

# ORGANIZATION OF CURRICULUM AND EDUCATION IN TECHNICAL TRAINING

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## Abstract

Proper management of the realization of the general and special training objectives of technical higher education makes it necessary to organize the curriculum and the educational process according to didactic, methodological aspects. Selection of curriculum elements with deductive and inductive approach and their horizontal and vertical arrangement are required. In addition, the curriculum concentration of a given subject, i.e. its connection to other subjects, must be taken into account. This article intends to add to this by raising some points.

**Keywords:** curriculum, deductive, inductive, horizontal, vertical.

## 1. Organizing the curriculum

In the interest of motivating towards the different technical domains and specialty fields it is useful if – within the framework of the fundamental subjects connected to these fields – the characteristic problems are introduced in the curricular conception from the very beginning. These are served well by the so called associative, or unified curricula. Their essence is presented in Figure 1. By comparing them to the two basic versions: the deductive and the inductive (which generalizes based on the specific) curricula. [1].

The deductive approach therefore consists in getting from known true statements to new true statements by means of deduction, while the inductive learning consists in formulating generally valid statements based on specific observations. Regarding the knowledge obtained by the latter method, it cannot be considered to be certainly and absolutely true, only probably (hypothetically) true, since the generalization is based on a finite (low) number of observations. The inductive approach is a complex process; it has the following essential elements: searching

for analogies, induction of rules, establishing of counter-examples, proof. An example for the inductive method would be the teaching of the crystallization process of pure metals by establishing and analyzing the cooling graphs and by confirmation of the Gibbs phase law. An example of the deductive method would be the teaching of the crystallization process of pure metals based on a given cooling graph and the Gibbs phase law. Further examples of the deductive method can be seen in Figure 2. [2].

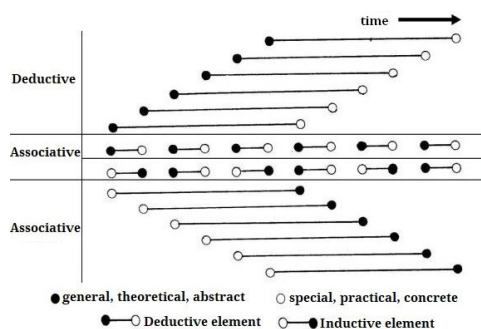


Figure 1. Curriculum structures

The system of criteria for the teaching of the structures mentioned in **Figure 2.** is as follows:

- basic principles, fundamental notions
- technological parameters and calculations
- procedures and equipment
- applicability, advantages, disadvantages, economic viability
- management of quality, necessary and opportune material analysis
- safety technique, environmental protection
- country-specific considerations, international comparison

The selection and organizing of the taught contents becomes more and more an activity that needs expertise and therefore it is a task for every teacher and every teaching collective, with

the appreciation of different groups of factors (**Figure 3.**) [3].

The two categories of additive teaching aims from the first group of factors are the scientific worldview and the human competences that provide the necessary stability for the organizing of the teaching – learning activity and at the same time they allow for a flexible space for any changes that can occur as a means to prove the progressive and adaptive nature of the organizing of teaching. These aims are never unidirectional or deterministic; they also contain the regulative effect of feedback coming from both the results of the teaching and the qualitative control processes.

	I.	II.	III.
Steps	Refreshing of previously learned information, organizing them into a new system (e.g. a recapitulation of the mechanisms of shape-shifting)	Establishing of new notions, basic principles. Teaching of the fundamentals of technologies (e.g. the processing of the principles of plastic-forming)	Applying of new knowledge, teaching of unique manufacturing technologies (e.g. teaching of rolling, smithing technologies)
Methods	Investigating the level of previous knowledge by means of questions. Completing previous knowledge by discussion and solving problems.	Explanations and illustration by the teacher, in some cases visiting the factories for the processing of new information. Teaching based on problems in the phase of applications.	Explanations and illustrations by the teacher, discussions. Autonomous processing of informations based on a directed series of questions from the manual. Autonomous applications: solving of problems.
Results	New competences in applying fundamental knowledge.	Learning of new notions, correlations, principles and structures.	Experience in applying knowledge in technologies.

Figure 2. Deductive processing of curricula

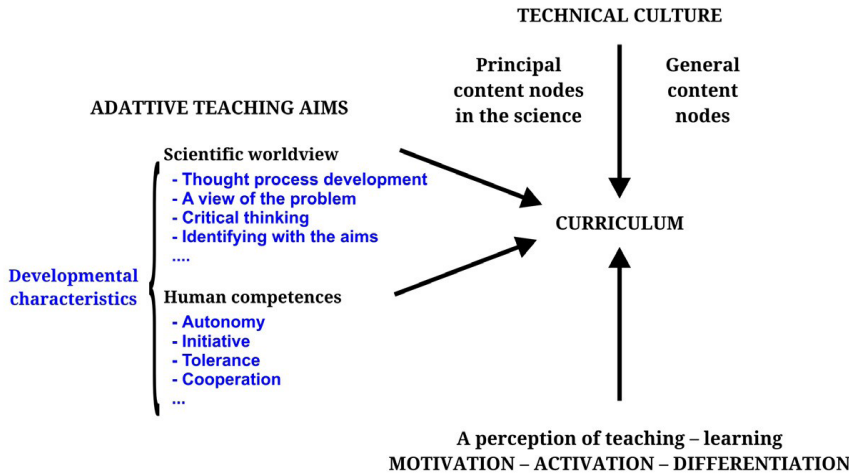


Figure 3. Factors that influence curriculum selection

The second group of factors consists of the notion of a technical culture that is the sum of all relations towards specialty sciences and all material, social and spiritual objectivations in other words, always a sum of things (values) and activities (original creation, practical use, reshaping re-creation, interiorization etc.).

The third group of factors is the perception of teaching – learning, the expression of which in the curriculum makes it possible for students with very different capabilities, motivations and fields of interest to learn in a way that matches both expectations and their own interest [3].

## 2. Organizing of teaching

The curriculum chosen based on principles has to be organized in categories according to well defined criteria; this is a pre-condition for contouring its main sections which later will form the basis of the teaching – learning process. Therefore the globally assigned contents of culture have to be arranged accordingly. This arrangement can be approached from two directions: a horizontal one and a vertical one.

The vertical approach aims at a realization of the sequentiality given by the very build of the curriculum, this direction is strongly connected with the educational system and the system of teaching itself [4]

The horizontal approach poses the question of the specific thematic units that can contain during the process of teaching the different interconnected blocks of the curriculum. The horizontal arrangement is strongly connected with the selection of the curriculum, the structure of which is represented in Figure 4.

The subject and its curriculum are not some reduced version or copy of a science but a means of preparing the students – with scientific exigency and also practical effectiveness – to their future careers.

A modern curriculum is not a system of isolated subjects, but one that aims for a structure of scientific modules, that is, higher and inter-related units, scientific modules in which the contained subjects still keep their relative autonomy.

The teaching of the different themes within any given subject has to happen according to the inner logic of the entire unit and that requires the collaboration of the teachers of different specialty fields [3].

In the construction of a curriculum an important role must be attributed to the curricular concentration, that is to say that the inter-relations of different subjects have to be mapped out precisely in order to know when and how extensively those specific informations will be taught, that are necessary for processing new knowledge but are taught as part of different subjects.

This is necessary in order to build on pre-existing knowledge and thus avoid futile (and time consuming) repetitions and also to include the absolutely necessary parts [5] of hitherto unknown material in the curriculum of the given subject. In Figure 5. we represented the content abstracts for the curricular concentration of two basic subjects.

## 3. Conclusions

The above viewpoints and the examples presented can serve as a sample for organizing technical education and its curriculum while not ignoring the fact that the properly weighted presentation

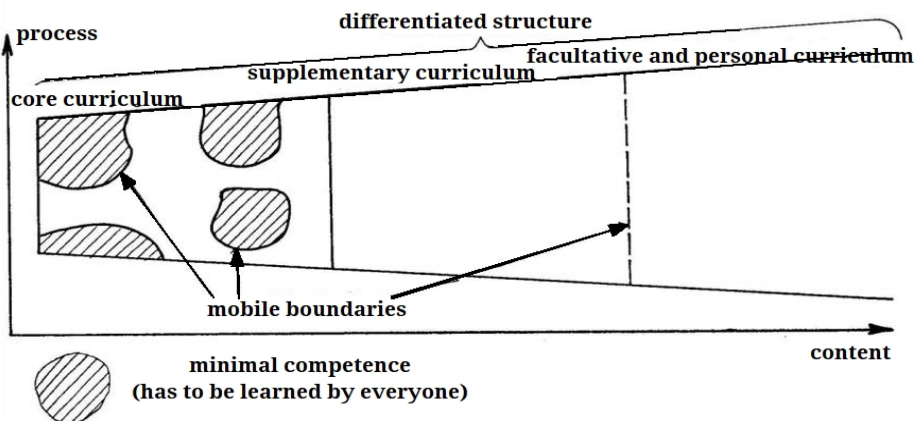


Figure 4. Curriculum structure

	MATERIAL SCIENCE	MATERIAL TECHNOLOGIES	
<b>MATHEMATICS</b> Basics of vector algebra, analytic geometry of straight line and plane, matrix calculus, tensor algebra, differential equations and its applications, function analysis	Material structure, macro-, micro-, crystal- and atomic structure. Material structure analysis: visual, non-destructive, microscopic and electron-microscopic	Production of materials, processing of bio-materials, manufacturing of plastic, metallurgy, ceramics production	<b>MECHANICS</b> Tension states, shape shifting states, shape shifting energies, equivalent tension, measuring to rigidity, measuring to solidity
	selection of materials: bio-materials, synthetics, metals, ceramics, composites	shaping technologies: casting, powder-forging, production of sintered pottery, shaping, machining, cutting	
<b>ENGINEERING PHYSICS</b> Modeling, statistical view, atomic structure of materials, free electron gas model, solid-state physics, thermodynamics, electricity, magnetism, optics, acoustics	Characteristics of materials: Mechanical, thermal, electric, magnetic, optical, acoustic, tensile testing, hardness measuring. Analysis of physical characteristics	Joining technologies: welding, soldering, adhesive bonding, mechanical bonding	<b>MACHINE PARTS</b> Projection graphics, workshop design, construction engineering and material selection, forming of welded structures, bonding elements and their applications
	Material workability by casting, sintering, shaping, machining, cutting, joining, surface treatment. Technological experiments	Technologies that change the structure of materials: Altering monolithic materials (foaming, felting, manufacturing of composites, thermal treatment, surface treatment)	
<b>TECHNICAL CHEMISTRY</b> Organic and inorganic chemistry, chemical bonds, counterweights, reactions and equations	Damage resistance of materials: resistance to gliding, fatigue, breaking, abrasion, corrosion, thermal and biological damage. Resistance to aging	information resources and methods of technological planning	<b>GENERAL MECHANICS</b> Physical quantities and measuring units, physical and empirical laws, models, basic measurements in engineering
<b>BIOLOGY</b> Cellular biology, histology, organology, morphology	Viewpoints of material selection: engineering, safety, standards, qualities, economy- ecology-related	Mechanizing, robotics and automation in technologies	<b>INFORMATICS</b> Data processing, databases, engineering algorithms

**Figure 5.** Content extract of curricular concentration for the subjects of material science and material technologies

of each subject needs a thorough background knowledge and an ability to organize it. The aim of this present article is to give some „motivation” to that through a series of intriguing thoughts.

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