Natural resources and technologies in educational activities
Natural resources and technologies in educational activities:

Education in times of accelerated technological development

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Translated into English by T.P. Blank and M. Popov
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Preface

This book is concerned with philosophical and physiological aspects of educational activities in the times of a global crisis that has three aspects: (1) a civilisation crisis caused by accelerated technological development, (2) a biosphere-ecological crisis, and (3) the crisis of anthropocentric world view.

For most of human history, people acquired knowledge from their parents and passed it on, largely unchanged, to their children. In more recent times, however, the situation changed such that a significant portion of a person’s knowledge is replaced during a lifetime. This process is still accelerating. At the same time, mankind approaches for the first time in its history the limits of the capabilities of the biosphere to adapt to the technological development. A basic change in thinking from the anthropocentric to a geobiocentric view is necessary. The unprecedented demand for knowledge and learning (and relearning), now far exceeds the capabilities of traditional education systems.

We believe that to meet the educational challenges of the future it is necessary to take a systematic and scientifically grounded approach to teaching. In our book we present neurological and physiological findings that are relevant to understanding the process of learning, its limitations, and the contexts in which learning proceeds quickly, or grinds to a halt. Various types of learning and the associated physiological responses are presented, and the consequences for the design of learning programs and environments are discussed.

The most immediate audience for the book are researchers in the fields of human cognition, learning and education. However, our ultimate goal is to reach school teachers, university professors, policy makers and other people involved in education on a practical level. The topic of the book is not just “educational”. It is rather concerned with the role of education in the contemporary world, thus having a very broad social and philosophical context.
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Foreword of the editor of the English edition

The book that you hold in your hands deals with existential problems that mankind encountered during the 20th century. The central focus of the book is the human being looked at from different perspectives: biological, sociological, ecological and geological. Sometimes mankind is viewed from a distant, geological perspective, sometimes from up close, at the level of neurodynamic processes in the brain. At the same time an attempt is made to combine all perspectives into one complete picture.

The authors believe that mankind is currently living in a crisis that has ecological, technological and ethical components – a view, that was already expressed by Vladimir Vernadsky at the beginning of the 20th century [1]. The crisis has three “dimensions”: (1) a civilisation crisis connected with accelerated technological development, (2) a biosphere-ecological crisis, and (3) the crisis of anthropocentric world view.

Let us look at the first dimension of the crisis. In the middle of the 20th century, there occurred a very important event that went unnoticed at the time: The “characteristic time” of technological development reached the characteristic time of human reproduction. This event has implications for many human activities but most importantly for the essential part of the continuation and development of human culture – education. Because a significant portion of a person’s knowledge is now replaced during a lifetime, education can no longer be a fixed period in a person’s life. It becomes a life-long, constantly changing process.

The importance of education is amplified by the second dimension of the crisis: Mankind has reached the limits of exploitation of the living layer of our planet – the Biosphere. Further uncontrolled development in this direction may threaten the existence of the
Biosphere and by extension mankind itself. Mankind needs to treat the Biosphere with sufficient respect, and the first step in this direction is to understand it better. For this, huge amounts of information need to be processed, as the biosphere is incomparably more complex than all artificial, man-made systems.

The third dimension of the crisis is that of the human-centric world view. The old conception of mankind as being “above” nature is no longer adequate. It may even be life-threatening. Mankind is capable of many things, but supporting life on the planet Earth is not yet one of them. This remains the exclusive domain of the Living Nature.

That these three crises arose simultaneously is not coincidental. They are merely three different aspects of the same process. This “triad” of the crisis resurfaces throughout the book.

The second major theme of the book is education. The accelerated technological progress requires a more complete utilization of the human cognitive capacity on all three levels: superconsciousness, consciousness and subconsciousness (the latter is more commonly known as the unconscious). Current education systems rely almost exclusively on communication of knowledge through language and subsequent practice exercises. Therefore, only the consciousness and subconsciousness are activated, and the immense power of the superconsciousness is not used. Tapping this great resource is, admittedly, not completely straightforward, since the superconsciousness is well protected against direct “tampering”. It is mostly accessible through emotions, in particular the experience of “newness”. An important objective of the book is to present psychological and neurophysiological findings concerning the interaction with the superconsciousness.

Another concept closely related to superconsciousness is that of “complete knowledge”. The authors compare it with a mosaic when explaining the term: Every person looking at a mosaic sees the same picture, which is made up of small parts, but is also resilient to the loss of some elements. One could equate “complete knowledge” with “seeing the whole picture”. Most people today may know a lot about a single piece of the mosaic, but they do not know, or even care, how the piece fits into the mosaic as a whole. To meet the challenges of the future, the authors insist, everybody must maintain at least a rough idea of the whole picture. When this happens, productivity will rise sharply, because less time is wasted on unnecessary objectives,
and because collaboration between people becomes decentralized and much more effective.

The integration of theoretical and empirical pieces of knowledge into a complete picture happens in the superconsciousness. For this process to work, the individual pieces of knowledge must cover a sufficiently large area (avoiding excessive specialization). Also, the pieces must be able to be integrated into a larger context. Finally, the fragments must stay in memory for a sufficiently long time. The moment of finally “solving the puzzle” is commonly referred to as “insight” or “revelation” and is one of the strongest cognitive emotions.

The concept of complete knowledge is of course not new. It is for instance quite similar to Spinoza’s “third kind of knowledge”. In his “Ethics” Spinoza distinguishes three kinds of knowledge: The first kind could be described as fragmentary empirical knowledge. The second kind is abstract scientific thought. The third kind Spinoza calls “intuitive knowledge”. It is this kind of knowledge that comes closest to “actually understanding”. In the “Ethics” Spinoza writes [2]: “PROP. XXV. The highest endeavour of the mind, and the highest virtue is to understand things by the third kind of knowledge.” And “PROP. XXVII. From this third kind of knowledge arises the highest possible mental acquiescence.”

Of course, cognitive activity cannot happen without its material substrate – the human brain and the body as a whole. Both are extensively discussed in the book. The structure and function of the brain receive particular attention. A rough understanding of how the brain works is essential for the design of educational materials. Cognitive activity follows certain temporal patterns, and effective educational programs will consider them. Here is one example: Probably the best-known structural characteristic of the brain is its functional asymmetry. The left hemisphere is predominately responsible for language processing and logic, i.e. information that can be communicated to other people. It is associated with consciousness. The right hemisphere dominates in spatial orientation, creativity and perception of the “larger picture”. The interaction between the two hemispheres proceeds through the corpus callosum and happens on a time scale of 2 to 4 seconds (e.g. formation of a mental picture from a verbal description or the verbalization of an newly found solution). This delay is an example of temporal structure that should be considered in “educational technology”.
Superconsciousness resides in the right hemisphere and the oldest neuronal structures, the archicortex. In these primitive structures, perceived information is "rated" by its immediate importance for the individual. The archicortex is also the part of the brain that is associated with emotions. For cognitive activity, one emotion is of particular note: the emotion of "newness". In order for information to pass into superconsciousness it must be both new and important for the individual. Only then are the structures of the archicortex activated. In this regard, a special role is played by the hippocampus: it ensures continuous activation of the neocortex, for a time that is sufficient to store information that has been classified as "new". The emotional approach to information is, therefore, the only way to permanently store it in memory.

Quite opposed to the role of superconsciousness is that of the subconsciousness. This is the "non-verbal" level of consciousness, and its existence has been shown in numerous experiments. Activities that were once conscious, but that are repeated very often, eventually lose the verbal component; they are "automated away" and relocated into the lower levels of the neocortex. This relocation greatly reduces reaction times and frees up the consciousness for other activities.

In traditional education, the consciousness and subconsciousness are stimulated with the standard "lecture/practice" model. Superconsciousness, on the other hand, is usually left out completely. Of course, the phenomenon of superconsciousness is not entirely unknown to humans: people in the creative professions are familiar with it. But in education this part of the human psyche is treated as it does not exist.

Another often ignored fact is that cognitive activity leads to morphological changes in the brain and, therefore, activates metabolism. Just like other external factors, cognitive processes and emotions can trigger several kinds of the general adaptation syndrome. This facet of cognition, that it is also a physiological process, should not be ignored.

The fact that very different external stimuli can trigger a standard response that involves vital systems at all levels of the organism was discovered in 1936 by the Canadian physiologist Hans Selye, [4]. Selye called this response "stress". Stress temporarily increases the resistance of the organism, but this happens at the cost of partial destruction and a large expenditure of energy and materials. It is an emergency response. For a long time, stress was considered to be the only "general adaptation syndrome". However, in the 1970s it
was discovered that it is only one of the nonspecific reactions of the body. Stress is a result of very strong stimuli. With small to medium inputs, the body develops two qualitatively different responses: the training reaction and the activation reaction [5]. Successful applications of cognitive technology will make use of the latter two reactions while avoiding stress.

As already mentioned, the activation reaction is the general adaptation syndrome in the case of medium-strength stressors. The activation reaction is marked by a large increase in the resilience of the organism, very well balanced metabolism and high work capacity. To actively use and manage adaptation reactions, it is essential to follow their temporal structure. In particular, the normal functioning of the activation reaction requires at least six hours of continuous initial stimulation. After this time begins a phase of highly productive creative work. If the following two or three days are not used productively, the activation loses its usefulness. Needless to say, the temporal structure of current educational activity is very far removed from the above. Only sometimes, during extended project work can activation be achieved, in principle.

A topic not touched upon by the authors, but which is of great importance in the opinion of the editor, is the role of human communication. Access to the superconsciousness can not only be facilitated by properly structured information but also by another person. The ability of directly influencing another human being – through the power of suggestion – is one of the fundamental properties of the human psyche [6]. The most effective carrier and disseminator of “complete knowledge” may be another human being. By transferring the right emotional state to students, a teacher can activate their superconsciousness. Very often the difference between good and bad teachers lies not in the choice and structure of materials, but in the direct influence on the students.

What then are the “natural resources” of cognitive activities that the authors propose? In summary they are:

1. Active use of the superconsciousness with the aim of attaining complete knowledge. This can be achieved by strong emotional support of the cognitive activity and by beginning the learning process with a live demonstration instead of a verbal description.

2. Sufficiently broad analysis of the object, to supply a sufficient number of pieces from which to construct the complete picture. Also, a conscious effort should be made to synthesize the fragmentary knowledge into a whole.
3. Use of the physiological activation reaction. If the temporal constraints of the activation reaction are impossible to meet for “organizational reasons”, one must fall back to the less effective training reaction. Stress must be avoided whenever possible.

The editor of the English edition would add one more point:

4. Creation of emotional bonds between the people pursuing a cognitive activity. The naturally emotional character of human relationships can be used to activate the superconsciousness.

The present book describes the topics summarized in this introduction in much greater detail and provides references for relevant original research. We are confident that users interested in cognitive and educational technologies will find it very useful.

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