problems of the teachers development into a metaphoric scenery and see if the characters re-enacting the situation in their own way, could represent it in a more coherent and articulated form, and even give us some clues to where to seek-&-find the practical solutions.

What follows next is a sketchy outline of our strategy aimed at developing wide range of intellectual skills as well as forming an attitude toward a group work among the schoolchildren of different national and cultural backgrounds.

Extracurricular activities

Nobody believes that the goals and objectives mentioned above could be achieved nowadays within the established school system. The main reason is that this very system was born centuries ago out of completely different set of socio-cultural, as well as economical needs and had been devised for the different purposes.

On the other hand we're by no means preaching for its immediate replacement by some other "system", equally bulky and inefficient. But it is conceivable to make a move toward the realization of the above mentioned goals and tasks by launching something which might be called "parallel", or "complementary" education, growing and evolving alongside the "legitimate" one without any intention to compete, even less to struggle with the latter.

Meanwhile, it could be done in the precincts of any ordinary school as extracurricular, non-obligatory activities having no slightest resemblance to the regular classes or lectures. Learning at home is another vast area where such approach might be quite appropriate and willingly accepted. And, of course, it must be done without any attempt of "teaching" — the main principle is the facilitation of learning. A methodological issue that needs to be discussed here is to what extent this facilitation may, and can be game-like.

CENTERS OF THE UNIVERSE

"Negative, chaotic, essentially irrational, a sheer waste"

Any game played with the objects and/or personae "living" in a microworld on the computer screen is, by definition, a computer-game, and UNESCO Recommendations on ICT in primary school treat this topic quite symptomatic under the heading "DRAWBACKS" OF ICT. It reads:

"The misuse of computer games, in some respects, is similar to other types of misuse, such as the activities of some hackers or the misuse of desk-top publishing. This phenomenon was analyzed in the 60s by J. Weitzenbaum. This behavior is based on having a feeling of control over a quasi-reality and the ability to raise self-esteem by achieving some goals inside this space. If something is going wrong, the person "in control" tries to fix it. In the worst case, this "fixing" is chaotic and essentially irrational.

A total effect of computer games should be considered negative, a time spent on it — a sheer waste. (My italics) There are many other meaningless pastimes, indeed: watching TV cartoon channels and reading comic strips may be estimated equally. However, computer games are evidently more attractive due to its interactivity and the active role of a player. Its appeal stems from a sum of such factors as a feeling of being in the midst of action, achieving power and success in through-the-screen world; a reflectory physiological reaction to the moving images, the dynamics of game (a desire to win back), and a curiosity for the unknown.

Some of these aspects also took place in other computer-related situations, first of all when one is getting accustomed with the new software applications (the virtual worlds in its essence), and while making programming (especially by hackers). It's worth noting that a programmer may perceive the corresponding worlds and events happening there in entirely irrational manner; a process of winning the game and debugging the program may depend on positions of planets or some ritual actions of men. <...>

An immersion into virtual reality, the lost of orientation in, and, finaly, all connections with life, or destructive behavior of hacker is, of course, a negative aspect of ICT development. However it would be unjust to separate it from other negative and positive phenomena of contemporary life, as well as information revolution is inseparable from the Future Shock.

The way out here <...> is not inside ICT, but in building the system of values and moral orientation for the youth in information sphere, in other words, in giving them good up-bringing."

I'm ready to subscribe to many, though not all of assertions quoted above, and ought to make (first again quote) some reservations.

High degree of interaction

Alfred Bork, one of the founding fathers of ICT-based education, wrote in 1994:

"There seem to be an assumption in informal education that unless material is game-like it can not be effectively used in home environments. One sees this increasingly in the television programs <...> for science and mathematics. <...>

The issue is not to produce games, but to encourage learning. We do need to keep people motivated. Games are not the only way to motivate students in learning science and mathematics; it may be that motivation produced by games in not the most conductive for deep learning in these areas. We emphasize that the materials to be created are intended to compete, for students time, with television <...> and with computer games. The question then is whether this competition is successful, and learning is increased, not whether we imitate games and perhaps try to subvert them to educational purposes. <...> ...material can be very highly motivating without having an explicit game-like structure. This is a high degree of interaction. Programs interacting frequently with the user, even if they are serious programs with no aspect of games, will, we have demonstrated, hold students interest for long periods of time. <...>

This is not to say that games are not frequently usable. But one must be cautious. Many things called games are not viewed by children as games. Games often imply of competition, while in many learning activities we would encourage cooperation between learners... We want people to learn not because it shows that they are "superior" to someone else, but because they enjoy learning, find it pleasurable activity. It is only the second situation that will lead to strong life-long learning for all students.

The computer games in home and in the arcades are based on violence <...> and it's close relative, competition. We will stress cooperative human endeavors, getting students to work in groups and encouraging such cooperation. We want to establish partnership between children, learning relationships that are profitable to all of them". (Learning Science and Mathematics at home. January 12, 1994)

Hypergame

To our opinion the most promising approach is a hyper-game in which the participants invoke the fundamental risks and challenges which man has to respond to from the dawn of human history by the House-Building, i.e. creating ever expanding physical and symbolic environments of human habitat.

A hypergame presentation, analysis and synthesis is the way of looking at very diffuse and ill-defined problem situations involving interactions between a large number of participants. The approach considers situations in terms of diverse points of view, values and attitudes of the people involved; the options available to them, and their personal preferences. It acknowledges explicitly that different participants may view the situation and related problems in many different ways. The thinking and building scenarios and object-models in hypergame terms can help those making decisions about systems which involve people to produce more effective designs. More often than not it would call not for competition but for co-operation and collaboration.

In our case the challenge could be re-domestication of an artificially mortified wilderness, or a man-made desert land. This task is fully justifiable both for pragmatic persons and those searching new horizons in learning in the days of social instability, economic recession, political turmoil, and a rapidly expanding educational "disaster area". A participation of schoolchildren in any country would be possible through the telecommunication network. We have developed a scenario of such a hyper-game - let's call it The Game - designated *Centers of the Universe*, and I'm going to explain briefly its core idea.

Crucial quest

As the great French thinker Teilhard de Chardin once said in his famous book "The Phenomenon of Man", each person is the center of the universe he/she is constructing for him/herself and for the ones he/she loves or cares for.

But all too often we are not very pleased with the universes we have constructed. And even we are, it soon appears to us that our own universe more often than not is incongruent and alien to all the others.

It's interesting to know, whether our universes are fatally incongruent, alien and mutually exclusive. Or there is some hope that by mobilizing all our skills, knowledge and good will we might be able to modify and improve a bit the designs and constructions of our universes?

In order to get a plausible answer one has to go on truly crucial quest.

Imagine that you and a small bunch of people of different ages, origins and backgrounds, who are speaking different languages and never met each other before, have just been transferred by some space adventure or accident to an unknown planet.

This planet is perfectly equal to our Earth in all its natural environment except the presence of Homo Sapiens. You and your fellows are the only humans, and all of you are devoid of any material artifacts. What you have to do in order to survive first, and, secondly, to live a rather decent, meaningful and joyful life until being rescued?

To build the world anew

In a sense you are in a position similar to that of Robinson Crusoe left alone on the uninhabited island after wrecking of your spaceship. The difference is that you didn't spare from it any useful things of contemporary civilization.

Unlike the people of the prehistoric times you can't cling to the old ancestral ways and customs of the tribe: those, as well as the tribe itself, are yet to be discovered, invented, created, and tested! Hence you have to take a risk of exploring a new found land of wilderness, and to domesticate it. Let's think about drawing a preliminary mental map, a plan, or priorities' list.

Obviously, you ought to make some tools right on the spot to provide food, cloth and shelter for your small community. Then, or rather simultaneously, you must create some simple objects for elementary child- and healthcare. And, in view of inevitable frictions, tensions, and collisions you must provide some specific artifacts to organize and sustain the community itself: the common language, symbols and rituals, shared values, beliefs and myths, some social institutions, distribution of goods, law and justice, etc., not forgetting about education!

In this context we shall ask our children to find the ways for solving possible conflicts and problems using their inquisitiveness and intellectual curiosity, their newly acquired experience, their wit and imagination in the process of designing, probing, and experimenting instead of fighting and battling with their fists and weapons.

Let us see what our children's creativity guided by some universal principles of love, respect and mutual support can achieve when they do imagine and with their own hands construct not the one but many models of a New Universe together.

In short, let us give them an opportunity to model an entire civilization anew during the course of our Game, and to re-enact an imaginative course of cultural evolution and social history of mankind.

Inventing alternative history

There is a lot of questions which the Game will inevitably pose to them. Should they repeat all the logic or, for that matter, illogic of the historical path which mankind has already done? Is it necessary to repeat all its blunders and mistakes, its wrong decisions and dead ends? Its arrogance and bellicosity, its injustice and bloodshed, its economic, military and ecological crises?

Or is it possible to present within the framework of our game some healthy imaginary alternatives to the already known historical development? And if so, why not to invent alternative history not only for our separate past, but for our common future as well? Why not to start to design immediately the ways and means not only for the better understanding, but for making together something tangible and useful enough in our day to day educational activities?

We positively believe that if the schoolchildren of all countries — and, perhaps, some adults who are childish enough — would start a game like this, it will help them to develop new consciousness which will enable them, when they are grown up, to cooperate and collaborate creatively on both local problem solving and global projects.

Prospects

A theme of The Space Robinsons seems quite appropriate in the prospects of future exploration, learning, and growth. It has a flavor of sci-fi adventures and it's a good primer in collaborative work on such subjects as "Making the Habitat". We "hatch" a Planet, bring Space Travelers, and make a shelter for them. The focus on Housebuilding and household arrangement would allow us to exchange (if even the most simplified) spontaneous expressions of our native world-attitudes, family symbols, traditional life-styles, etc. and other of the participants.

It also would give us the opportunity to make comparisons between our basic cultural patterns, to draw distinctions, to expose the similarities and to produce some synthesis of those elements that fit best to the problem in question.

At the same tine a proliferation of the Game via Internet would give a powerful impetus to further qualitative and quantitative growth of the electronically networked schools as the agents of change, making them much more informed of, responsive to, and efficient in their particular fields of operations. By the same token it would facilitate their becoming more deeply concerned with and influential upon the broader socio-cultural, political, and even economic situation of many societies in transition. The schools may invite leading scientists, authors, artists, and other public figures from all over the globe, to participate in the game and make their contribution into the design sketches for our future developments.

An access to the schools electronic bulletin boards and telecommunication conferences on the most urgent problems of contemporary life modeled within the Game would prompt intellectuals, social workers, and all concerned citizens to explore the new ways of resolving existing controversies and conflicts by probing common ground within the moral and cultural realms.

On the other hand It would help schools to be more articulated, structured, and accountable in their own aims, ways and means, public activities, and other educational matters.

Prerequisites

That was just a general idea of The Game so far; a lot of hard work has to be done for its practical implementation. It is no less obvious that these goals and results can not be achieved just by pronouncing them ex-cathedra, or by measures taken by any of the state's offices. No positive changes could be expected unless and until the profound transformation takes place within the very core of the one's psyche, resulting in spiritual re-awakening and creation of a new value orientation and new societal culture. Transformation of such kind and scale can only be performed through the multitude of individual initiatives, joint efforts and diligent day-to day work of numerous non-governmental organizations (NGOs) functioning independently but keeping in close touch with each other.

The churches and religious colleges of various denominations, private schools, communal charity and mental health centers; philosophical societies and academies of free thinkers, political clubs and human rights watchers; environmentalists, cultural preservationists and social design groups — these are potentially (some of them already actually) the foremost path-finders and torch-bearers on that dark night journey toward the new dawn. Up to now most of them have been operating on solitary basis, sometimes even not knowing of similar organizations with the same goals and having no means to find each other.

DIVISION II. TO TELL THE MENU FROM THE DISHES

LIVING AND LEARNING WITH VIRTUAL ENTITIES

The problems brought up for discussion at many of the UNESCO meetings on Informatics, or ICT, are not entirely new. They don't strike us as a bolt out of blue Cyberspace. Just look at the words by which those problems are formulated. For example, we talk of *abstractions* and *representations,* then move to *lure, temptation*, etc. One would rather think of Scholastic theology (St. Thomas', perhaps). At the same time such themes and topics — as well as, say, the problem of our natural environment, — were never felt more urgent than today. Let's take a topic of the *info-ethic* seen from the educational perspective.

Three interconnected realities

Before plunging into specifics let's designate the notions of three distinctive, but interconnected "realities" we are refer to while carrying along our discourse.

One is *outer reality*: the on-going, irreversible events of temporal/spatial object-world.

Another — *inner reality* of an individual's psychic, or conceptual life — such as thoughts, mental images< dreams, etc., that is, intangible and non-spatial — events somehow correlated with the outer ones.

Yet another — intermediate, or *artificial virtual reality* which an individual is constructing in order to project his/her concepts into the ephemeral external images. The poetry, painting, music and theater, as well as philosophy and theoretical science, not to say of mathematics or chess, does belong to this category.

It is not out of place to remark here, that a number of eminent religious and political thinkers of the past used to warn their contemporaries against the risk of being too deeply involved, enchanted, even intoxicated with such virtual entities, or "false figments of imagination" as they often used to call it.

In fact, they shouldn't had been so much worried about. Up to the twentieth century these "figments" were successfully kept under strict control of the Church, the State, the School, and the dominant societal mores and customs. It was not very hard to achieve this because the "traditional", pre-digital virtual realities, being essentially non-interactive, were easily controllable from the outside with rather simple means.

The advent of computers, modems and global networking has shattered the very foundation of that *regime ancient*.

Infinite smorgasbord

Nowadays every kid given (at least of a middle-class family in developed country) an affordable mass-produced technology, is welcome to Cyberspace for browsing through the practically infinite smorgasbord of virtual reaches appealing to any heart's desire. There is a great risk of indiscriminate tasting and devouring these viands and victuals, threatening with the heavy indigestion and poisoning the adolescent minds.

As far as our particular topic is concerned a casual gastronomic metaphor hits the point more sharply than it seems. Alan C.Key, the leading proponent of computerized teaching and learning, has cited the famous physicist Murrey Gell-Mann who once said: "education in 20th century is like being taken to the world's greatest restaurant and being fed the menu."

Taking this comparison a little further Dr.Kay continued: "In the near future, all the representations that human beings have invented will be instantly accessible anywhere in the world on intimate, notebook-size computers. But will we be able to get from the menu to the food? Or will we no longer understand the difference between the two? Worse, will we lose even the ability to read the menu and be satisfied just to recognize that it is one?"

Let us ponder upon these dilemmas.

The menu is nothing but a highly abstract verbal description, nearly a designation of the exquisite food. To consummate the latter — and under favorable circumstances it could be a memorable learning! — one must absorb its immensely complex organic matter charged with energy and sufficiently cooked.

At the same time everything we want from the former can be delivered to us in its entirety with only small amount of information carrying just the names of the dishes. But nobody ever thought of the menu as a *practical* teaching and learning device of any kind. Neither should we feel contend with this self-evident conclusion.

A cook-book

Somewhere beside, or in-between the menu and the dishes lies the cook-book which gives us less abstract, more concrete representation of our subject. Many gourmets are the avid (one may say — voracious) readers of such a literature. And it's not exceptional that a gourmet happens to be also a decent cook, — not *le chef,* though, but a capable dilettante.

Suppose you are a newcomer here, an aspiring novice premeditated to become a connoisseur.

Being intrigued by, and attracted to the art of cookery you would get a serious, perhaps a professional cook-book, and start reading. Let's assume for a while that the only cook-book available contains no pictures, just words. Nonetheless, even this purely verbal source of required information could be quite valuable for the truly interested, therefore — diligent student-apprentice.

There are the recipi and instructions, operations and procedures, "algorithms" and "programs" in a quite literal sense. You can get a lot of knowledge on how to pick up and treat the various ingredients with proper cutlery and utensils; how to have them seasoned with the right spices, timing and temperature; how to assess the end result and have it served gracefully. After taking this introductory course you'll be appreciably more prepared to take a "laboratory" lesson at the actual kitchen.

By the way, there is a lot of room for improvement in the means of representation of the content in question.

Just think of how much your read-and-learn progress could be accelerated and benefited in many other aspects if the cook-book used was not only verbal, but also pictorial. Better yet — accompanied by the instructional video. The best of all — equipped with a latest interactive computer tutorial — a three-dimensional multisensory simulation of the making, cooking and serving your own *piece de resistance*.

Needless to say, you still couldn't be able to eat physically the virtual product of your efforts. However, this fact does not diminish the value and significance of those knowledge and skills you have acquired in the process. They will be of much help at the final practical stages of your apprenticeship. And we may be sure that if the education of Cyberspace age will be organized along the similar lines every graduate will make no mistake in telling the menu from the dishes.

Let's generalize a bit on what was said.

Palpable r*e-externalization* of the "pure ideas"

There are several levels of abstraction that may be used — though not always simultaneously because of institutional and technical difficulties — in any teaching and learning process. Cyberspace allows us to integrate and operate them all jointly, in the most natural, flexible, cohesive, and personalized manner.

For example, very often we develop our ability to manipulate symbols on the basis of our dexterity in manipulating material objects, especially tools. After the epoch-making works of Lev Vygotsky, Jean Piaget, and Jerome Bruner it became a cliche to talk about the *interiorization* of physical tools. We would make their "psychic" counterparts in the form of *conceptual tools*, then start using the latter to construct our own internal versions of reality, or many realities, for that matter.

No one can deny today that a human being has a number of ways and means to know and think about the world. There are different modes of doing, seeing and manipulating things and symbols alike. In the field of modern education it is convincingly represented by the pioneering works of Howard Gardner on *Multiple Intelligence*.

The individuals also differ from one another both in their in-born predisposition and acquired personal preferences for a peculiar choice of those ways and means.

By the same token the humans are capable *to invent* the new, more and more sophisticated and efficient mental instruments. They are striving for them in order to perform more and more intricate intellectual functions, thus trying to erect more and more elaborated epistemological edifices.

Cyberspace can be quite justifiably seen as the heaven-sent gift for such exercises, — sort of Platonic dream coming true in the form of the visual, audible, even palpable r*e-externalization* of the "pure ideas"!

Here we come to a very impressive discovery: an educational interactivity of this sort does offer us a good model of what is going on in the Internet at large.

Complete promiscuity is not desired

It was Vinton G.Serf, the founding father of the Internet, who first saw its new *problematique* brought forth with Al Gore's proclamation of the "information superhighway". In 1994 he called for shifting the main focus of attention from purely technical problems of high speed search, switching and connecting the computers to the potentially much more complicated social, legal and institutional implications of building a reliable information infrastructure.

A predominant and ever-growing emphasis on trade and commerce in the Cyberspace has been already evident. On the other hand there were neither officially imposed norms and rules, nor voluntary adopted multilateral gentleman's agreement to regulate the often contradicting strivings, aspirations, and demands, — that is, to make all the transactions run smoothly. As an immediate result "the <current> Internet framework has enabled a kind of anarchic".

Dr.Serf held, in his turn, a strong opinion that even in the virtual business world "complete promiscuity is not desired". His favorite idea was that "before we can *compete* in the electronic information infrastructure, we have to *cooperate* to develop the framework." Talking about the latter he implied first of all a set of relationships based upon the clear understanding of mutual interests, common good, and ultimate interdependence.

Characteristically for him was also a direct reference to such notions as the rules of the game and the fair play. He didn't use the word "ethic", but came quite close to it while saying: "First we have to build the playing field so our software products and services will interwork: *then* we can compete!"

Jerry Michalski (once sort of a house-writer in Esther Dyson's Release 1.0) had tried to investigate how "the human nature meets communication technology" and came to conclusion that "Cyberspace mirrors the real life and surpasses it. It has economies, social events and crimes. It has public and private areas, religions and social norms".

To my humble opinion it would be safe to say that we have to deal conceptually with both in order to understand the true nature of each one of them.

THE HUMAN SIDE OF THE DIGITAL WORLD

Could one *honestly* keep on tracking, monitoring, surveying and recommending anything sensible related to the new developments of information/communication technology in education/culture without entirely losing one's self-esteem?

Here are some desperately disparate notes trusted into the bottle buried in the sand on the beach instead of being thrown into ocean waves.

Lagging behind — for how long?

As a schoolboy in the mid-forties I had a textbook on physics where just a couple of paragraphs was devoted to the wireless transmission of signals and the only device shown was an "Edison's valve".

Chances are that majority of today's science (as well as "Informatics") textbooks would treat the advanced ICT in similar fashion. And given the ever accelerating pace of change, the relative lagging behind gets even greater.

I see no way to reverse the trade wind as far as we pretend ourselves holding a position of the neutral observers and/or "objective" investigators submitting reports on some quasi-"natural" phenomena we are supposed to describe, interpret, understand and evaluate "scientifically".

Why not to declare *urbi et orbi* that we are the participants (though without clear-cut role assignments) in an educational/cultural project, or several different, simultaneously running projects, sometimes separate, sometimes bordering, sometimes overlapping, sometimes contradicting each other.

Hence, in case we want to reconcile them somehow and get a synoptic view of all we must launch yet another meta-project of a higher order?

<Douglas (Goedel, Escher, Bach) Hofstadter's famous saying: "Anything you can do, I can do meta".>

A propos, who are "we"?

User-centered stand

First of all we are users of the ICT, who are trying to turn them into the ICT based technologies for education and cultural development.

And we proclaim the user-centered approach to the ICT in education and culture.

Despite all that hype-rhetoric in the media a user remains the least thought-of topic in today's discussion on the future of ICT.

The most of what is being written and spoken so far in favor of ICT does reflect the inside views (and interests) of those who are making, advertising and selling it to the users — all too often without paying any attention to the inherent needs of the latter.

The most of what is being written and spoken against ICT by its critics reflects the outside and alien views of those who are not using it at all, and do not bother to know more about its intrinsic meaning and potential capacities and fields of possible applications.

Myopic tunnel visions

There is a centuries-long cleavage, sometimes sharp confrontation between two strains of thought deeply imbedded in the mainstream of European culture; one of which may be labeled Technomania, another — Technophobia.

Technomaniacs believe that man is called first and foremost to invent and use more and more efficient tools in order to fulfill the ever increasing number of man's desire to the benefit of all people on Earth. They identify technology with civilization in general, and are sure that before long it would be possible to construct a machine able to perform higher mental functions of the human brain (Artificial Intelligence).

Technofobiacs believe that technomaniacs are driven not by the care for people's good, even not by the sheer ingenuity, but by a covert (sometimes overt) will to power over all things living, which, in final analysis, betrays their in-born Death-wish and a hatred to the Life itself. Technophobiacs blames all the social evils on technology and preach the return to the simple habits of the "natural", or "organic" man unspoiled by techno-civilization.

A contemporary layman-user of technology (especially educationist) very often is confused and led astray by these conflicting views, inhibiting his/her own creative pondering and tackling on the concrete issues in question.

A time is ripe to analyze and re-evaluate the hidden assumptions that underlies the myopic tunnel visions of both camps in order to enable the users to understand better what's going on in the trade, thus allowing them to express and articulate their personal wants and preferences; — that is, to give their voices in a current dispute.

Once again, who are "we"?

Continuous trade-off

Of course, we are not just a small bunch of "experts", or gurus, but all those interested citizens of our local/global communities, longing for and striving to something beyond the assigned routine daily work with computers in schools, offices, factories or homes.

We are those, who are searching for something new; designing and conducting experiments, sharing experience and discussing the results with our colleagues and friends right on the spot or via WWW.

We are working together on the very loose (to put it mildly) organizational/financial basis.

Apropos, how many of "us" had contributed, and in what proportion to that damn UNESCO Recommendations on ICT in primary school?

It goes without saying that contribution of any member of the "team" (if there was any) cannot be measured strictly in anything like the "man/hours". There was a continuous "trade-off" between participants, not just mechanical additions of passive building blocs; a continuos exchange, sharing, and "collaboration of minds", if only at modest scale.

Towards a re-definition of work and tools

A lesson we could draw for the future:

An understanding of the true nature and content of such trade-off requires some sort of a dynamic definition of a project we are to launch and corroborate. Only this will enable us to organize our work along the lines more suited to the realm of ICT.

In fact we need a fundamental redefinition of the work, or labour itself. Former definitions were based on the idea of production of identical items of rather simple things: tons of steel, grosses of needles (as in Adam Smith's "Wealth of Nations"), thousands of cars per week, etc.

Information-&-communication era calls for new economy dealing with entities that are essentially non-additive.

Now is the time also to reconsider many notions of technology everybody takes for granted.

A WORK-TOOL TO PLAY WITH (OR AGAINST)

We tend to forget to what a large extent our mentality, down to its basic concepts, had been forged by prevailing technologies of the old and recent past. It's good to refresh it in our memory in view of the rising tide of the new attackers on conscious and unconscious psyche of the next generation(s) which would be surrounded by the ICT the minute they are born.

From Mechanics to Cybernetics

Ever since early humans started to make tools they begun to be increasingly influenced back by the creations of their own brains and hands.

Using more and more elaborate tools and technologies in order to change and control his natural outer environment the historical man was and still is changing his own inner nature, corporeal and psychic alike.

I am not inclined to discuss whether the man's tool making ability per se is a blessing, or a curse. The variegated examples of both positive and negative outcomes of Technology Triumphant abound. The question is if we could find some ways and means to orient and direct the march of technological progress more for the better than for the worse.

It was rather hard to do with the mechanical technologies of classical Machine Age. _The very feeling of having at one's command enormous quantities of mass and energy to shape the matter had intoxicated a man's mind with an illusion of omnipotence and made him almost completely forgetful about anything related to qualitative aspects of existence.

An advent of information technologies brought back the issue of quality under the label of "engineering psychology" or ergonomics — those hybrid disciplines aimed at successful coupling human and mechanical elements in the "man/machine systems". (Was it just the coincidence that the protagonist of Robert Pirzig's novel *Zen and The Art of The Motorcycle Maintenance*, who is tormented by the loss of the very notion of quality in our contemporary life, happens to be a trade-writer, churning out the computer operators' manuals?)

A man's Weltanschauung changed very significantly when one has to deal not with fiery furnaces and gigantic cog-wheels and levers, linked together by a linear chain of causes and effects, but with delicate typing keyboards and phantom-like images flashing on the monitor screen.

A Toy for the Adults

In the old mechanical world any scientific community regarding itself sane would unanimously reject a proposition to discuss the very idea of a smart machine that could understand the written commands and, when in doubt, ask its user: "Are you sure you are really want me to perform this function?"

Until computers entered the scene there was a clear and indisputable divide and cleavage between the realms of work and of leisure.

Nobody mixed working tools (of labour) and technologies with various playthings and game-gears.

To a very large extent (though often by inertia only) we still hold these distinctions valid. As a matter of fact can you imagine a farmer playing a zero-sum game against his plough and tractor? Or a blacksmith against his hammer and anvil?

But a lot of professionals who have had computers as the main immediate tool of their craft were doing exactly the same thing since the sixties: they used to turn these machines into the indefatigable partners and adversaries in a multitude of competitive games right at their work-place — and not only in a spare time!

In the mid-seventies the video-games became a household item; Nintendo made them detachable from TV-set and portable; to-day it is prosperous multi-billion industry.

Personal computers brought the same options to the millions of adults. Mid-nineties surveys show that considerable amount of work-time is spent on games, especially those which are pre-installed in the popular applications (Microsoft Windows comes with four of them). That's why Boeing Corp. removed Window's solitaire game from all its machines, and Sun Microsystems banned its managers from using presentation software to create fancy slides for meetings because they have been put more and more time fumbling around with colours and shapes rather with its business content. <In the Copenhagen Airport I just saw a big poster: STOP THE TECHNOLOGY MADNESS with modestly small words beneath (no doubt, being unnoticed by almost all passers-by): Sun Microsystems.>

From Yang-Control to Yin-Caring

But let us leave the adults alone for a while and concentrate on what kids are doing — and thinking, or, at least, saying about the computer games.

At first digital toys used to be targeted solely at boys; video-games <Cf.Papert: Children's Machine> taught them to be comfortable with "serious" computers (though can we call computers really serious, no matter how costly they are?).

Now we see the Tomogotchis, virtual pets, become the rage for the girls, and the lessons are shifting. The first time I saw a proto-, or archetype of that kind was a virtual human-like creature named Kevin, who used to dwell in his cottage on the computer screen at Stepan Pachikov's flat back in mid-'80s and was very much loved and cared of by Stiopa's son, who later became adventurous WWW surfer.

It was Sherry Turckle of MIT who first had paid a close attention to the core of the matter in her 1984 book The Second Self: Computers and a Human Spirit.

She had found that boys and girls often had very different attitudes to programming. Two fourth graders: the boy envisioned his program in its entirety, then broke it down into parts and tackled one piece at a time — sort of "hard mastery".

The girls was less reductionist and went back and forth with her program: she would do one thing, step back, evaluate, then proceed again — a process of bricolage, or tinkering (Papert wrote about it at length in many places).

The idea of bricolage has recently taken on a new meaning. Graphic interface becomes dominant paradigm. Most users, male and female alike, use bricolage: they cannot see engine under the hood. "Everything is on the surface. You don't read the rule book: you do it by tinkering. The danger is that this sort of bricolage becomes a model for all understanding. <Rules of Geometry and Deduction. Cf. AI, Language and Education>_A boy of 13 was playing SimLife. As Turkle became frustrated because she could not understand the rules of the game, Tim tried to comfort her: Don't let it bother you if you don't understand. I just say to myself that I probably won't be able to understand the whole game anytime soon. So I just play.

Reading and Writing to develop critical skills

Parents and educators should figure out how to impart critical reading skills.

When we read, we think “who, what, when, where and why" (what for) about the text, we question it critically.

To love books, but also word-processing which liberate writing capacity. (Body/Mind relationships at the most basic, and higher — level).

Play computer checker and learn analytical skills. Nevertheless, actual drawing is better when in ROL <Rest Of Life — now!> to feel the texture, "the resistance of material".

A Platonic World in search of the Sensual

A seduction of the world without emotional aspects — computers, technology, especially digital, where everything is reducible to logical atoms, are freed from any mystery. Is it conceivable to integrate both opposites? If computer is a Platonic world lets try to model their reconciliation. Impossible to do without a human moderator, he/she is thus reconciliatory.

This generation of kids, in confronting digital objects <agents?> and virtual space, are completely comfortable with what might be called "cycling through" (or "rounded paths of thoughts", according to Father Florensky), or bricolage and tinkering, or radical heterogeneity of theory. But it is an acceptance of fluidity that is striking. Tamagochi: what are we becoming if we are emotionally reacting to these objects that are evoking these responses that are meant to be our responses to our children?”(Turkle)

Dynamic agents of my imagination

A shift from war games to Tomogotchi.

The transition is from object-to-think-with to object-to-nurture. (Is anything nurtured by me — an object? Or subject?)

The new hook for these kids, and not just for kids, is *nurturance* instead of control and mastery.

You know intellectually that it is not another creature, but the emotion of not being able to let Tomogotchi down is on different register. The point is not just to be involved with technology; the point is "Technology for what? What it is doing for us?”

How people foist projections and needs — intellectual and emotional — onto computers and, more recently, the on-line world. <There’s the living human(s) out there, not just a machine. But in isolated computer is also the traces of human will and thought. Somebody imagined various situation I may encounter — with whom, or what? >

Encounters with real life which bring problems that I’m trying to solve — to find solutions — with the help of computer as a "smart tool", an expert system and as a support system, my outer memory, keeping “facts” and my own interpretations, allowing me to reminisce and compare, to prompt me, to ignite my imaginations, enhance my mental capacities and faculties.

Dynamic agents of my imagination. To randomize, make helpful hints. To increase variety shown to me, presented to me in manipulative way. A tool, a machine — a prompter to think. Andre Sinyavsky: a plant (in soviet concentration camp) is a good object to learn about things far above that plant as such.

Interface value

Turkle: “I’m trying in one way or another to get people to look at the subjective side of technology. My focus is on individual experience, on the construction of identity and the way technology is used on the construction of identity".

She talks about Virtual reality vs Real Life, or Rest Of Life (ROL)

Some women, who assume male names on-line can talk more easily and are listened to more readily. Whereas men posing as female characters are occasionally harassed sexually or upbraided for talking too much.

Internet to be a world where people can often subtly expand, in a healthy way, their repertoire of interactions — just as they did when the telephone appeared.

Turkle is worried about the trend of taking things on the computer purely at “interface value” — that is, not understanding or caring to understand *why and how they work*.

Seymour Papert laments: to observe, explore, and fix home radio & family car used to play a great role in cognitive and creative development of a boy in the '30s and '40s — nothing of this sort nowadays because everything is sealed-down and hidden under the un-removable covers.

T.A.Harris remarks: A tool often works better and has more meaning if we have some idea how it was developed, how it is different.

Three-fold nature of Man/Computer interaction

A brilliant idea of Aaron Marcus back in 1985. The *three-fold nature of Man/Computer interaction*, or three specific intersections of The Image of Information Age:

Outer-Faces (the images of information that computers produce: texts, tables, forms, charts, maps, photos, diagrams);

Inter-Faces (frames of information the computer presents to its user: verbal questions and answers, touch-screen visuals to interact with, etc.);

Inner-Faces (program visualization; all those means by which a computer system makes itself known to the people who builds and maintain it).

We should pay attention to all three "faces" in using ICT as an instruments and environments for learning.

Times of passage

Let's consider more seriously the consequences of allocating too much of our emotional being to, among other things, psychology programs, software agents and ubiquitous Tamagotchis. Papert invites a child to identify with the Turtle on the screen.

To see ways in which ideas about computers as a model of mind were getting into people's individual ways of thinking about themselves.

Victor Turner: Transitional, or liminal moments <Piaget's transitional objects> would occur at times of passage when traditional social structures may be suspended, re-evaluated and often reconstructed. One of the main function of *les rites du passage*. <B. Brecht warned against common attitude to see and treat the artifacts of social construction in such a way as if they were natural facts>

The computer seemed a perfect liminal object: it was both alive and not alive, both mind and not mind.

Life on the Screen: a problem of (pseudo?) Identity in the Age of Internet

DIGITAL MYTHOPLASTICS: GETTING REAL?

"Personalization" and "animation" of tools

Tools and technologies in ancient societies used to be wrapped by myths and rituals. They were "made" and felt as animate, perceptive, possessing its own will and dignity, reconcilable with human soul and strivings.

When today's users responds emotionally to a computer in case of some technical trouble, they typically call it unprintable names, hold down all the keys and may be contemplate throwing it out of a window. How to make people happy about the relationship between man and machine — and how to make computers more soothing when they detect frustration? Some experts think that *synthetic emotions* could make computers nicer.

New interest in how people feel about computers, as opposed to simply how they use them. — Byron Reeves & Clifford I.Nass of Stanford.— How people respond to a computer's personality. They shown that even computer-literate people respond emotionally to machine-generated messages they see on a screen, as well as apparently irrelevant details, such as quality of synthesized voice. As much like those that would be elicited by a real person.

An unhelpful error message, for ex., elicit the same signs of irritation, as an impolite comment from an unlikable person. Involuntary & largely unconscious responses have potentially important consequences. Users engage in general stereotyping of machines, for ex., being more likely to rate "macho" voice as more authoritative than a female one. Users also enjoyed interacting better w. a screen character of their own ethnicity than w. one portrayed differently.

Visual cues are important in conveying meaning. Joseph Olive of Bell Labs has found that displaying an animated, expressive face synchronized w. the voice can make the result significantly more intelligible. ("Talking Heads" at Media Lab)

Because many people today spend more time interacting with a computer than with other people, hardware and software designers must have a keen interest in such issues.

Emotion-sensitive computer?

At MIT, Rosalind W. Picard & her students made a next step — giving computers the power to sense users emotional state. The computer will need the ability to recognize & express emotions in order to be genuinely intelligent: Psychologists have established that emotions greatly affect how people make decisions in the real world. So a computer that recognize & respond to emotions might be a better collaborator than today's insensitive, pigheaded machines.

Detecting emotions is difficult for a machine, especially when someone is trying to conceal them. Picard: the apparatus detect frowning in volunteers who are asked to perform a simple task & frustrated by simulated glitch. To monitor the frown muscles by sensor attaches to special eyeglasses.

Paul Fernandes (w.Picard_):_"better than random detection of frustration responses by skin conductance and by blood flow at fingertip".

Jonathan Klein (MIT) is building on Picard's results to make friendlier digital helpmates. Strategies for calming frustrated users. Solicit a dialog or comment on user's annoyance sympathetically without judgment (inferred from observation of skilled human listeners). <Invisible Battle. Technique of the orthodox hermits>

One day computer may detect user is feeling down — & try to adapt by livening things up. <Suitable stories; look at these strips and tell me, what's close to your own situation, or condition. Photo robot of emotional states, of problem situations of your psyche. Stories compressed and expressed by personae>

To be predictable, controllable & comprehensible

There are strong arguments against. (I discussed it with V.M.Zinchenko in mid-'70 in relations to design ergonomics for big-system operators).

Computers to support emotionally, or affectedly? — Ben Shneiderman at Univ of Maryland. "People want computers be predictable, controllable and comprehensible" — not adaptive, autonomous & intelligent. Computer interface — a good tool which should do what he is instructed to do <by someone else or by mixelf> and nothing else.

A futility of making machines like people (e.g. talking car). Serious ethical questions about allowing people to be manipulated by machines in ways that they not aware of.

Picard: address only emotions that people do not try to hide. Microsoft BOB's digital progeny are alive & well — as the humanoid assistants, such as "Einstein" & "Clip-it" that dispense advise in MS Office '97 built-in system.

It brings us back to the fundamental question of what people have in mind when they discuss the possibility of AI in principle.

Has AI survived?

I'm skipping nostalgically the pages of 1988 book — The AI Debate (which I had expropriated from my daughter after she got her degree from Moscow Univ) — a number of really intriguing insights. Almost a decade later — another attempt to evaluate: "HAL's Legacy: 2001's computer as Dream & Reality. Ed. by David G.Stork. MIT Press,1997, reviewed by Paul Wallich in Sc.American. Here' are the main points.

Antropomorhic vision of AI: actual computer expert systems demonstrated near-human, occasionally superhuman autonomous abilities in range of fields from medical diagnosis to ore prospecting or financial analysis.

But these idiot savants did not show even the slightest sign of achieving general competence. In the subsequent AI winter — brought by the end of a military research spree as well as inevitable collision between venture capitalism and reality — only the mechanical cockroaches survived. Researchers scaled back their ambitions and aimed at achieving the cognitive and survival skills of a lobster or a cricket rather than a virtuoso surgeon or an ace fighter pilot.

If mechanical evolution proceeds a million times faster than its natural predecessor, we might expect the emergence of a digital dog from the famous Ray Bradbury novel in a century or two. Some stalwarts of the AL establishment, however, are calling for reevaluation of the essential goal of artificial-intelligence research. They contend that trying to create a thinking machine — for the time being, at last — is like asking the Wright brothers for an artificial bird, complete with feathers and flapping wings.

Cognitive prosthesis

Patrick Hayes of the Beckman Institute <not a contributor to the book under review> coined the term "cognitive prosthesis" to embrace a range of software tools, including automated memory aids and job-scheduling systems, that help people think more effectively, much as cars help them to move from place to place or hydraulic presses help them to bend and form metal. <An Orthodox Icon depicting the image of Deity is none else but a crutch, костыль, prosthesis for the crippled soul of a man — according to Father Pavel Florensky.>

No one expects to get into a car and sleep at the wheel while being conveyed automatically to correct destination. and perhaps no one should expect a computer program to diagnose patients infallibly or command a major battle. But even now software written using the techniques developed by AI researchers reminds doctors of possibilities they might have missed or schedules the transport aircraft that deliver supplies to combatants in far-off lands. The programs are nothing like HAL, but without people working toward the same vision expressed by Clarke & Kubrick, even these limited intellectual tools would not exist.

AI or not AI — there are a real flood of personal computers everywhere (at least in the civilized parts of the world), which penetrates education K to 12 and it is not out of place pose a tentative question:

Superhighway or the narrow path? The New Learning Utopia?

CHANNELING INFORMATION THROUGH THE ORGANIZED EDUCATIONAL CONTEXT

Utopia again

After Plato and the Neo-Platonic Humanists the utopian visions and proposals had become an indispensable part of the European culture. Nearer to our times a number of socio-political and techno-scientific utopias has gained wide public acclaim. The most radical of them, such as Communist's and Fascist's, have been even tried in praxis.

But in the realm of education the very genre of utopia until recently remained, so to speak, underdeveloped; that is, being relatively modest in its pretensions, obviously more conservative than inventive, and incomparably less popular. (The bolshevists' revolutionary zeal somehow circumvented the school — after some radical experiments in the '20s all returneth again according to its circuits.)

Now, at last, we have the brand new one, bold, innovative, and already on its way to be practically realized at the grand scale.

At close inspection, however, it bears evident familial resemblance with a long chain of intellectual predecessors from the historical past. Among them are Comenius' Pan-Sophia; the Encyclopedists' efforts to gather together all the world's knowledge in the finite set of volumes; Vannevar Bush's *memex* — a disc contained a micro-film reader and stores of film that would serve as the equivalent of an entire research library; and Ted Nelson's concept of the hypertext that was eventually corroborated by many others and fashioned into the WWW.

Information Unlimited

This latest utopia states that in a short while, when all the technical, financial, legal and other innumerable road-blocs and obstacles are hopefully eliminated, the true educational paradise would be reached (the late Ivan Illich's dream of *Deschooling Society* fulfilled). It goes like this.

Any individual willing to learn anything interested and valuable for him/her, could easily (given a computerized gear) do so by entering interactive three- dimensional multimedia environment filled with virtual realities of all kinds. There will be no schools,

classrooms, teachers and pupils as we know them today. Everyone will be free to choose, or design his/her own curriculum, subject matters, procedures; hire distant consultants, etc.

The corner stone of this great edifice of New Education is nothing else as unlimited access to all the world's information storage and the on-line exchange with all and everybody who would happen to be agreeable and affordable enough.

This paradigm-shifting assertion — let's name it Information Unlimited — leaves at least one doubt undispelled, and I dare to accentuate it here.

Environmental Learning

A philosophy behind IU is usually formulated in terms of what might be called Environmental Learning. It stems from the irrefutable fact that a baby learns to speak its native tongue without any special teaching; that is, by some kind of osmosis from the everyday language environment created by its parents, senior brother and sisters, other relative and neighbors.

Ergo: give a baby, or a child equally rich and friendly environment of 3R's, math, physics, biology, history etc. — and you get a perfectly educated person.

So far so good, but what is the precise meaning of the word "environment" we apply to our topic?

The baby (even infant) is exposed to teaching every time he/she interacts with a mother during breast-feeding and other kinds of nursing, being encouraged or (though gently) rebuked in case of positive or negative reactions. _

The baby is constantly taught — to a large degree compulsively — how to behave, and the speech (intonations, mimics, gestures) he/she is addressed do serve as the tools of that teaching.

Very soon the baby learns how to signal his vital needs through pre-verbal vocalization and even how to use it on the planned purpose to achieve his own goals by making adults do what he wanted them to do. Then comes all those successive developmental events and stages so brilliantly described in the classic works of Vigotsky/Luria, Piaget, Bruner et al.

Sanctions to switch the channel

In all these cases the baby deals not with "environment" but with his Universe populated by the sensible, sympathetic and emphatic, loving and compassionate, conscious and intelligent human beings exercising protective bodies, caring and caressing hands, expressive and impressive voices and faces full of different emotions, meanings and intentions. From now on all the information — and even "objective" data — that the baby and child would receive from any outer sources, will be interpreted by him as messages sent by someone who has a power to communicate and govern (the *numinous* one, as Rudolph Otto would say), and in turn, might be addressed in the course of the (supposedly teaching) encounter.

Wrote T.H.Harris in 1967: "A three-years-old who sits before a TV set <in the late '90s — fumbling with the remote-control, or even with a keyboard of PC> many hours a day is recording <in his memory> what he sees. The programs he watches are "taught" concept of life <not just "environmental information"!!!>. If he watches programs of violence, I believe he records violence in his Parents <the area of the cortex where, according to Penfield and Berne, the first taught experiences are imprinted and kept alive all through the life of a person>... This is certain if his parents do not express opposition by switching the channel. If they enjoy violent programs the youngster get a double sanction — the set and the folks — and he assumes permission to be violent provided he collects the required amount of injustices."

Let's consider the first encounter with the literacy. It can hardly be mastered in the same osmotic way as the mother tongue. Even less so by the child left alone to himself, just via Information Unlimited and Environmental Learning.

In the times long past the first written (printed) texts read, shown *and* taught to the kids were the Decalogue and *Pater Noster* (a good piece of poetic prose, at any rate).

Imagine a baby who is just thrown into the hurricane of the omnipresent texts of to-day's advertising boards, TV, newspapers, comic strips and pop magazines with nobody to help him understand the very nature of all these enigmatic signs and navigate safely amidst the numerous _Scillas and Charibdas. Multiply it by a factor of WWW.

We'd better stop now so you can infer the ineluctable conclusion by yourself.

P.S. A person(a) to communicate and interact with

There is the movement launched in mid-'70s and since then gaining momentum, mostly in Northern Europe, referred to as "Governess education". Ragnhild Soderberg and other researchers have called attention to the desirability of an early formal reading education. Its starting point is to actively "push" the child into reading using the greatest possible kindness while taking into account all possible knowledge of the individual. It is hardly feasible in ordinary school and a classroom, but the very idea deserves attention in relation to the prospect of the virtual *governeur* — neither a robot, nor an agent, but a person(a) to communicate and interact with by means of multimedia ICT.

Here we come again, because there's no escape from, to the main mission of a teacher

CYBERSPACE SUPPORT SYSTEMS

The purposes and functions of CSS, comprised of the high-level language multimedia authorware, d-bases, inference engines, smart interfaces, modems, fiber-optic cables, networked telecommunication links etc., transcend those of the already known expert systems,

though the notion of former usually incorporates the latter. In fact CSS would constitute the main alternative to the presently dominated expert systems by enabling users to become the everlearning experts of their own. Let us to explain the difference to clear the essence.

Cyberspace Support Systems vs Expert Systems

Frank Lloyd Write, the great American architect, had once said: "An expert is one who does not have to think. He knows".

Do we?

Each expert system built by the "knowledge engineers", represents an isolated cognitive domain: a finite set of well-defined problems solved before, plus the formal rules for drawing appropriate conclusions, — a closed "microworld" cut off from all the commonsensical "on the spot" judgments; emotional involvement, and "live" social intercourse.

Whereas professional experts remain indispensable in all traditional, long established, regular and well charted fields of human activities and enterprises, they simply can not cope with the sudden, unusual and unique. But there is a threateningly fast growing amount of entirely new, unprecedented, and vitally important problems of which no one on Earth could claim to be experienced, knowledgeable and authoritative enough.

Unlike expert systems the SC would give the user(s) neither precise answers on specified questions, nor time-tested operational instructions on how to perform particular task(s).

The SC would provide the choice of options for, and constraints to what user(s) can do in order to think productively and creatively within the full range of one's mental faculties and social connections when tackling extremely ill-defined problems.

A System that helps thinking

The idea of collective Support System proper was first introduced in 1979 by Gerald de Sew, Ask and Mike, corroborated since 1986 within the research program on Support, Survival and Culture at the University of Amsterdam; and made the main point of interest of the Center for Innovation and CO-operative Technology established there in 1990.

Our addition of "Cyberspace" to "Support System" emphasizes the focus on Shared Virtual Realities which are inherently present, created, manipulated, and developed by the user(s) in order to model actual problem situation(s), to reflect upon it, and to communicate newly gained experience.

The Cyberspace Support Systems are to provide the choice of options for, and constraints to what user(s) can do in order to think productively and creatively when facing, pondering and tackling the Dialogically Structured Problems (DSP).

The Dialogically Structured Problems

Dialogically Structured Problems are those which could not be properly posed, shaped and structured (not to say — solved) save in a dialogue between humans, or between human and a machine substituting some human qualities.

Cyberspace Support Systems are called to find solutions for the problems that are intrinsically insoluble without some intellectual, moral or aesthetic help from the Other Person.

The numerous problems of that kind — extremely complex and ill-defined — stem from highly uncertain situations so characteristic of all areas of contemporary life and fields of activity, especially in education.

It's a fact that two (or more) people can make things and reaching the goals that each of them never can do alone. But the opposite is also true. The historical drama of mankind abounds with vivid examples.

Ambivalence and crises

Through collaboration and co-operation the families, societies, and civilizations had emerged; kingdoms and empires had been forged; folks and nations liberated, cultures flourished, business enterprises organised and prospered, — or oppressed, enslaved, destroyed, held down, curbed, checked and inhibited.

This dual and ambivalent nature of collaboration and co-operation becomes especially troublesome in the times of rapid changes and crises.

Now so many individuals, groups, organisations, or societies at large are in need to step out of their stifling habits, ideological straitjackets and assigned roles; to acquire fresh ideas, approaches and world views, to master new technologies and the ways of living.

No ready-made answers

The destiny of the whole mankind is at risk unless it learns how to deal with such great dilemmas of today as the choice between desire for fast reaction and for long-term building; between the parochial and global attitudes; between individualistic and collectivist standings, between intention and implementation.

No ready-made recipes, or one-sided directional solutions can be available and valid in such dramatic circumstances. The insistence on "the one and only true" or "righteous" path would lead only to a dead end, or a catastropphe.

There is no hope for making any progress towards the even smallest positive results except to initiate a comprehensive dialogue of people with vested interests and at least two different positions, opinions, or points of view on how to act and perform their functional roles.

So Dialogically Structured Problems do arise every time when an indefinite number of actors (individuals or groups) tries to increase,— tentatively, and more or less simultaneously, — their competence for action. They can do it most efficiently by

accumulating the "history", or "permanent memory" (centralized and/or distributed) of their interaction in role-playing, along with continuos replenishment and renewal of the intellectual, emotional, and aesthetic resources at hand.

Due to their very nature the dialogically structured problems can change unpredictably and chaotically any moment, transforming their character, form and content, or even vanish to be replaced by something else.

Two classes of DSP

It's admissible to discern two main classes of DSPs — external and internal (in fact they interpenetrate).

Most obvious contemporary examples of external DSP are: the organization of educational and recreational environments, the designing of human habitat and business management, or welfare and health services; the launching and development of new social or political movements and institutions, etc.

But there are no less serious internal DSPs of grand scale, — familiar to the millions but scarcely tackled outside the therapist coach or confessional booth, — that can not be solved at all unless treated interactively in similar ways.

Some of internal DSP are timeless, some had been brought upon by industrial civilization, some have more recent (post-industrial) origin, some are originating right now.

Internal DSPs

A great lot of people is haunted, even tormented by the feeling of being lonely, abandoned, estranged, or buttoned-up and emotionally deprived. All too many suffer from being too shy, irresolute, indecisive, inferior, or having low self-esteem. There are timid ones who not dare to give voice to express themselves, to look for new horizons or tap their creative abilities. Some others play macho, boost masculinity and strong will in fear to expose their soft white underbelly and to reveal an urgent need for compassion and love.

A list of internal DSPs is far from being complete.

One more typical example: a headlong strive for power, social status, or success at any cost, devastating and deeply frustrating one's soul.

Yet another: workaholism, sort of all-devouring functional drug addiction. It goes hand in hand with the general inability to alternate vital activities and different life roles.

Nowadays, as never before, we are called, prompted, pressed, urged, or even coerced to live during our lifetime not just one life but many.

At an ever-accelerating rate the competitive, aggressive and demanding hi-tech world makes us change our roles, positions, functions, lifestyles, cultural environments, and, last but not least, our disguises, or personae — those many masks we wear.

It's not an easy task to keep pace with this race while remaining sane and retaining one's authenticity.

The need for new cultural tools and social channels

More and more people get a feeling of growing alienation and inner emptiness. Many are longing for community, or communion with those who have similar sentiments. They need some therapy to restore their lost balance, some incentive to further personal growth, and some learning to acquire appropriate skills and knowledge.

The trouble is that there are neither adequate cultural tools and social channels for intimate contacts, communication and exchange; nor specific treatment procedures, nor relevant education and training courses available so far.

As we can see, the range of internal DSPs is practically unlimited — as well as the need (and the potential market demand) for the ways, means, channels and supporting tools that could help people to find, or to work out the desirable solutions.

Lets ponder upon how the possible configuration of such ways, means, channels and tools might look like, if only in principle.

Innovation by Interaction

The solving of Dialogically Structured Problems is always an act of Innovation, — a Departure from the Established (considered "old", "unfit", or "inadequate" in present situation) with an aim to introduce and implement something radically New instead (supposedly more vital, promising, or efficient).

An immediate cause for this departure may be some new invention (technological, or artistic); it may as well be a recollection, or restoration of something from the distant past, neglected and long-forgotten, but coming to be very valuable and badly needed today.

The above mentioned Innovation often appears as the result of interaction within the viable collective of actors and systems, which in turn emerges from the structured continuation of mutually accepted relations spontaneously arising between them.

Maintaining interaction implies the set of agreements in terms of appropriate language structures, connection circuits and exchange protocols.

Special cases of these are the aggregations of user languages containing verbal (both oral and written), visual-pictorial and bodily-kinetic components; sufficient information storage, retrieval and processing tools, and communication facilities.

Functions of CSS

Cyberspace Support Systems we have in mind is nothing but similar structures/aggregations, helping users:

- to connect people laterally, not hierarchically;
- to generate interactively their own personal and/or group histories;
- to contribute ("down-load") any kind of data/information/knowledge from any sources, personal or otherwise;
- to exchange symbolic "goods" and "services" thus creating, storing, and enriching the local memories and shared values, i.e."cultures".

Let's repeat it again: initially CSS is not an expert system (though any type of the latter could be "down-loaded" into the former). It does not replace general properties of the world outside of any users' interaction by somebody else's made models of the past or future.

CSS maintains interaction that can grow in complexity and produce something of significance and value for the user(s) which is (at least partially) represented, sorted (chronologically and systematically) and stored inside the system in the form of words, sights and sounds, accessible for the further re-interpretation, manipulation, reconstruction and transformation by the user(s).

The "products" of interaction may include the models of past and future, as well as the models of users-participants themselves; that is, any Cyberspace Support System can be enhanced by its own expert system(s).

Applications

Applications of CSS are numerous. To name just a few: general education and training of all kinds; organizations for community development, entertainment and sports; initiation and launching innovation projects; individual and group psycho- and social therapy; social consulting and case-work; societal rule-sets (etiquette) meant to maintain interaction and personal dignity in times of existential crises (birth, puberty, coming to age, marriage, death, divorce), etc.

Strangely enough, the problematique of cooperation and collaboration implying actor's dialogue as its indispensable part, were until recently very much neglected by the leading experts in managerial and organizational studies — even when they talked about necessity of being creative.

The very notion of organisation, or management in business and elsewhere, including theory and methods of organizing people's work, have been treated without any reference to the above mentioned interactive concepts. Highlighted were such topics as conflict, competition, power struggle and fight between the actors, or control vested in a single senior actor sitting atop the hierarchical pyramid.

Synergy or tyranny

Dialogically Structured Problems require the opposite approach. In order to collaborate and co-operate each participant/user of Support Systems should observe two unshakable principles.

Firstly, he or she has to leave appropriate gaps, or "blank spaces" (one could say - making interruptions) in his/her repertoire, or set of peculiar actions, to be filled-in by other collaborative/cooperative actors.

Secondly, each actor has to maintain a communicative exchange of signals, signs and messages to monitor the process of connecting and interlocking various actions and activities in time and space.

Differences and discrepancies in the definitions and perceptions of such gaps and exchanges determine success or failure of whole enterprise which rely on Support System; that is, realization of one of two possibilities — the positive synergy or negative tyranny.

The problem of appropriately leaving gaps in actor's repertoire belongs to a domain of formal organization within Support System. Its solution requires an explicit distinction between descriptive and directional flows of information and messages; hence it's based mainly on vertical control.

The problem of communicative exchange is mainly informal. It may be solved only by sharing mind-sets, thought-images, "memories" and "workspaces" allocated to various users of Support System. This process is based on horizontal flows of messages without any distinction between descriptive and directional modes.

Constructing new languages

The evolution of Support System implies the ever increasing strengthening of horizontal flows of communication; they would help to aggregate spatially distributed people into the coherent troupe of actors who show quickly emerging and growing activities, synergies, and competencies.

The most promising development would be the some open link between the Support System's formal and the informal aspects: a language that allows the constraints of the formal to interplay with the options of the informal. The languages like this can help maintain close cooperation between acting persons even when their responsibilities become decentralized.

The task of constructing and testing such languages poses many a question which presently is hard to answer. Too many people may need, or use the same resources in pursuing widely diversified, often contradictory, even competing goals, and thereby can destroy all possibilities of prediction of the probable outcome(s) of their efforts. Dialogically Structured Problems, as we said earlier, do not allow "closed problem" formulations: they depend essentially on fluctuating local conditions - therefore, not on the predetermined, but on emerging order.

Solutions to such problems are related basically to the questions of mutual support (to ensure that all the participants get the benefits of cooperation); of survival (to ensure that the actors can "stay in the game"), and of culture (to ensure linguistic, in a broad sense — verbal, graphical, musical of scenic— resources big enough to design and implement the particular collaborative projects). This brings us back to the question of how could we continually design and re-design our collaborative educational project(s). It's time, perhaps, to take a bit more closer look at some general principles, tools, and procedures of designing.

PART IV. NONEXISTENT YET POSSIBLE

DIVISION I. CONCEPTUAL DESIGN AS GENERAL HEURISTICS

HELPFUL HINTS

Plunge into the unknown

The road to hell is paved with the good intentions (the historic lessons of communism are the best examples: compare the outcomes of Marxist-Leninist-Stalinist-Maoist & Pol-Potist socio-economic and cultural projects implemented in Russia, China, Cambodia and elsewhere). Intended to change, transform, or reinvent something in the life of ourselves, or of the other people, or of the whole Planet, we must:

(a) maximize our creative abilities in finding the most adequate ways and means to achieve the goals stated;

(b) minimize the risk of possible negative, destructive, deadly side-effects which may result both from the wrong initial assumptions and from unintentional faults, miscalculations, or omissions crept into our brilliant schemes, plans, programs and projects.

Suppose you have to make a vitally important decision in a situation entirely foreign and alien to you, while there is no one on Earth whom you could consult, or beg for advice.

How to tackle an urgent, extremely complicated, essentially ill-defined, and un-precedented new problem(s) when you failed to find any scientifically proved data-and-knowledge base, or a ready-made "algorithmic" recipe, or a systematic engineering method for its solution in the past and present experiences of your own and of the whole mankind?

Get ready to plunge into the unknown.

Be watchful

The headlong rush into a sink-or-swim action trial (and fatally irreparable error) nowadays is nothing but one-way trip to hell (often not for you alone). The new Armageddon and Holocaust may be easily triggered up by a small unforeseen side-effects of some careless steps taken with fairly good intentions. Be watchful and don't risk too much.

Use your imagination

Meanwhile, we can use our gift to imagine, and re-present (externalize in words, pictures, and musical/dance/theatrical performances) two set of entities:

(a) something which is wanted and possible but nonexistent yet, thus making us to face the problem of its realization and acquisition;

(b) some practicable courses of actions (operations and procedures involving our spiritual/bodily behavior and constructive activity with materials and tools) aimed at getting desired solutions together with analyzing, testing and evaluating their probable outcomes before implementing them in real life practice.

Get virtual experience

Hence, we can acquire sort of imaginary probabilistic experience(s) of the future shaped by our conscious efforts to make things a bit better than they are now.

On the ground of that "virtual" experience we learn how to cope with contingency and develop advanced projects which may be not purely visionary but having some commonsensical, pragmatic, down-to-earth anchorage.

Call it General Design

This is what we call Design, using this term in different contexts both as a noun and a verb to denote (and connote) a process and/or a result of a uniquely human activity of problem-solving and decision making in the face of extreme uncertainty and ever increasing time-deficit, with utterly high penalty for error.

There is a lot of literature on Design — architectural, industrial, graphic, interior, floral, hair-, stage-, book-, video-, web-, and many other genres of designing. We shall talk about General Design in the above mentioned sense, borrowing heavily from the now classic writings of J.C.Jones, C.J. Alexander, A.Osborn, W.J.Gordon, and, especially, Don Koberg and Jim Bagnall who managed to summarize and compress the true essence of Design spirit and working principles on the pages of their "Universal Traveler" of the '70s and the '80s.

Seven steps of designing

A concise Design textbook would give us the Logical General Sequence of Events named Designing, or the Design Process, and sub-divided (structured) into consecutive stages like this:

1. ACCEPT SITUATION: To find reasons for going on [to state initial intentions; to accept the problem as a challenge, to give up personal autonomy, and to allow the problem to become a driving force of process].
2. ANALYZE: To get the facts and feelings [to know about the ins and outs of the problem, to discover what the "world of the problem" contains, etc.].
3. DEFINE: To determine essential ingredients [to decide what we believe to be the main issues of the problem; to conceptualize and to clarify those goals concerning the problem situation].
4. IDEATE: To generate options for achieving the essential goal(s) [To search out all possible ways of realizing the major goals; to search for the means to achieve the determined ends].
5. SELECT: To choose from the options [to compare our defined goals with the possible ways of getting there; to determine the best ways to go].
6. IMPLEMENT: To take action (or plan to act) [To give physical form to our selected "best ways"; to make real or "realize" what we intend - if only in modeling approximation.
7. EVALUATE: To review and plan again [To determine the effects or ramifications as well as the degree of progress of our design activity; to self-improve].

A series of Design stages looks linear but actually it's recursive (circular, or, rather, spiral-like; evolving, ever expanding, never ending).

THE FOURTH STEP

Where the idea of transformation takes its birth

Just a glance at this list would show that in the beginning we deal mostly with empirical data, facts and knowledge about what is given to us and how do we feel about it. That is, we deal with what we already have now, and what we'd like to change but can't because we do not know how to transform our (or the world's) present situation for something better.

At the end of the list we deal with what we got (if only in our imagination) as a result, or end-product of our (if only virtual) goal-oriented actions organized according to some guiding idea of transformation which was born at stage IDEATE.

Coincidentia Oppositorum

You see that a stage of Ideation (numbered 4) is located right in the middle of the list, marking the central and most dramatic turn in the movement of the Design Time Flow.

At this point the opposition of teleological and causal motivations of successive design events does reach its climax (the nearest metaphor I could find would be the unimaginable coincidental occurrence of Zenith and Nadir, or the Winter and Summer Solstici; Coincidentia Oppositorum, as the Alchemists used to call it).

Paradoxically, this conflict resolves itself (if only for just one timeless glimpse of Eternity) in their interpenetration and reconciliation, leaving us a rather bleak memory of that vision of absolute harmony, unattainable during the course of history, and only approximated to a very modest degree after a period of very hard work lubricated with not a small amount of blood, sweat and tears.

Essential peculiarities

All Design stages are equally indispensable (we can't skip, or misrule no one of them without completely ruin the whole process of Design) but Stage Four differs essentially from the others in some peculiar aspects.

At Stages One, Two Three, Fife, Six and Seven we may successfully (though in different measure) apply our ability of the step-by-step logical, scientific, critical-analytical, systematic thinking and objective rational judgment together with our subject-specific professional expertise (say, in architecture, chemistry, mechanical engineering, transportation, electronics, etc.).

At Stage Four the above listed faculties are loosing their efficiency and ponderability, thus becoming less and less operative (though never entirely written off).

To achieve desired outcomes we have to rely mainly on holistic vision and connectedness, intuitive grasping, insight, and spontaneous creative impulses (not unlike those which inspire poets and artists), coming from quite unusual, obscure and utterly elusive sources of our imagination.

The forms of things unknown

Roughly speaking, Stage Four can be understood (both structurally and functionally) as a mediator, a communication link, or a friendly interface between what is given and what is wanted, assigned, seen as the goal to be achieved.

Or as a hall of mnemonic mirrors (or multimedia echo-chambers) where the images of the Past and the Future can talk to, and interact with each other in an endless row of ever present mutual reflections.

Or as a platform for a sympathetic dialogue and fruitful interplay of those art, science, and technology generated options to be chosen out of broad spectrum, and then developed recursively along the way through the later stages.

Or (shortly) as a metaphoric scenery for displaying the shapes of things yet unknown.

The poet's eye, in a fine frenzy rolling,
Doth glance from heaven to earth, from earth to heaven;
And, as imagination bodies forth
The forms of things unknown, the poet's pen
Turns them to shapes, and gives to airy nothing
A local habitation and a name.
(Theseus to Hippolita in Act V of Midsummer-night's Dream)

Indetermined Nature of Man

We could say that this urge for playing with shapes of unknown things is deeply rooted in the very nature of human being. Wrote Pico Della Mirandola five hundred years ago:

> "God took man as a creature of indeterminate nature, and, assigning him a place in the middle of the world, addressed him thus: 'Neither a fixed body nor a form that is peculiar to thyself have we given thee, Adam; to the end that according to thy longing and according to thy judgment thou mayest have and possess what abode, what form, and what functions thought shalt desire. The nature of all other things is limited and constrained within the bounds of laws prescribed by us. Thou, constrained by no limits... shalt ordain for thyself the limits of thy nature... All the maker and molder of thyself in whatever shape thou shalt prefer, thou shalt have the power to degenerate into lower forms of life, which are brutish. Thou shalt have the power, out of thy soul and judgment to be reborn into the higher forms, which are divine'.

And, as Lewis Mumford adds, that choice recurs at every stage in man's development.

And Aldous Huxley agrees:

> The choice is always ours. Then, let me choose
> The longest art, the hard Promethean way
> Cherishingly to tend and feed and fun
> That inward fire, whose small precarious flame,
> Kindled or quenched, creates
> The noble or the ignoble men we are,
> The worlds we live in and the very fates,
> Our bright or muddy star.

Prometheus, Orpheus, et al.

Apropos Prometheus: it was Mumford who lectured in the early '50s "that Orpheus, not Prometheus, was man's first teacher and benefactor; that man became human, not because he made fire his servant, but because he found it possible, by means of his symbols, to express fellowship and love, to enrich his present life with vivid memories of the past and formative <I'd say: creative/transformative — LP> impulses toward the future, to expand and intensify those moments of life that had value and significance for him". [Art and Technics]

Then in '67 Vladimir Tassalov, a soviet Russian art-historian and philosopher published a solid monograph entitled Prometheus Or Orpheus, where he collected and presented a lot of substantial evidences showing that Orpheus is notably dependent on Prometheus in many important aspects of his artistic activities; — thus should not be elevated too high as a supreme and authoritarian ruler in the Art realm.

I consider both mythic figures as two interdependent, equally important and indispensable facets, or manifestation of one creative-transformative Source, emanating its energies in an infinite spectrum of directions, forms, and frequencies/wave-lengths.

In contemporary World/Human Crisis (and may I remind you that in Greek the word *crisis* means the Court Trial?) both Prometheus and Orpheus (together with Zeus, of course) should be summoned to testify before the Grand Jury in order to give convincing justifications for everything they have committed on (or to) the Earth and its inhabitantants so far.

On jugglers and communication

Maybe just one more quote - this time from Duke Ellington's preliminary notes to his First Concert of Sacred Music:

"Communication itself is what baffles the multitude. It is both so difficult and so simple. Of all man's fears, I think men are most afraid of being what they are - in direct communication with the world at large. They fear reprisals, the most personal of which is that they "won't be understood." Yet, every time God's children thrown away fear in pursuit of honesty - trying to communicate, understood or not -miracles have happened.

Wisdom is something that man partially enjoys -One and only One has *all* the wisdom. God has total understanding. There are some people who speak one language and some who speak many languages. Every man prays in his own language, and there is no language that God does not understand.

It has been said there was once a man who accompanied his worship by juggling. He was not the world's greatest juggler, but it was the thing he did best. And so it was accepted by God."

(Obviously Duke have heard from somebody about the medieval fable of Juggler of the Virgin, re-told by Anatol France.)

The Madman/Rationalist collaboration

We have enumerated the basic methodological principles and Stages of Design Process — sort of conceptual tool-kit proven to be useful by a number of responsible practitioners who struggled hard to meet these requirements.

My contribution, presumably, might consist of some assistance in enhancing imaginative output of the group during the Stage of Ideation. In other words, I can provide some heuristic stimuli and support during the period of generating multiple options, or working hypotheses on what should be done, to be weighted, checked and tested in "virtual" experiments before choosing those that seem more sound than the others, thus eligible for further research and development.

Many famous scientists and technologists of today describe a path which led them to their discoveries and inventions in terms very similar to an inner picture of an artist that Paul Valery, the famous French poet, had drawn early in this century.

Two different persons, or *personae* (said he) do co-exist, converse, interact and collaborate in the soul of a poet.

One is a mystic, or a mad visionary throwing out incessantly an endless flow of fragmented and disparate figments of his imagination without ever bothering of what may happen to them.

Another — a highly skilled and assiduous rationalist-craftsman, who picks-up, surveys and evaluates them critically, rejecting 99% as good-for-nothing and retaining 1% as a set of raw materials, or building blocks to be processed, recombined and configured into a finished "product", or constructed edifice (Since the '60s we see analogous division of labour between the team-members in system-engineering groups: so called "organized creative technology").

As if our Universe was designed

I'm neither mad enough to function efficiently as a first one of these two, nor skillful and diligent to perform the role of the second. But I've learned something on how to initiate, mediate and support a growing dialogue and productive interaction of this twosome by teasing and provoking, as well as interpreting, connecting and get moving the seemingly incompatible parts in case the ideation comes to a standstill.

In such agency I would ask the participants to accept temporarily some (including the most weird) ascertoric propositions of mine (borrowed from a wide range of suitable sources) as the basis, a starting point, or a psychic springboard, and then to act mentally in the pursuit of proper solutions AS IF MY ASSERTIONS ARE FACTUALLY TRUE (however absurd it may look from the scientific, or even just commonsensical point of view).

For a starter - to agree with me (to fuel our imagining in generating options) that the Universe not only *had begun*, but also *begotten*, or, better still, was *willingly designed* and actually *created*, say, in six days (or eons).

Something prevents me from stating it right now. I'd rather make a small detour and draw your attention to a fascinating news of neuro-science on bi-camerality of human cranium, directly related to my train of thought.

A SMALL RETREAT ONTO SCIENTIFIC GROUND

Michael Gazzaniga, who proliferated and popularized the Split Brain theme back in the '70s, reviewing the latest discoveries in this field (Scientific American, July '98) has reported and speculated, among other things, on some interesting new findings made by George L.Wolford of Dartmouth Univ. I can't help citing/paraphrasing it here *in extenso* (abridged and slightly edited, with entry's sub-titles added).

We can't do without theory, no matter how outlandish

Two buttons that can be lit from the inside and used as stimuli, are placed (one higher, another lower) before two groups of living creatures - humans as well as animals - under test.

The experimenter manipulates the stimulus so that light appears in the top button 80% of the time but in random sequence. While it quickly becomes evident to both groups that top button is illuminated more often, a striking contrast between the humans' and animals' reaction is observed.

People invariably try to figure out the entire pattern or sequence - and deeply believe they can. Yet by adopting this strategy, they are correct only 68% of the time. If they always pressed the top button, they would be correct 80% of the time.

Rats and other animals (apes included) are more likely to "learn to maximize" and to press only top button.

Why?

It turns out the right hemisphere behaves in the same way: it does not interpret its experience and find deeper meaning. It continues to live only in the thin moment of the present - and to be correct 80% of the time.

But the left, when asked to explain why it is attempting to figure out the whole sequence, always comes up with the theory, no matter how outlandish.

This phenomenon is best explained from the evolutionary point of view.

Loosing in order to gain

The human brain, like any brain, is a collection of neurological adaptations established through natural selection. These adaptations each have their own representation - they can be lateralized to specific regions or networks in the brain. Throughout the animal kingdom, however, capacities are generally not lateralized. Instead, they tend to be found in both hemispheres to roughly equal degrees. And although monkeys show some signs of lateral specialization, these are rare and inconsistent.

For this reason, it has always appeared that the lateralization seen in the human brain was an evolutionary add-on: mechanisms or abilities that were laid down in one hemisphere only. But researches recently stumbled across an amazing hemispheric dissociation that challenged this view. It forced them to speculate that some lateralized phenomena may arise from a hemisphere's *losing* an ability - not gaining it!

Lateralization as salvation

In what must have been fierce competition for cortical space, the evolving primate brain would have been hard pressed to gain new faculties without loosing old ones. Lateralization could have been its salvation. Because two hemispheres are connected, mutational tinkering with a homologous cortical region could give rise to a new function - yet not cost the animal, because the other side would remain unaffected.

It had been discovered that both hemispheres could perceive illusory contours - but that the right hemisphere was able to grasp certain perceptual groupings that the left can not... Could it be that the emergence of a human capacity like language - or an interpretive mechanism - chased that this perceptual skill out of the left brain? Our uniquely human skills may well be produced by minute and circumscribed neuronal networks. And yet our highly modularized brain generates the feeling in all of us that we are integrated and unified. How so, given that we are a collection of specialized modules (e.g., Mervin Minsky's *robot-agents* in his famous The Society of Mind)?

The answer may be that the *left hemisphere seeks explanations for why* events occur. The advantage of such a system is obvious. By going beyond the simple observation of events and asking *why* they happened, a brain can cope with these same events better, should they happen again.

Inventive and interpretative left hemisphere has a conscious experience very different from that of the truthful, literal right brain. Although both hemispheres can be viewed as conscious, the left brain's consciousness far surpassed that of the right. [End of my quotation from Gazzaniga]

Left hemisphere rehabilitated

The most amazing inference we can get after reading this report is that neither left, nor right brain alone is fully in charge of creative thinking (as for me, I always looked suspiciously at those hasty, short-sighted, and over-simplified drastic dichotomies).

The left one appears to be more inquisitive and inventive, though getting inputs by being fed with the impressions from the right.

It'll be save to say (after some authoritative experts, who gave us experimental evidences for it) that *each hemisphere mirrors* to a certain extent, and in its own special manner, the *functional properties of the other* (again a raw of reciprocally reflecting images in the pair of parallel looking-glasses!).

Hence, we should be more cautious in stating that the right brain is contend "to live only in the thin moment of the present - and to be correct 80% of the time." It is quite probable that the *right brain does provide the left one* not only with the holistic perceptions of the factual present, but also *with the madman's flashing outbursts of something which comes to us from the future*, or maybe even from *beyond* time/space boundaries.

Here I'm leaving scientific grounds to plunge into a very murky and dubious waters. For the sake of heuristic purposes please make believe that the following is true as far as we're moving through the Ideation Stage of Design Process.

CAPACITY TO MAKE

Poeia

The task or reinventing education requires a capacity to generate a lot of outlandish theories not only on why given events occur, but also on what we should do, and how we should act in order to shape those not yet existing patterns of events we'd like to emerge.

Thus we have to exploit both hemispheres (as well as our eyes, ears, and hands) and get them work in concert not only in cognitive domain but also in the domain of designing, as well as making and constructing, producing and manufacturing all kinds of things, soft and hard, spiritual and tangible.

After all, God had created not Heaven alone but the Heaven *and* the Earth; and out of that earth He — by His own hands — had *maketh* the man. The Greek word for "making" is "*poeia*", and some Russian theologians loved to use an expression: "He, The Poet of heaven and earth", and to call corresponding work-process "*Cosmopoesis*". At this stage of His creative activity He appeared to be the Master Craftsman.

Longing for Master

OK, so it was at the beginning of Time, but where to find a master experienced enough in reinventing today's education? I suspect the only way is to reinvent first (i.e. to design) such figure in hoping that there'll be some volunteers willing to implement our project.

Many would laugh, or shake their heads, saying: Hey! don't we already have such masters? Have you ever heard of Moses, Buddha, Jesus, or Mohammed? And of the Apostles, the Saints, and the Church Fathers, Doctors of Faith?

Yes, these great Teachers of humanity had left us a boundless legacy of infinite value. The question is how to come into actual possession of it, in other words — how to use it creatively, because that was just what they wanted and expected (still expect) from their disciples, heirs and successors.

It's not an easy task, as we can see in retrospect. There's a parable composed by Vladimir Solovyev, an outstanding Russian mystic-poet-philosopher (1853-1900). This is rather long, but it would spare me (and you) from my helpless trying to express what I feel obliged to explain in relation to my and ours possible contribution(s). Here it goes.

A parable of Architect's disciples

There was a great architect who once said to his disciples: "you know I came here to erect anew the main sanctuary of this country ruined by an earthquake. The work has already begun: I've drawn an overall plan, the cite is cleared of the debris, and the foundations were laid.

You shall replace me in performing the rest while I am absent. I'll be back, indeed, but I can't tell you when. Thus, do your work as if the whole enterprise must be done without me. You'll have an opportunity to apply those directions I gave you. I trust you and I will not dictate you any details of the business. Do observe only the rules of our art. Besides, I'm leaving to you the unshakable basis of our Temple laid by me, and an overall plan drawn by me: this will suffice for you if you will keep fidelity and adherence to your duty. And I myself shall not leave you entirely: in spirit, and in thought I shall be present amongst you all the time". He brought them to the cite, showed the foundations of new church, and had given them an overall plan.

After his departure all the disciples set to work together and about one third of the edifice was built soon. But because an enterprise was so big and complicated, the original team couldn't handle it further alone and was forced to invite extra men to help them. Shortly afterwards the senior managers started to wrangle seriously with each other. Some were arguing that among two things left by the absent Master - a foundation and an overall plan - only a plan is important and obligatory, so nothing could prevent them from throwing out the old foundations and starting to build a Temple from scratch at some new site. In the heat of the dispute they've been stating (contrary to their own previous views) that the Master never actually showed them the site, and never laid the foundation - all this was just a fable concocted by their adversaries. The latter defended the exclusiveness of the foundation by saying that it was the only real thing left to them by the Master and their only duty is a conservation of what was already built earlier without any intention to continue the construction, for (they said) it is the one and only Master who can make the work complete when he comes back.

Opposites meet, and both parties soon agreed that everything must remain as it is. They only differed in their temperaments and behavioral patterns. The party insisting on conservation was making a lot of minute repair works with tireless energy. Party of those, who thought they could neglect the foundation already given, had (after many futile attempts to build the edifice on the new site), solemnly declared that there is no need to make anything at all: what really matters in the art, in their opinion, is the theory, contemplation of beautiful specimen and discourse on methods, but not a practical implementation of any plans. And even if the Master had left them his plan, it was by no means aimed at prompting them to work together over the actual construction, but exclusively at providing them with perfect model, so each of them, by studying it diligently, could become eventually a full-fledged architect. So the most arduous ones had their lives dedicated to meditation and pondering upon the design of ideal Temple, as well as to daily memorizing and repetition of the explanations of this project compiled by the eldest disciples honored to hear them right from the Master's mouth. But the majority was contend to think about Temple once a week while pursuing their private businesses the rest of the time.

However, there was a few workers-dissidents who, after careful study of the original plan and its authentic interpretations, had discovered exact instructions, out of which one may conclude that the basis of the Temple had been actually laid and could never be changed. Among other things they came across the following words of the great architect: "Here is the unshakable foundations I laid myself; upon this one my Temple must be erected, and then it will remained stable under earthquakes and any destructive actions". Awestruck by these words the good workers decided to give-up their dissent and to join immediately the ranks of the foundations-keepers to participate it their conservationist's efforts. Nonetheless, there was one who said:

"Let us admit to being in the wrong; let's pay all the justice and render homage to the old comrades of ours, let's unite with them at the beginning of the edifice which we deserted so cowardly, and which they had guarded and kept in good order so selflessly.

But first of all we should be faithful to the thought of our Teacher. And he had laid this foundation not to leave it intact, but to build his Temple on it. Thus, we must all unite to erect - on a foundation given to us - the edifice in its entirety. May we have time enough to make it complete before our Teacher comes back? This is quite another question and the Teacher himself didn't want to answer it. But he definitely did command us to work and move ahead with his enterprise; he even had added that we shall make more than he".

Exhortations of this worker seemed strange to the majority of his comrades. Some called him Utopist, others accused him of being arrogant and presumptuous. But the voice of his conscience was telling him clearly that the Teacher absentee is with him in spirit and in truth. [End of a Parable]

Intrinsic feature

There's many a lesson not only in ethic but also in heuristics that might be learn from Vladimir Solovyev's parable of Architect's disciples. The metaphor of designing and constructing the Temple (which is both a sanctuary and an archetype for any human habitat) is immensely rich, provoking and fruitful (I'm going to elaborate it later).

I think that in approaching our sub-task of Reinventing Master-Teacher it would be not out of place to stress an intrinsic feature of this conceivable figure by quoting one great actual assistant-reinventor of humans:

For yourselves know how ye ought to follow us: for we behaved not ourselves disorderly among you;
Neither did we eat any man's bread for nought; but wrought with labour and travail night and day, that we might not be chargeable to any of you;
Not because we have not power, but to make ourselves an ensample unto you to follow us;
For even when we were with you, this we commanded you, that if any would not work, neither should he eat. [II Thessalonians 3:7-10]

And much earlier it was said by another author:

In the sweat of thy face shalt thou eat bread.., [Gen. 3:19]

(I prefer to use King James Version for quotation as being more suggestive, though New Standard American is undoubtedly excellent in its precision.)

Reinventing Human

My point is that being busy with Reinventing Education we should not forget to reinvent also the human capacity to work, as well as the work per se (Matthew Fox, a leading proponent of *Creation theology and spirituality*, has already wrote a book on it). And I definitely want to begin with the problems of that one-third of educational edifice (both already built and conceivable within our reinvention perspective) which is aimed at mastering technological work-skills necessary (though not sufficient) for our survival in present situation, and (hopefully) quite useful for our children (grandchildren) willing to live a more or less decent life in a foreseeable future.

To avoid confusion let me to remind you that I'm saying "one third" in relation to the remaining two thirds of what we agreed to call the Trinity of Education (see Part I, Division I, **ANCIENT LEGACY AND MODERN TRENDS).**

By reinventing the labour aspect of education we implicitly try to reinvent human: the former is like a design studio, a laboratory, and/or a workshop where the reinvention of the latter can proceed; and an old (legitimate) education obviously doesn't fit for this purpose.

Here are some other postulates and points of conceptual departure.

Collaborative effort

A new-born human is a Human just *in posse*.

A Human in posse becomes Human *in esse* only after she/he is made, or created Human.

Making, or creating a Human is a synergetic process: it implies a synergy of wills, a collaborative effort of both Creator and Creature. And it has no clear-cut temporal and/or spatial boundaries or limits; for some individuals it takes a lifetime.

Said Eric Hoffer in his Reflections on Human Condition:

> "Nature attains perfection, but man never does. There is a perfect ant, a perfect bee, but man is perpetually unfinished. He is both an unfinished animal and unfinished man. It is this incurable unfinishidness which sets man apart from other living things for, in the attempt to finish himself, man becomes a creator. Moreover, the incurable unfinishedness keeps him perpetually immature, perpetually capable of learning and growth."

A new-born is becoming made and created Human with a participation of her/his parents and kins, nannies and attendants, play-mates and peers, governeurs, tutors and teachers and many other persons who she/he happened to meet, affectionately encounter, communicate, and interact with — directly or via numerous mediatory artifacts (toys. tools, signs and symbolic representations; written and recorded messages, etc.).

We call such process an education in broadest sense, not confined to any established institutions and able to transcend all systems of formal schooling.

DIVISION II. TRANS-SCHOOLING

COMING HOME

More and more voices are insisting that a home — not a school! — could, and should be made the main center of educational activity. Lewis S. Perelman was especially compelling on this theme in his 1992 book SCHOOL'S OUT. Hyperlearning, the New Technology, and the End of Education. (I decidedly disagree with him in just one point: instead of "the End..." in the sub-title, there must be written "the Beginning...". I'd like to make also a minor insertion into the main title: "SCHOOL(as we know it)'S OUT" — that's why it would be wiser to talk about Trans-schooling, or, perhaps, about Open Education.) Here are some of his arguments.

Let them see your work

At the verge of the XXI-th century it becomes obvious: you have to create a home where learning is a necessary part of your way of life. Make learning a normal daily activity for the whole family.

Children become what they behold. Parents who are learners have children who are learners. Learning is as natural a human passion as sex. School may have stomped a lot of that passion out of you, but your kids still have gobs of it and you can renew yours by exercising it. How "smart" or "educated" you are doesn't matter - it's eagerness and openness to learn new things that counts. Rather than harangue the kids about doing their homework, let them see doing yours. One of the best investments you can make in your children is to invest in your own economic advancement, and that almost invariably means learning new staff. Most of this has nothing to do with taking courses or passing tests.

Real things in real places

One of the best ways research has found to nurture kid's learning is simply for the family to have dinner together and talk about what's going on in their world [and work]. A learning family needs not to be ponderously series or "intellectual". It's a matter of being ardently engrossed in whatever interests you, staying insatiably curious, and never letting the need to know something go unsatisfied.

Some high-learning families are avid sports fans — especially for baseball, which demands constant study of history and statistics to be fully enjoyed. High-learning homes are information-rich, even those that are not money-rich. They are full of books, newspapers, magazines, stereo, video, computers, toys for grown-ups as well as kids - all sort of things that stimulate and nurture curiosity. Providing a brain-stimulating home-environment is valuable to kids at all ages, but it is especially critical in the first year of life.

The lesson of learning "in context" and participating in "communities of practice" is that the most valuable learning takes place not in classrooms but in doing real things in real places connected with real people in real social institutions. All sorts of community organizations give kids opportunity to learn by practice, to be socialized by real society.

Strengthening families and children

If it fits your family circumstances, home schooling of children is an option that deserves your serious consideration. While there is some uncertainty in the numbers, estimates are that more than half a million American children are now schooled at home, an increase of ten times over the last decade. Home schooling is fairly easy to adopt in thirty two states that only require the parents who teach their own children have a high school diploma. Other states make it more difficult, requiring parents to have a college degree or to pass a teacher's exam, but home schooling is possible almost everywhere in the US. The home school option has the attraction of strengthening both families and children while striking a powerful political blow against the education establishment.

Remember: Learning and schooling are on collision course. Report cards, grades, SATs, degrees are all phony claptrap. Celebrate and invest in learning with passion and confidence, and your family's economic prospects and self-esteem will be well taken care of.

Such are J.S.Perelman's arguments.

The heaviest and often cited critical objection to his proposals: a scope of working activities, crafts, skills and types of occupation offered to the kid(s) inside an average family is usually too narrow.

Let's meditate on how this obstacle could be sufficiently diminished, if not eliminated within the rapidly widening horizons of the contemporary ICT-based cottage-industries. Its educational correlates might be called trans-schooling.

Learning/producing community

Imagine a rural community of the learning-&-home-schooling families, whose adult members are small home-based entrepreneurs developing and producing (sometimes co-operatively) various commodities and rendering services for the niche-markets and selected target-groups. Their trades might include organically grown vegetables, fragrance-healing herbs and exotic flowers; thoroughly-bred pedigree dogs and pets; hand-made traditional furniture, custom built hi-end vacuum-tube stereo amplifiers for audiophiles, software applications to suite unique user's preferences; festive music composed and played on private occasions, art-therapy sessions, etc., as well as consulting the customers/clients on how to extract maximal pleasures out of it while remaining physically and spiritually sane.

Every kid in such community can browse freely through many different in-door/out-door work-spaces and activities being driven by sheer curiosity, mimicking this or that job in plays and games, watching closely those which seem more impressive and attractive, asking questions fearlessly and getting concise answers, trying to imitate some, then choosing one or two particular arts, crafts, sciences or professions to be learned seriously through apprenticeship — either under the guidance of her/his own parent or relative, or under some other adult community member(s).

What if two, three, or more local communities of this kind would co-operate both in producing/marketing goods and educating their young alike, keeping in touch electronically and exchanging apprentices on regular basis, so that each adolescent girl and boy could have her/his own period of Wanderjahren? We may expect that something like the commonwealth of the networked rural guilds would eventually emerge.

Perhaps I'm running forward too fast in my ideational attempts to reinvent not only an education, but a work and a village as well.

Guilds remembered

It is instructive to compare this flippant figment of my inflamed imagination with what we know about the real historical medieval guilds.

The latter had appeared to be an essentially urban phenomenon: strictly regimented closed type organizations of craftsmen, and very conservative social casts. While maintaining high quality standards of their legitimately certified produce by clinging to the long time tested materials, tools and procedures, those risk-avoiding guilds were trying desperately to keep their monopoly on specific trades, opposing the slightest inner change, rejecting and severely persecuting the very thought of any innovation. Nonetheless, they fell prey of the dissenters: these bold risk-taking craftsmen-entrepreneurs who were essentially innovative and inventive (see Part I, Division II, Ch. **APPRENTICESHIP REHABILITATED).**

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In fact, a human was reinvented once again (after a series of preceding reinventions): that time in a shape of insatiably curious and ever-imaginative homo-inventor and re-inventor, brought to life by the spirit of industrial capitalism to become a builder of modern technological civilization that many do perceive now as an embodiment of all evils.

Are we trapped in a vicious circle?

Tapping the wells

The question is in fact if there's any options to break this circle and turn it into a spiral of sustainable development.

It would be quite appropriate to reassess (from the standpoint of possible reinvention) what had been designed, done and actually achieved by the generations of our creative predecessors striving to improve or transform their (and our) worlds. I believe we can be judicious and prudent enough to do it by taking neither nihilistic stance, nor exhibiting a fundamentalists' back-to-basics rage.

Since the days immemorial there were many immensely precious seeds of future planted around due to the human (demonic? divine?) ingenuity. Just a few yielded good crop, others had been spoiled by malaise, chronic ailments and monstrous mutations. The rest of them didn't give shoots at all so far because of some fault, accident or misfortune. Nevertheless, they are still lying dormant but having a chance to germinate and bring fruits when the favorable circumstances do occur and sufficient cultivation is applied. By unearthing these buried treasures we could tap the wells of abundance and get across an inexhaustible flow of juvenile energies, flashing insights and fascinating design concepts.

Of course, there's also a danger of becoming embarrassed, over-enchanted, even intoxicated by too many riches: a person who is practicing the ideation too recklessly is often at risk of being driven to the verge of insanity or, at least — complete intellectual irresponsibility. A sort of the mental Sorcerer's Apprentice case naturally comes to mind, indeed, but no matter what your opinion on Erica Jong's writings is in general, you hardly would deny the fairness of one casual remark of hers: "The trouble is, if you don't risk anything, you risk even more".

Just an instrumental look

It's time now to make a sight-seeing tour across the cultural landscape of the olden days and see if we could find there not ready-made solutions but something that would help us to tackle our present problems a bit more acutely and with due circumspection.

Remember: I'm going to ponder (or ideate) firstly upon just one aspect, or dimension of our reinvention schemes — a technological one. It starts with daily grind to get daily bread and would lead us towards a pluralistic, multi-leveled, widely diversified realm of labour and travail, arts and crafts, research and discovery, cognition and invention, tools and apparata, signs and messages, numbers and measures, knowledge, skills and operational procedures for processing matter, energy and information.

In other words — towards everything which enables the mankind to design and construct the objective carrier-structures and support-systems indispensable for organizing, performing, conducting and consummating what the people consider the desirable and decent human life in all its dimensions, be it bodily-material, emotional, or spiritual.

Stated plainly — we are looking at the instrumental side of man's activity, being interested first in the variety and complexity of means used for reaching goals, fulfilling needs, satisfying passions, exercising fancies, making dreams come true.

Warning: the following text should be taken as just a number of assorted quotations from (or retellings of) the well-known sources. No time for going to library, at my hand now I have just Lewis Mumford's classics: Technics and Civilization [T&C], Art and Technics {A&T], and The Myth of The Machine {MoM]; Mike Cooley's Architect or Bee [AoB]? (The Human Price of Technology); Rene Dubos' A God Within [GW]; Gary Snyder's The Old Ways [TOW]; Paul Sheppard's Nature and Madness [N&M]; Elisabet Sahtouris' GAIA: The Human Journey from Chaos to Cosmos [GAIA], and some others. I'm not trying to compile out of it something systematic, or even slightly coherent; the only justification of my typing is the hope that you'll probably find this bricolage rather thought-provoking and make use of it in your own tinkering.

DAILY GRIND & DAILY BREAD

Centrality of work

No matter how far the tenor of today's life has gone away from Protestant's ethic and the teachings of such ideologues as Thomas Carlyle or Karl Marx, no one would deny that work, or labour (as its synonym), is still vitally important for a human. The centrality of work has not been lessened by the advent of computers and industrial robots; nor was it dismissed by the "civilization of leisure".

Dictionaries define work (within the range of meanings relevant for our discussion) as bodily and/or mental effort directed towards doing or making something; as occupation, employment, earning one's bread; something which a person does and/or produce as a task, or duty, etc. Here's more elaborated definition:

Industrious devotion to a single task whose end product is socially useful [i.e. has a use value] but whose immediate reward might be small to the worker him/herself, or might even, when prolonged [especially compulsory], turn into a penalty. Such work could be justified only if its ultimate use to the community proved greater than could be achieved by a more fitful, capricious, "amateurish" attitude toward the job.[MoM 137] As a matter of fact, the notion of work is deeply ambivalent; charged, or loaded with contradictory impulses and emotions.

Initial blessing

As a result of some doleful accident in history work became a curse for our forebears (In the sweat of thy face..., Gen 3:19) but initially, before the Fall and Expulsion, it was a blessing: granted with perfect vegetable menu Adam had been put "into the garden of Eden to dress it and keep it" (Gen. 2:15)

Even now we would have moments in our lives when the work (sometimes in our gardens) brings us sheer joy; and we wish our children to have it too. And weren't all the beauties of the Earth and Heaven came to be only after The Lord undertook a six days' labour to make it? By the way, it was rather hard even for the Almighty, because after seeing that it was very good, God ended his work which he had made; and he rested on the seventh day from all his work which he had made [Gen 2:2]

I often think the (educationally) best poetical-musical retelling of Creation Story was given in two Duke Ellington's Sacred Concerts.

A "phrase with six tones"

The First Concert opens with "In The Beginning God..." [wrote Stanley Dance] — the first four words which open the King James Version, provided the program's main theme. The six syllables were symbolized by a "phrase with six tones", which was used many times, many ways. In the piano introduction, in the elemental awe [void and darkness] of Harry Carney's baritone sax solo, in the soaring flights of Jimmy Hamilton's clarinet [the spirit of God moved upon the face of the waters], and in the [Dukes's) lyrics which Brok Peters delivers so powerfully, Ellington wonders about unimaginable, when there was "no heaven, no earth". Then, with sounding brass, tinkling cymbal *and* the tongues of men, he tells of the world's creation."

I can't resist quoting from the Second Concert's *Something About Believing*:

"There is much mystery in the history,
To be exact, accept the fact,
An example or two here for me and you.
Animals, birds and fish,
Have senses much keener and stronger.
And scientists do the difficult today,
And even impossible just takes a little longer."

Pardon me for my habitual deviations.

Pre-historic reminiscing

Paleo-anthropologists tell us that a globally spread myth(s) of Paradise Lost reveals some pre-historic reminiscing of life lead by Paleolithic food-gatherers and nomadic hunters who needn't do much work (labour) even on gardening.

"Eden was no garden - it was foragers' paradise" remarks Paul Sheppard after Nigel Calder. The garden image of the paradise is apparently a debased figure, in which the cultures of husbandry described a lost world, using the best landscape images they new. But "Adam" means "red" and has to do with men of the red upland soils rather than with the black cultivated ones. The yearning that the myth first expressed must have been that of disillusioned tillers of the soil for a long-lost life of freedom and relative ease. Eventually the urban ideology of civilization, in which men defined themselves by contrast to wild savages, made the nomadic life untenable. [N&M, 27,136]

Was it so that an advent of agriculture brought some "dehumanization" to the life of Neolithic settlers?

Shall we be happier by making ourselves nomads again?

Some recent attempts look rather discouraging. On the contrary, there's growing mood for "re-settling" of contemporary human instead of being always on the move (or on the run).

Re-inhabitation

Gary Snyder is his 1977 essay on Re-Inhabitation refers to Wendell Berry's "the unsettling of America" where the latter points out that the way the economic system works now, you're penalized if you try to stay in one spot and do anything well. All land is under the

gun, and any person or group of people who tries to stay there and do some one thing well, long enough, to be able to say, "I really love and know this place", stands to be penalized. The economics of it works so that anyone who jumps at the chance of quick profit is rewarded — doing proper agriculture means not to jump at the most profitable chance — proper forest management or game management means doing things with the future in mind — and the future is unable to pay as for it right now. Doing things right means living as though your grandchildren would also be alive, in this land, carrying on the work we're doing right now, with deepening delight...

Re-inhabitory refers to the tiny number of persons who come out of industrial societies (collected or squandered the fruits of 8000 years of civilization) and then start to turn back to the land, to place. This come for some with the rational and scientific realization of inter-connectedness, and planetary limits. But the actual demands of a life committed to a place, and living somewhat by the sunshine green plant energy that is concentrating in this spot, are so physically and intellectually intense, that it is moral and spiritual choice as well. [G.Snyder. The Old Ways (six essays). Re-inhabitation]

Triple alienation

Snyder was not just a poet and theorist: since the early '70s he'd been living in the cabin he had built himself in the northern Sierra Nevada, planting fruit trees, growing beans and breeding chickens, more often than not dubbing as hunter-gatherer. And he knew the topic first-hand when it comes to talk about loss of the physical contact with the world we live in, especially physical work.

"If there is any one thing that's unhealthy in America, it's that it is a whole civilization trying to get out of work". There is "a triple alienation when you try to avoid work: first, you're trying to get energy sources to do it for you; second, you no longer know what your body can do, where your food or water come from; third, you loose the capacity to discover the unity of mind and body via your work." [The Real Work: Interviews and Talks]

Down from the soft clouds

Commenting on this [in The New York Review of Books, Apr.11, 1991] Bill McKibben remarks:

But Snyder does not believe that hard work is good because it helps you to get ahead, or be prepared for "the real world", or teaches you the value of a dollar. It is important for just the opposite reason: it brings you down from the soft clouds of whatever modern life we're leading, and back into contact with the world the every other generation of human beings has ever known, and that is the source of our instinct, our myth, our art. "That's the real work: to make the world as real as it is, and to find ourselves as real as we are in it."

May be slowly reviving

McKibbon (who happened to read Snyder's writings while traveling along the banks of Lake Baikal in Russia's Eastern Siberia) makes a sound conclusion deserving to be quoted at length:

"We can't all live the way Snyder does, of course, not in this crowded generation. He remarkably overstated the situation in his Earth House Hold (1969)" by writing that "industrial society appears to be finished." But everyone can learn from his notion of responsible work: walking, not riding; composting or recycling, not throwing things out. Even in the middle of a city, everyone can practice his fellowship with other species. In the first place, wilderness is everywhere: "ineradicable population of fungi, moss, mold, yeasts, and such... deer mice on the back porch, deer bounding across the freeway, pigeons in the park, spiders in the corner."

Everyone, except the poor, can consciously lower his or her standard of living. And most important, everyone can try to find pleasure not so much in the acquisition of things, but in the body, in friendship, in dance and music, in an effort to create a community. We can start to make deep changes now, and someday, generations hence, if we haven't already gone too far, we might slowly subside into some equilibrium with the earth. I have no illusions that we will do these things in great numbers, but this is an interesting moment when the longheld aesthetic arguments for a simpler life are suddenly being seen to coincide neatly with the hard-headed calculations of the atmospheric chemists. Snyder is among the first to sense this conjunction. <...>

The world may be slowly dying, but Snyder's life and work show that it may be slowly reviving too" [end of McKibbon's]

GIFT TO DEVELOP

A sportsman craft

Back to times and places, when there was (pre-historians say) no labour in modern sense, and where abundance of game, fruits and nuts made life relatively easy and secure for pre-agrarian humans. They were quite contend with very primitive wood and stone tools but it didn't prevent them (contrary to the Marxist doctrine) from getting such impressive artistic achievements as the amazingly realistic cave-paintings of animals.

There still exist today (in the deserts and forests of Australia, Africa and South America) few nomadic tribes that derive their sustenance almost exclusively from the hunter-gatherer way of living. These people develop great physical vigour and very efficient visual-motor skills, speak complex languages, have rich mythology and intricate web of kinship and social customs, even though they live in much poorer natural surroundings.

What they (and those Paleolithic men elsewhere) didn't develop (and didn't bother of), is (was) a capacity — both bodily and psychic — for doing something that requires a long, repetitive and regular series of the very same exact hands' movements for shaping naturally given staff.

The first prehistoric craft — the making of tools by chopping the pebbles — was vaguely similar in principle to aiming and shooting the prey with a few brisk and brusque striking blows that render the evident (positive or negative) result immediately. One might call it a sport-(or sportsman's) craft, so to speak.

Grinding. boring, and polishing

The Neolithic revolution was marked, *inter alia*, by a drastic innovation in processing hard materials which left one of the most profound technological imprint on the human culture in general and became a generic feature of all the phenomena we would associate with the notion of civilization. At the root of this truly victorious (or defeating?) innovation laid the method of tool-making by grinding. boring, and polishing.

Writes Mumford: The patient application to a single task, reduced to a single monotonous set of motions, advancing slowly, almost imperceptibly, toward completion, was far from characteristic of food-collectors or hunters. This new trait became visible first among the skilled flint-knappers who made the finely chipped Solutrean and Magdalenian spearheads and gravers. But the grinding of even soft stones is a tedious and laborious process; granite or diorite, both extremely hard, demand a willingness to endure drudgery that no human group had ever imposed on itself before. Our very word to express ennui, "boring", derives from — boring. Here was ritual repetition pushed almost beyond endurance.

We obviously ought to include grinding in our ProTec Course — how to reconcile it with the idea of joyful learning?

A practice for all later cultures

Only groups that were prepared to remain long in the same spot, to apply themselves to the same task, to repeat the same motions day after day, were capable of gaining the rewards of Neolithic culture. The restless ones, the impatient and adventurous ones, must have found the daily routine of the Neolithic hamlet intolerable, as compared with the excitement of the chase, or fishing with net and line. Such people reverted to the hunt or became nomadic herdsmen.

Neolithic tool-maker first invented "daily work" in the sense that all later cultures were to practice it. One of our common expression for work, 'the daily grind,' would not have been a figure of speech in the early Neolithic community. [MoM 137]

But not only grain needed daily grinding.

With the first Paleolithic stone utensils, the mortar and the stone lamp, went a decisive contribution to all technology - circular motion. And with the translation of this motion from the hand to the wheel came the next important machine, after the bow and arrow, the potters wheel. And the wheel started to roll along...

Price and reward

In grinding, steady application counts for more than the fine sensory-motor coordination needed for flint-knapping. Those who were ready to submit to this discipline would have also have the patience to watch the same plants, through all the process of growth, season by season, and of repeating the same process, year after year, to achieve the same anticipated result. These repetitive habits proved to be immensely productive. But ... in some degree they dulled the imagination, and tended to select and advance the more submissive types, while by providing a better food supply they in turn ensured their multiplication and survival. <...> A price seemed not too high, and reward was really overwhelming.

...The great incentive to grinding came from the domestication of the cereals... With the cultivation of grains, a new order of settlement became possible in parts of the planet not favored by tropical luxuriant and equable climate... Equally radical innovation became the invention of daily bread — a direct reward for the "daily grind". [MoM 138]

Permanent cultivation

Groups now remain rooted in one spot, surrounded by fields under permanent cultivation, slowly making improvements in the landscape, digging ditches and irrigation canals, making terraces, planting trees, which later generations would be grateful for.

The future became predictable as never before; and the cultivator not merely sought to retain the ancestral past, but to expand all his present possibilities: once the daily bread was assured, those wider migrations and transplantation of men, which made the country town and the city possible, speedily followed. [MoM 139]

Now we come in our retrospective journey to the threshold where Civilization had begun. About ten millennia after that period dr. Brian Swimme, an American astrophysicist turned "cosmopsychologist" wrote in the Prologue to his book "*The Universe Is a Green Dragon*" sub-titled "*A cosmic creation story*":

> "Our modern Western civilization began with the kind of cultural schizophrenia...Our scientific enterprise effectively decoupled itself from our humanistic-spiritual traditions... The sciences were effective in their mechanistic formulations and thus became entrenched in mechanism. <...> But something tremendous is occurring in our time... the radical transformation of our fundamental world-view as a cosmic story of our origins and development takes hold in human awareness. <...> The universe can no longer be regarded as a result of chance collisions of materials, nor as deterministic mechanism. The universe considered as a whole is more like a developing being. The universe has a beginning and is in the midst of its development: a vast cosmic epigenesis. <...>
>
> How does the deeper understanding empower us? By enabling us to reinvent the human within the new cosmic story. Nothing less will suffice. <...> We will discover our larger role only by reinventing the human as a dimension of the emergent universe."

And in the last chapter he explained the meaning of his "just talking" about such issues:

"To understand human language, we need to place ourselves within the context of Earth as a self-organizing reality. The Earth taught itself how to create the photosynthetic processes, how to bloom forth with the power of angiosperms, how to create topsoil; Earth did not learn these things from Mars or the Andromeda Galaxy. Earth education is self-education.

Humans are engaged in the same dynamic of self-educating reality. So, here we sit, talking a further development of the ancient Earth activity of education. Our situation involves something new —self-reflection— manifested especially through language, but language itself is just a part of a larger teaching process. We sit, talking, engaged in the education process of the Earth. Is that clear?"

To bring this a little closer to the main topic of our discussion let's touch very briefly the issue of environmental, or ecological education.

MAINTAINING THE HOME FOR ALL LIVING

Science of co-habitation

A term "ecology" was originated early in nineteenth century by Karl Ritter, a German geographer and *Natur-Philisoph*, to denote a new discipline of studying the conditions under which the living organisms would co-exist and interact within their immediate surrounding.

This term is coined of two ancient Greek words: *eicos* (*oicumene*) and *logos*..

Logos, as everybody knows, means the *word (verb),* as well as *knowledge,* and/or *science* (of any subject-matter).

Eicos (*oicumene*) is a bit difficult to translate because it relates to an experience of people who used to live about two and a half thousands years ago in the world much smaller and simpler (socially, culturally, and geographically) than ours.

For those ancient people *Eicos* had meant a *visible space*, or *expanse* of land grasped by the eyes of a man looking around to observe *the clearly confined area of his native dwelling place*, a village or a city/state, seen *synoptically* that is, from the one point of view (say, by standing at the top of a high hill).

In many cases and to a very large degree it was linguistically equal to an *abode*, a *family hearth*, or a *family* itself, a *paternal house*, a *home*, a *habitat* in which one lives, where he does belong, and which he calls *his own*.

In the broadest sense *eicos,* or *oicumene* meant a man-centered, human-populated universe, a house the size of a world (or the world, intimately felt as a home) a cosmos comprised of innumerable tiny microcosms, each one reflecting the others and the whole.

In short, *ecology* can be interpreted as a *science of co-habitation* of who- or whatever happens to habitate (populate) a given place, space, or area delineated with more or less discernible boundaries.

Studying ecosystems

It is, of course, a generalisation all too wide, and a notion all too abstract for any practical applications. The pioneers of ecology were, by necessity, forced to deal with more restricted situations, — the *microcosms* that are now called local *ecosystems*.

Wrote American entomologist Stephen Forbes back in 1887: "A lake... forms a little world within itself — a microcosm within which all the elemental forces are at work and the play of life goes on in full, but on so small a scale as to bring it within the *mental grasp*."

The various ecosystems, with which any *ecologist* deals now are thus his own mental creations (remarks Rene Dubos, the famous contemporary microbiologist, pathologist and ecological thinker), because they derive their size and shape from the characteristics and limitations of his senses and conceptual apparatus. It is through this conceptual framework an academic ecologist perceives the empirical world and then selects and isolate mentally what he is going to investigate, and how.

Nowadays ecological approach covers a multitude of specialised, as well as universalised areas of research: from the global physical ecology through the social, economic and cultural ecologies of various human communities, corporate organisations, and occupational groups down to the psycho-ecology of an individual and back to the "ecology of mind". Some quite intelligent people are inclined to suspect that this trend has already brought the whole enterprise to the brink of absurdity. Some others think there's still hope for separating the wheat from the chaff.

Anyway, since its inception an ecology had been developed rather smoothly as long as it remained just a discipline neighbouring at the intersection of botany, zoology, and biology.

It was a rule that a professional ecologist could and should maintain a position of an "uninvolved" outer observer of facts and events occurring in Nature. According to the methodology of positivism he was forbidden to disturb or exert influence upon the natural phenomena and processes under study with any "artifacts", including his own presence, not to say of deliberate interventions. The mission of ecology at its early stage was purely intellectual/cognitive — getting an "objective truth" about the concrete ecosystem(s).

Defending the Planet

But it was found before long that more and more ecosystems are in danger, or even close to extinction; that the non-renewable resources of the Earth are rapidly shrinking; that our natural environment is getting badly polluted, and the very survival of the biosphere is questionable.

The main cause for the approaching Doomsday lies, as it was revealed, in an increasing tide of human economic/industrial activity (e.g. cutting off the forests, erecting dams and building railroads, pumping and burning more oil, infesting global ocean, salinating the soil, collecting nuclear waste, damaging ozone layer, etc.).

Hence more and more ecologists began to see themselves as defenders of the endangered species, woodlands, pristine riverbanks, and the Planet itself.

By the same token the cognitive function of ecology was supplemented with the protective and the conservational one. More often than not it has led many ecologists to launch a Crusade against the expansion of the man-made environment which (they said) is threatening the existence of Life itself.

Such Crusaders are still around. Their top priority is always (and absolutely just, indeed) the restoration of Nature's reproductive cycles, which suffers from the aggression of technologically-equipped humans.

The primordial Paradisic state is proclaimed the (exclusive) ideal, whereas the practical imperative is to stop an anthropogenic impact on the environment, because it is considered negative by definition.

Synergistic approach

The one-sidedness and limitations of this alarmist-conservationist pathetic and rhetoric is obvious. More sound alternative is not the liquidation of all things technological but the strategy of sustainable development. The latter proceeds on the opportunity to create principally new nature-friendly, or *soft* technologies designed to serve two main goals:

(a) protecting the natural/cultural environment from oncoming threats, and

(b) facilitating subsequent non-violent co-evolution.

A basic attitude, or intellectual and emotional drive behind this strategy, is known under the name of Synergetics. It represents a joint movement of scientific/artistic/philosophical/religious thoughts-and-actions that fits better than any other to meet this truly global challenge. It sees not only causal and/or probabilistic links in the Universe, but a vibrating web of dynamic interdependencies: a certain oncoming roll-call, a kind of mutual support and aid of acting forces. It is amazing how few ecologists share a similar world-outlook.

The above mentioned paradigm of synergistic approach is so far ignored, at least not shown explicitly enough in neither manifestos, declarations, and programs, nor in the theory and practice of contemporary ecological education. Any instrumental, goal-oriented, tool-manipulative productive activity is seen mostly as a means to reveal and (always belatedly) restrain the damage done to the environment by civilization — not as creative force capable of transforming this civilisation from the inside.

One of a few exceptions is "The Solar Education" by the late Professor Marc Koltun, internationally famous specialist in the field of alternative energy sources and a great pedagogue.

Projection of human potential

Training the generation able to follow the path toward the sustainable development requires a broader and more adequate educational basis. It would be wise to chose as a starting point a synergetically understood "trinity" of restoration, preservation, and creation of natural/cultural integrity. Thus, the great Russian philosopher Vladimir Solovyev considered the most important goal of human activities in "cultivation of land, caring for it, and aiming at its future replenishment and revival".

Vladimir Vernadsky never stopped to emphasize that "Man, his thoughts, and labour are facing the question of reorganizing biosphere of free-thinking man as a whole. Ideal of our democracy are in unison with spontaneous geological process, and with the laws of Nature".

Teilhard de Chardin reproached natural scientists for their indecision "to admit the presence of a determined direction and a privileged axis of evolution", resulting in the fact that "people are not decisive enough to undertake arrangement of the Earth". He insisted on the right to speak of the "human leap of evolution" and of noo-genesis as a conscious sequel of cosmogenesis.

It is necessary now to find bright and convincing metaphors of synergetics, which will allow us to bring these fundamental conjectures closer together with the pragmatism of ecological education, and to perceive any of its local tasks in the light of global problems.

This approach has deep historical roots. It is compatible both with Judeo-Christian theology, seeing man as a "mediator between the lives of angels and nature" (Pseudo-Dionisius Areopagita) and Marxism, according to which man, in trying to transform Nature into his "non-organic body", implements "practical creation of the subject world", where "all subjects would become a subjectivity of himself". According to both doctrines, everything created by humans in order to maintain their existence on the Planet appears in the course of increasing actualization and projections of human potential onto the Universe.

This idea, known as a *theory of organoprojection,* was most consecutively developed first by Ernst Kapp in the nineteenth century, corroborated later by Father Pavel Florensky, and found its continuation in the works on the history of culture and technology (especially telecommunication) by Andre Leroix Gourhan and Marshall McLuhan.

Tangible plexus

Karl Ritter, the godfather of ecology, considered the whole Earth as the common home of humanity, which has defined dynamics that organically gave birth to all cultural innovations. Educational value and learning implications of this metaphor are virtually limitless.

Nature, if perceived as a Home being built (or destroyed!) with participation of all people, ceases to be an abstract concept. It would become something immeasurably bigger and more valuable than just a pantry of resources or a faceless "environment".

In its turn, each home where children are being raised; each kindergarten when they are taught ABC, each outdoor playground where they impersonate and imitate their future adult roles, occupations, and businesses, would appear as a tangible plexus of practically all essential issues of ecology. Consequently, all those places could and should serve as a versatile educational laboratory models. As for nature-friendly and at the same time hi-tech homes, like the one built by Amory and Hunter Lovins in the Rocky Mountains, these are by

their very conception, the embodiments of the synergic spirit — the micro-polygones of sustainable development, and the outposts of ecological education for the twenty-first century.

Thereby, the original and absolutely concrete meaning of the concept of ecology is being restored, encompassing all the implication of building, maintenance and developing the Home for all living..

It would also be appropriate to remind here the origin of the term *synergetics*. The word *energy* (*energeia* — the work-implementing force) in the Ancient Greek used to have the same root as the words meaning both work itself, and a tool to implement the work.

Synergy (literally — collaboration) is the term that Eastern Orthodox Church uses to denote collaboration of men with God in the process of divine House-building.

We shall use it while talking about men and women of various nations, professions and creeds, who are trying to "synergise" in their efforts to promote life-supporting sustainable development of all the "systems" which would help people to be more more creative and humane.

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In order to stop (if only for the present moment) my free stream of consciousness I want to recapitulate the main points of our concept of Propaedeutic Technology Course for Primary School.

RECAPITULATION

No act of human labour, especially undertaken in educational context, confines either to sheer execution, i.e. mechanical reproduction of a given exemplar, or to a transformation of just physical energy and matter. Even the crudest menial workmanship of a pupil is directed and controlled mentally through the inner information processing and communication with experts and fellow-workers, though the structural peculiarities of these activities in ordinary circumstances are barely realized by the actor(s).

An introduction of ICT used for iconic or diagrammatic representation of hands-on work actions with tangible entities does encourage cognitive reflection, critical analysis and creative synthesis of corresponding structures and procedures.

An acquired ability to manipulate symbols representing the logic of work activity helps the pupil to master the methods of its programming and optimization by means of pen-and-paper and/or computer modeling.

The assignments for modification and constructions of new operational procedures and functional logic would prompt the pupil to conduct imaginary experiments and heuristic search resulting in development of advanced cognitive abilities up to creative problem solving irrespectively of material substrate used.

As a minimum, ProTec course guarantees the acquisition of initial knowledge and skills necessary for managing contemporary man-machine systems functioning on the border of uncertainty and high risk. More often than not, the efficiency, smooth running, and the very safety of said systems depends on such peculiar traits and features of their "human element" as aesthetic sensitivity, personal empathy, quick imagination and readiness to communicate and interact with artistic spontaneity and engineering precision.

In any case ProTec would combine research, discovery and design approach to content and methodology of teaching and learning process itself, including its organizational, instrumental, procedural and other technological components and patterns. It's just cannot be another way.

INTERMEDIATE CONCLUSION

Such are some thoughts provoked by the problems of teachers' training for information society. There's no denying that I've been talking mostly of ICT-based education in general, centering predominantly on elementary school curriculum. My rationale was the strong conviction that we hardly could go far enough in preparing teachers unless having more clear picture of what we consider the most important aspects of both content and methods of teacher's activities in and out of school. Anyway I'm ready to discuss more concrete ideas of how to approach the latter issue proper.

It seems not out of place to end this long effusion of mine by quoting (with slight omission) what I had said as the closing remark at the Fourth East-West Seminar on New Technologies in Education held in Budapest, Hungary, May 6, 1994.

Dear colleagues,

first of all let me confess that I'm neither an educator, nor a technologist (and never had been the one, as they used to say before the investigation commission in not so distant past). But I was granted the great privilege to be invited to all four E-W seminars and had actually attended the last three of them. It gave me a chance to meet and befriend many outstanding people; to acquire some deep insights, and to get a lot of pleasure and joy.

As for the seminar proper, my attention was especially attracted to the proceedings of the Group B, led so elegantly by Dr. Gilberte Schuiten. The group has been working hard trying to *Re-define the Role of a Teacher* in the Information Age. In due course the participants have made a number of quite unexpected, sometimes really fascinating discoveries. It was just a series of startling revelations to me, and now I'd like to share with you some of the most astonishing ones.

It became pretty clear to us that the teacher, even an ordinary teacher in ordinary school, stripped off all technologies, be it new or old, is intrinsically endowed with innumerable capacities of the most improbable kind.

For example, the teacher can, and often does generate alphanumeric texts of considerable length and complexity.

More to it, she or he is naturally equipped with an in-built voice-recognition input and rather articulated verbal output device!

You probably wouldn't believe it, but it's a scientifically proven fact that the teacher is able to send and receive various messages coded in body-language!

Though it is really beyond the one's grasp, many teachers have a faculty (given a blackboard and the piece of chalk) to produce a little graphics, sometimes accompanied and additionally animated by a pantomime, song, and a simple dance!

Dr. Bengt Bengtson even went as far as to declare that the teacher is, by definition, *a walking interactive multimedia presentation*!

No less exciting was to hear from Dr.Cathleen Fulton that the main function of the above mentioned walking multimedia is to provide the nourishment to the minds of her/his pupils and to arose in their souls the enthusiasm for learning! (It's not out of place to mention here that the word *enthusiasm* literally means "being enthralled by God's presence", or "charged with the divine energies".)

So in olden days the traditional role of a teacher was to embody and represent to her or his pupils a total Universe — *the* Universe — full of mysteries and wonders and totally unpredictable chain of vibrant epiphanies.

Hence the main teacher's function used to be a living manifestation of the Cosmos condensed and concentrated in just one human person — the Microcosm. And in the process of communication and interaction with that type of a teacher the pupils used to learn how, in their turn, to become the microcosms — the little cosmoses — themselves.

Later on, both teacher's and pupil's roles had been changed drastically. *To the beginning of the last decade of the second millennium AD the teachers and pupils alike were usually treated simply as data gatherers, fact collectors, information retrievers, word processors, model builders, telecommunication connectors, users/programmers, symbol manipulators, knowledge constructors, in short — system operators, or rather, reading-writing-computing machines.* A picture really frustrating and depressing, for me at any rate.

Is there any hope to redefine the role of a teacher in such a way that could offer her or him more encouraging and rewarding option? I believe the answer is positive and the tools are already at hand.

By the competent and dexterous use of the state-of-the-art information technologies a modern teacher has a chance to liberate her/himself form that compulsory stalemate and to go back — or forward — to what The Teacher was and always will be called for.

That is, to be the spiritual originator, or progenitor, as well as co-creator of her/his spiritual siblings. And in this context it will be quite reasonable to keep on thinking and experimenting on how to use new educational technologies more fruitfully and creatively.

Thank you very much for your kind attention, dear colleagues.