

"Education is what survives when what has been learned has been forgotten."

B. F. Skinner

by Boris Fačkovec

When a child is born, her body is fragile, unprepared for the world when compared to newborns of other species. Her power is in the ability to learn and in willingness of the society to give her knowledge that will make her ruler of all nature. Education is the culture of reason, which instructs to challenge problems with passion but to cope with defeats and to learn from them. My undergraduate study changed me a lot - not only my view of the physical world, but also my personality. Homilies of professor Halik spoke to me and a semester of study at Faculty of Protestant Theology helped me to elaborate my personal views on soul, love and morality. Here I will discuss education only in its narrower sense, as the preparation of a person for its future profession. First because that is the sense Skinner was using in his article involving the quote. Second, I think that my experience both in learning and in teaching enables me to convey an unorthodox view to the teaching process and value of education.

Skinner in his article on future of teaching refuses oversimplified understanding of education as a process of copying facts from teaching material to students' heads. He emphasizes the importance of development of "specific intellectual skills, abilities, attitudes and tastes" which will be useful to graduates even in the technological world where knowledge changes rapidly with time. I fundamentally agree with this stance. Memorized facts will be either inapplicable in a narrow subfield one will pursue, or will be overcome by up-to-date information, or will be so essential that they will be used on daily basis and never forgotten. Neither of the options justifies spending much time and effort on memorizing. When explicitly memorized facts are forgotten, more important outcomes of education - *intuition* and *motivation* - remain.

I think that teaching generally applicable knowledge, such as fast reading, clear writing, metamathematics and theory of knowledge, should be improved in our countries (Slovakia or Czech Republic). Efficiency of one's work can be indisputably boosted by improving her reading ability. In some countries, these skills are well recognized and incorporated into educational system. For example, American universities include academic writing as a part of undergraduate programs. Many people think that these skills are talents which cannot be trained or learned. Some people are even severely mistaken believing that these skills are innate. It has been recently shown that even IQ can significantly change during teen age.

Yes, we should teach skills rather than facts. But are they entirely different? Mathematical voice inside me draws attention to the fact that all the human knowledge is in principle "just" collection of facts. I believe in useful and sincere Wittgensteinian concept of non-existence of unreasoned. In my opinion, everything can be stated in an *explicit* way, no matter if it is a list of enzyme classes, methodology of distillation column startup, relationship between behavioral psychology and philosophy of mathematics or essence of chemical intuition. However, people can think in different yet compatible ways - using their intuition and emotions. Intuitive reasoning has similar relationship to explicit rational reasoning like

object oriented programming has to procedural programming. In fact, objects are written in terms of procedures but they can be conceived as complex objects with properties depending on the context. Thinking in terms of objects is more natural and efficient. Similarly, we solve surprisingly complex problems by our intuition in seconds.

Intuitive reasoning is vastly used in the learning process. The amount of data acquired while learning is higher than we usually imagine; far most of what is learned in school is never explicitly mentioned. When assumptions of a model are presented, it is also implicitly stated which sets of assumptions do not work - and there are myriads of those. Exploring all these possibilities, as well as making connections to other knowledge is left to a student. I enjoy revealing new connections and arranging them into more global pictures, which also help me keep everything in mind for years by recreating the forgotten partial knowledge from what remains. As a result, I had not need to study for the final physical chemistry examination which I passed on June 7th. I have also been developing my own summaries of the most important unstated principles. These rules of thumb were popular among high school students who I used to prepare for the chemistry olympiad.

The key to success, at least in science, is in right long-lasting *motivation*. It has been found that creativity cannot be motivated by financial reward. I think that the desire to explore is in everyone, it simply must not be suppressed when confronted with the overwhelming knowledge of predecessors. Bad education produces either motivated dilettantes or dubious professionals, both types with their potential wasted, whilst good education makes professionals feel comfortable in the world of their research yet never satisfied with status quo. I was lucky to study elite study program where my peers were highly motivated and inspired each other. Lectures spontaneously used to turn into discussions about surprising reaction pathways or latest research in the non-linear dynamics. In our laboratory I have also an opportunity to be a part of community of smart kind people sharing my enjoyment of discussions bringing disturbance to the global picture.

To summarize, I think that good education leaves a positive feeling about further studying and a global picture, both being of information value far above the the value of explicitly memorized facts. The proportion between the explicit and implicit knowledge depends on a particular subject, and so does the severity of loss caused by forgetting what is explicitly learned.