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CURRICULUM CONTENT OF THE TRAINING FOR THE DISCIPLINES OF MATHEMATICS

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Abstract

Contents are knowledge units supporting the achievement of reference and operational objectives. They occur in the curriculum either as a transposition of didactic coordinates for certain skills that are representative for the targeted domain, or as a flexible model on the basis of which authors of handbooks may provide proper pedagogic solutions for conducting the educational act. Contents are means supporting the achievement of the established frame and reference objectives. Content units are organized either thematically, or in agreement with the fields which constitute the various objects of study. The choice of the order regarding the covering of these contents in class rests with the teacher or the department, on condition that the didactic logic of the domain and a certain number of hours allotted for syntheses and recapitulation are respected. The curriculum specifies the type of knowledge, abilities and skills that the students in the respective grade should acquire, as well as the order in which these should be learnt.

Key words*:* cognitive obstacle; cognitive evaluation; conceptual texture; didactic transposition; optimization of learning processes

1. The curricular contents of training

The curricular contents of training constitute, together with the objectives, the basic elements of the curricular project. The didactics of mathematics should pay very much attention to the connections established between the two components: the general and specific/ intermediary objectives (frame and reference objectives) that lie at the basis of the curricular construction of the curriculum and the syllabus; and the concrete/ operational objectives that lie at the basis of selecting the essential contents circulated during a lesson.

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The didactics of mathematics should take into consideration the present modern meaning of training, which refers precisely to the "set of cognitive attitudes and strategies that provide mastery and exploitation of knowledge according to the general and specific objectives established on special explicit, pedagogic and value criteria at the level of the curriculum and syllabus." The curricular view upon the content of education is rendered by Văideanu (1988): through the formula of the inversed triad, priority knowledge turns into higher attitudes towards knowledge, which enables a proper selection and appropriate use of the cognitive strategies and knowledge (information and methodology).

The first aspect refers to the integration of all forms of organizing training at the level of the content. To this effect, three types of content are integrated at the level of the curriculum: formal, non-formal and informal. The second aspect refers to integrating, in the structure of the principles of learning and of the syllabi, certain contents which may reflect issues related to the contemporary world (the new types of educations: demographic education; ecological education; education for democracy; civic education; modern health education; modern home education etc.). The general objectives describe broadly the expected results and are meant to provide the major orientation of education, in agreement with the educational policy of society, validated by different official documents. They are not directly connected with the various didactic contents, but are, nevertheless, relevant for each school discipline in terms of the criteria which should be adapted in the pedagogic design activity.

By analyzing some remarkable research on the general objectives of teaching mathematics (Watson, 1972; Delessert, 1974; Servais, 1976; Hauson and Mellin-Olsen, 1986; Darfler and McLene, 1986), we have found that they are different in relation to three dimensions:

a) forming the skills and abilities necessary for the individual's professional and social life;

b) becoming conversant with the particularities of the mathematical activity – based on deducing new results from previous informational and formative acquisitions, with the final end of constant development of the operational side of thinking;

c) introduction into the study of mathematical models, for solving concrete problems from the natural, social or economic environment at high technological parameters.

The following statements express, in fact, the utility of mathematics:

- In various pedagogical circumstances valid in the context of general education and training for the individual's social and personal life.
- The pedagogical models, the taxonomy, the structure, correspond to mathematical thinking because the objectives' model is a model of mathematical thought applied to social action, in

the sense that it teaches us how to think correctly about the relation between the general, specific and concrete levels of human action.

- Also in pedagogy, Mathematics teaches us how to establish learning hierarchies which may eventually be formalized.
- In training for continuing studies in a field which requires, directly or indirectly, the use of thinking.
- In Mathematics and in applying Mathematics as a tool for developing other sciences and as a tool for transforming reality. One of the basic criteria for selecting the educational content is the unity of concepts and the mathematical procedures for the individual's social and professional life.

Mathematical education provides basic information which supports training in a wide variety of practical activity fields. It also ensures a first initiation in how the respective information – with a high methodological value – may be used to solve high complexity practical problems. Many specialized works believe that the skills and abilities related to the application of the mathematical tool to describe and represent reality enter the structure of a wide range of professions. These skills and abilities include:

a) using numbers in operations of counting, ordering, indexing, encoding;

b) performing measurements;

c) making numerical calculations;

d) interpreting information rendered numerically;

e) interpreting information rendered graphically.

2. Pedagogic objectives

Concrete pedagogic objectives aim at the actions that the student has to perform, under the guidance of the teacher, during the lesson. According to the expected type of behaviour, pedagogic objectives fall into the following categories: competence pedagogical objectives and performance pedagogical objectives.

Competence pedagogical objectives orient the teaching-learning activity and specify the behaviours that should be formed at students. These are organized into three major domains:

- the cognitive domain – acquiring knowledge, forming skills and intellectual abilities;

- the affective domain – forming feelings, attitudes, beliefs;

- the psycho-motor domain – elaborating motor skills, mental operations etc.

Performance pedagogical objectives are also called *reference* objectives. In the training activity, there may be identified the following performance objectives, interdependent at the level of the educational process: objectives of mastering knowledge; transfer objectives; expression objectives.

Objectives of *mastering knowledge* project the student's performance in terms of precise information. These can be easily evaluated through precise evaluations. *Transfer objectives* are related to the training activities which require intra-disciplinary, interdisciplinary or trans-disciplinary mechanisms. *Expression objectives* design performances and didactic situations characteristic of solving problems or problematic situations etc. These are harder to evaluate compared to the objectives of mastering knowledge and transfer, because they stimulate the development of certain complex skills (communication, generalization-abstraction skills etc.).

3. The curriculum

The design of the curriculum relies on three types of approaches:

a) the systemic approach – unitary curriculum with intra- and interdisciplinary structures, opening towards constant learning (also including non-formal contents – for example, the connections between mathematical lessons and circles, camps, counselling);

b) the curricular approach to the curriculum (selecting disciplines, the number of hours, the forms of organization in relation to each educational stage and year) (mathematics raises special problems because it covers all grades);

c) psychological approach – selecting the disciplines, the curricular areas and the time allotted to these in relation to the psychological age of students, their attitudinal and skills level.

The *frame curriculum* specifies the educational objectives according to years of study, types of schools, establishes the total number of hours allotted to the specialized disciplines, which cannot exceed 5 hours per week and 7 hours per week in middle school. The National Council for the Curriculum has an *open* nature, being elaborated for each of the training stages and types of schools and high-schools, containing key words, finalities for each level of education (primary, middle and high-school), curricular cycles, nucleus curriculum and curriculum at the decision of the school, curricular areas/discipline.

For grades I-VIII there are stipulated 3-4 hours of Mathematics. For high-school, there are 2 hours for the vocational and theoretical profile, philology (M3), 3 hours for the technological profile, technical and theoretical profile, for the social sciences profile and for the profile of the sciences of nature, (M2), (M), 4 hours for the theoretical profile, the specialization of Mathematics and Computer science.

4. The syllabi

The *syllabi* are essential for the author of the discipline's Didactics, hence they should be read in the spirit of curricular pedagogy, which means:

1) reference to the objectives characteristic of the stage, grade, curricular area;

2) establishing the thematic structure (annual, quarterly, thematic, by modules);

3) respecting the socio-pedagogic criteria for the curricular elaboration of the syllabus:

a) the usefulness, in time, of knowledge (see mathematical value);

b) sequentiality (linear and concentric sequentiality re combined in Mathematics);

c) the coherence (the connections within the discipline as well as interdisciplinar: Arithmetics, Geometry, Algebra, Trigonometry…, and interdisciplinary Physics, Chemistry). We should note that the introduction of curricular areas facilitates the external coherence of the syllabus.

The new school curriculum, by its design as a balance between the nucleus curriculum and the school curriculum, contributes especially to the decentralization and flexibilization of curricular decisions at the level of school units. Syllabi are inspiring for a new didactic vision in elaborating school handbooks which, as curricular and didactic tools guide, to a significant extent, the teaching/learning process in class, including the evaluation of students and the stimulation of a sustainable learning motivation. The syllabi for grades 5-8 have the following structure: frame objectives, reference objectives, examples of learning activities, contents and curricular performance standards.

For the high-school grades 9-10, the curricular vision for elaborating the syllabi enables precisely a good orientation of teaching/learning in relation to training objectives, which aim at higher level competences, skills in applying knowledge and competences in new contexts, in solving theoretical and practical problems. The existence of several specializations with different ends and a varying number of hours for the same discipline has resulted in the elaboration of several types of syllabi M1, M2, M3.

One type of syllabi is given by the likeness between the goals of certain different specializations. For example, for Mathematics, there have been elaborated three types of syllabi called M1, M2, M3, corresponding to the categorization of specializations, according to the similarity of their goals.

The *syllabus* for Mathematics establishes the *content* of the discipline of Mathematics, according to specializations and profiles. Contents are means which support the achievement of the proposed frame and reference objectives. The content units are organized either thematically, or in agreement with the constitutive elements of the different study disciplines. The order in which these contents are covered in class rests with the teacher's or the department's decision, on condition that the didactic logic of the field is respected and a certain number of hours is allotted for syntheses and recapitulation. It specifies the type of knowledge, skills and abilities that the students should acquire throughout the respective grade and the order in which these should be learnt.

Elaborating the syllabi is compulsory for all teachers of Mathematics. In covering it, a certain rhythm should be maintained, reflected in the schedule for each class and discipline. The role of the teacher who teaches directly in class is essential, because ensuring the succession of a given theme according to his/her own schedule or the schedule of the department, the most fruitful and most stimulating didactic procedures are created and verified during teaching.

5. School handbooks

School handbooks should be built from a curricular perspective to the extent in which the syllabi have been elaborated from a curricular perspective. The syllabi are the support for the teacher's handbook (the didactics of the discipline) and for the student's handbook.

Alternative handbooks of Mathematics are useful to the extent in which they have a stable foundation of objectives and fundamental contents. This may enable the choice of some different ways of organizing learning, alternative evaluation, self-learning. For the author of the didactics of Mathematics it is important to master the concepts that have already been used in designing paradigms (formal, non-formal, ascending curriculum, curriculum for school discipline).

The school handbook represents the *basic means* used in the process of active education, as well as outside it, constituting the main bibliographic element of the student. It presents, in detail, the *content* of school syllabi. The main function of the handbook is that of informing the student, by constituting the student's main tool, which provides the possibility of learning continuously.

Therefore, authors of handbooks should take into account the fact that a handbook should not only help the student in learning Mathematics, but also accustom him to *individual work* with the

book of Mathematics. The handbook should *guide* the student towards *individual thinking*, provide moments of satisfaction and determine him to continue the creative effort.

Certain themes are organized so as to be taught through a *spiralling* process, which consists in returning to the same content, each time on a higher step. This way of presentation corresponds to the concentric system proper, or the qualitative and quantitative, or linear concentric system.

The *qualitative concentric system* designates the way in which knowledge is organized in educational programs, handbooks and lessons, so that the notions are acquired gradually, by renewal, reorganizations and reinterpretations until their full and correct construction. Thus, there are planned notions about *areas* and *volumes*, which are taught and learnt both in primary classes as well as in middle- and high-school.

The *quantitative concentric system* is the way in which knowledge is organized in school syllabi, handbooks and lessons, consisting in completed and detailed renewal of contents previously covered, a renewal reclaimed not necessarily by the difficulty of understanding notions, but particularly by the need of enriching knowledge in the succession of school grades and stages. In our opinion, a distinction should be drawn between the *general culture of Mathematics*, which is necessary for any student, and *specialized culture*, which is offered during classes of Mathematics to those who want to attend a faculty which demands Mathematical culture. General culture in Mathematics should cover a relatively limited sphere of concepts, strategies and skills, having a wide range of durability and applicability. In fact, the basis of the general culture of Mathematics is contained in the syllabi for grades 1-8 and 9-10 from the human profile.

The systematic transition from instructive education to that of modelling intellectual skills, as a new view upon the didactics of the discipline of Mathematics, has imposed the necessity of elaborating the existing high-school curriculum for Mathematics as a continuation of the middle-school curriculum. High-school mathematical education should highlight the exploitation of the student's creative potential.

Designing the Curriculum for Mathematics was done according to the following principles:

- ensuring continuity at the level of grades and cycles;
- updating the information taught and adjusting it to the students' age;
- differentiating and individualizing teaching-learning;
- centring on the formative aspect;

- transdisciplinary-interdisciplinary correlation (optimal scheduling of mathematical contents correlated with the real disciplines according to curricular areas, ensuring vertical and horizontal coherence);

- delimiting a compulsory level of mathematical training for all students and envisaging the possibilities for advancement in learning and achieving new performances.

The elaboration of this document took into account the flexible and open model of curricular design, which may provide authentic possibilities for handbook authors and, subsequently, for teachers and students. This curriculum aims at creating circumstances favourable to each student for assimilating content in an individual rhythm, for transferring accumulated knowledge from one study area into another.

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