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ENGINEERING EDUCATION NEEDS ASSOCIATIVE CURRICULUM.

Zoltan Lévai, Budapest Univ. of Technology, Hungary.

Educational process is an extremely complex and involved one. To illustrate the point, we try to give an idea of the process with the aid of a simplified algorithm. The educational process consists of three big, interrelated cycles. If education has been organised properly, circulation starts in all three circles at the same time and lasts to the end of education. This is possible in the case of an associative curriculum only.

Engineering education is a step-by-step procedure, with inflows and recurrences. It can best be demonstrated by an algorithm. The algorithm in the Figure consists of four inputs, one output, and three circles.

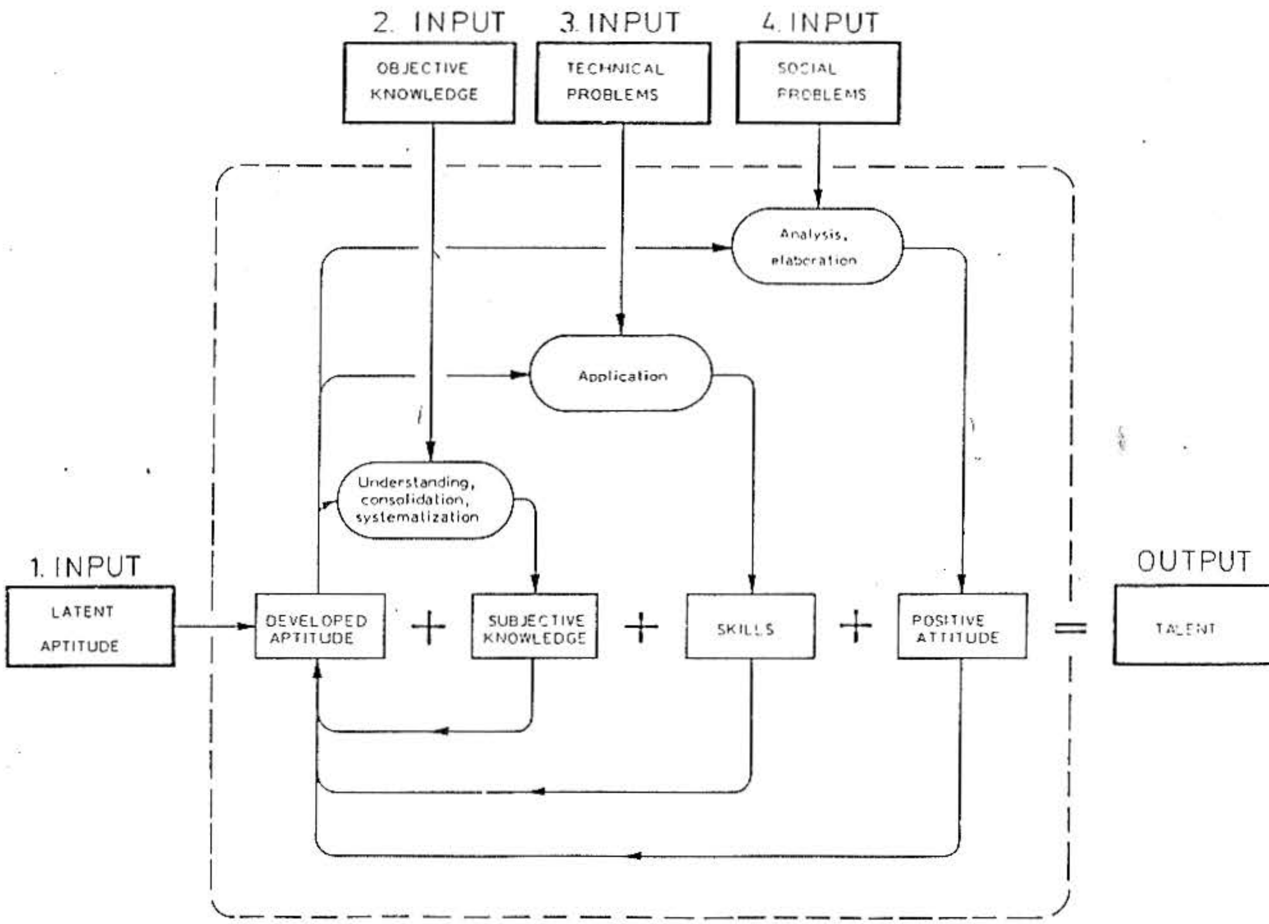
The four inputs are as follows:

- latent, undeveloped aptitude,
- objective knowledge,
- technical problems,
- social problems.

The first circle includes the understanding, recording and systematisation of objective knowledge. These activities lead to the increase of subjective knowledge and the development of aptitude.

In the second circle we find the solution of technical problems. This not only enhances the efficiency of the process which takes place in the first circle, but it also develops engineering skills. Naturally, it polishes the student's endowments and inclinations as well.

The third circle represents the analysis and the working out of social problems. They enhance the efficiency of the process in the first two circles and develop a positive attitude which is necessary for the engineer's profession.



If education has been organised properly, circulation starts in all three circles at the same time and lasts to the end of education. The result of education is the output:

Developed aptitude + Knowledge + Skills + Attitude = Talent

It is to be regretted that the general practice in engineering education is such that at the initial stage circulation is mostly in the first circle only. This is further aggravated by the fact that objective knowledge flowing into the student's mind at this time is predominantly general, theoretical, and abstract (deductive curriculum). This has numerous negative consequences, of which I propose to mention only three: the initial lack of professional motivation, the gap between theory and its application, and the late start of the time-consuming development of skills, where lost time cannot be made up.

I would like to clear up a misconception on the last point. Many think that theory (e.g. Mechanics) can be applied to a concrete problem in a deductive curriculum as well. While this is true, such an application develops only the skills needed to solve examples (which is naturally also indispensable to study) instead of developing the skills needed to recognise, define and solve real technical problems. And moreover, the lack of facing genuine engineering problems tends to distort the student›s technical outlook. The solution of many (and merrely) simplex examples only adds to the mistaken belief that all technical problems can be solved with the knowledge of a sole discipline: the one that the student happens to be studying. For obvious reasons, e.g. Mechanics offers only those problems whose solution requires the knowledge of only Mechanics, but the same also applies to Chemistry, Thermo-dynamics, Hydro-dynamics,etc .

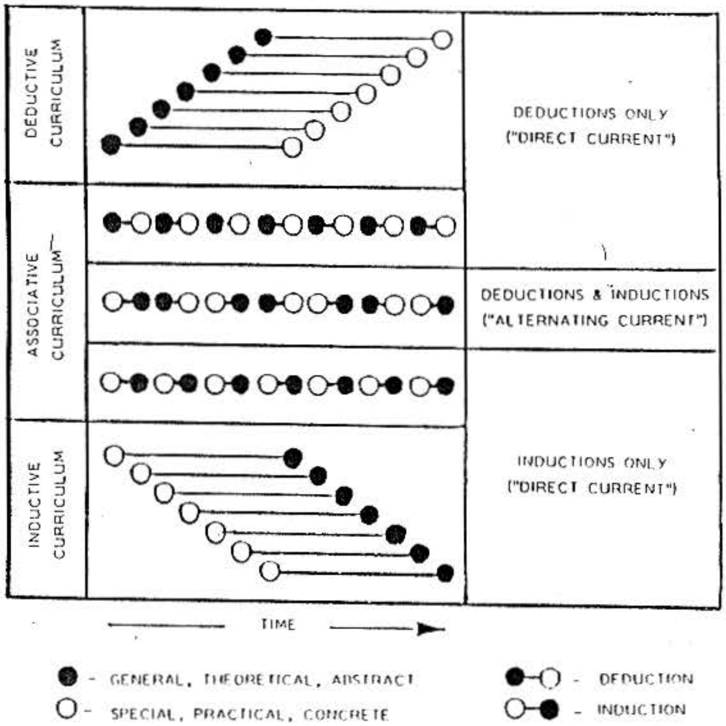
So that circulation should start in all three circles from the onset of engineering education, technical problems would also have to be introduced into the education process in the first years of studies. This implies that inflowing objective knowledge cannot be one-sidedly general (theoretical, abstract, etc.), either. Special, practical, concrete knowledge is also necessary. In other words, the former should be **associated** with the latter (associative+ curriculum), without considering for the time being whether general and special knowledge (theoretical and practical etc.), which are taught nearly simultaneously, are independent of each other, or perhaps it is the case of two versions (general and special) of the same knowledge. This is an interesting point, which depends an whether deduction and/or induction can be applied in the process of recognition, approach, etc. If it is an extremely deductive curriculum we deal with, only a deductive approach is in order: if we are faced with an extremely inductive curriculum, only an inductive approach can be used. Whereas in the case of an associative curriculum, both can be used in a discretionary proportion, depending on the degree and timing of the association.

Figure 2 shows five typical cases, where two examples, the lowermost and the topmost (which exist nowhere these days), indicate extremes.

As it can be seen, in an extreme case the associative curriculum can use either solely deductive or solely inductive approaches, while the deductive curriculum can use solely deductive, the inductive curriculum can use solely inductive approaches ("direct current process", positive or nagative respectively). Whereas only the associative curriculum is capable of producing an "alternating current process" of education.

There is one more quasi-problem we ought to deal with.

Just as only a fractional part of objective knowledge can be instilled into a student, so only the most characteristic technical problems, in limited numbers, should be introduced into the education process. This involves no particular problems in most fields of engineering, but it does in mechanical

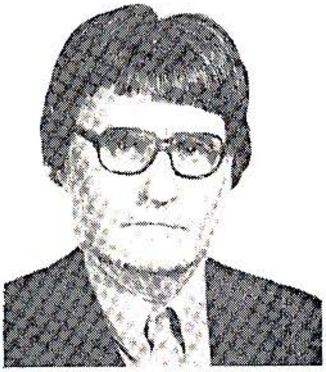


engineering for example. For it is so ramifying (it is practically involved in all other fields such as architecture, chemistry, electricity, etc.) that there are too many concrete technical problems that can be shown as examples of application. Unless we limited this multifariousness to a smaller field of practice, we would have to introduce too much special, practical and concrete knowledge into the education process. It is obvious, however, that it would be to the detriment of general, theoretical and abstract knowledge.

We must exercise great care in defining the latitude of the field of practice. The student should be able to acquire all important general and theoretical knowledge without undue exertion. To narrow down the special field, several fields of practice should be established: for example, automobile, building installation (heating, ventillation, air condition, machine tools, building machines, etc. in mechanical engineering.

Such a division in the curriculum does not necessarily mean specialisation. In the case of a field of practice which consists of hand-picked special subject-matters, the applicability of general, theoretical sciences taught as basic material will not be lost upon the student. One who learns the knack of design on an automobile, for instance, will make the most of his knowledge and his engineering skills in any machine factory after graduation.

+ The term "conductive" was used earlier, but it turned out to have already been reserved for a special field in pefagogy.



ZOLTAN LEVAI

Prof. Dr. Zoltán Lévai (1929) graduated at the Budapest University of Technology (1952), First scientific degree ("Candidate of Technical Sciences") gained in 1956 at the Leningrad Polytechnical Institute, the degree "Academic Doctor of Technical Sciences" at the Hungarian Academy of Sciences in 1966. Ford fellow in 1967-68. Founder of the second Hungarian automobile engineering department (1960), Vice-Rector from 1963 to 1967, dean of the transportation engineering department from 1979 to 1985. Director of the Vehicle Engineering Institute of the B.U.T. from 1979.
There appeared a great number of his publications on the problems of higher education, he prepared innumerable proposals for the education's development, not a few of which are already carried into effect.