

DIDACTICS AXIOMATIC DISCIPLINE AND ITS USE IN MATHEMATICS

Costică LUPU^{a *}

^a “Vasile Alecsandri” University of Bacău, Mărășești Street, 157, RO-600115, Bacău, Romania

Abstract

The article analyses five necessary axiomatic criteria to build the didactics of a discipline. Didactics means both the presentation of the axiomatic criteria defining and analysing and making evidence of the normative frame of the instructive activity projected and realized thought discipline in accordance with each school stage. Then the article analyses the pedagogical principles, namely the categorical imperatives having an axiomatic value, necessary in the design of didactic or educational activities. They were identified in the model of the structure of education, being valuable in the conceiving of the teaching — learning — assessment activities. The principles become operational on any design level if they are supported by the axiomatic theory.

Key words: axiomatic discipline, pedagogical principles, teaching process

The topic of the discipline didactics

The topic of the discipline didactics consists of the instructive activity projected in the teaching process organized in the appropriate context of the disciplines. The relationship between general and disciplines didactics is both logical and pedagogical. The logical relationship is the expression of the relation between the whole and the part. In this way, the issues of general didactics develop specifically in the context of every discipline and education stages. The pedagogical relationship is the expression of the consistency and coherence of the didactic discourse on every level of manifestation so that the discipline didactics should reflect, through specific means, the parallelism to the general didactics.

* E-mail address: costica_lupu@yahoo.com

The topic of discipline didactics appears on the level of the three dimensions of the teaching process as a frame for the realization of the instruction:

a) *the functional* dimension depends on the system of teaching which establishes the orientation frame of development (see the educational ideal and its aims), rendered pedagogically at the level of general and specific objectives valid for the educational stages and levels. The didactics of the discipline depends on the force and dynamics of the above mentioned objectives included in the curriculum and the syllabus.

b) *the structural* dimension of the teaching process consists of the main pedagogical resource distributed to Mathematics (informational human didactic budgetary resources) this dimension depends on the system, for example, the different distribution of the resources in the general education (8-10-12 years);

c) *the concrete operational* dimension depends on the teacher, the way in which the functional dimension is reevaluated, structured in accordance with each form, each student and context.

The latest pedagogical literature speaks about “the triangular structure of the individual knowledge” which leads to the “three dimensional orientation of education in the process of instruction”. This vision contributes a lot to the outline of the topic of discipline didactics in the circumstances of the latter’s development in accordance with a scientific model. This model reevaluates three levels of the scientific knowledge which should be put into practice on the level of instruction:

a) *the cognitive* level consists of elements of content with an immediate action value: information, knowledge, intellectual, psychomotor activities as distinctive elements resembling the bricks laying the basis for the general background at a certain age of professional development. In the case of the didactics of mathematics the appropriation of this level depends essentially on a major mental faculty – thinking, with its operational side, intelligence.

b) *the meta-cognitive* level consist of meta-cognitive knowledge:

- knowledge about self-knowledge, about the way the individual thinks and understands;
- abilities to concretize and explain the functioning of the mind, the progress of knowledge;
- the abilities to master the learning activities.

For Mathematics, the Didactics of these abilities are unavailable being the premises of an efficient, self conducted learning.

The concrete, operational dimension depends on the teacher, the way in which the functional dimension is re-evaluated and structured in accordance with each grade, student and context: the epistemic (paradigmatic level) which “implies attitudes of scientific investigation, organizing and initiating abilities of a scientific approach, knowledge and scientific” actions, therefore the didactics of maths cultivates all these useful qualities in all the domains (Cerghit, 2002, pp. 18-19).

We should be aware of the fact that the topic of discipline didactics means operating in relation to the 3 actions which ensure the structure of realization of the teaching process: teaching (teacher’s action to communicate to the student); learning (the student’s action as a result of teaching); assessment (the teacher’s and student’s continuous actions).

All the functional - structural elements of the process of teaching which constitutes the object of study specific to the Didactics of Mathematics are reevaluated on the level of planning concrete activities.

Axiomatic discipline and its use in Mathematics

1. The first axiom of defining and analysing instruction through school subjects confirms its quality in the psychosocial activity which respects and combines the resources and demands of internal and external development.

2. The second axiom refers to the fruits and finalities of the educational activities realised through the school subjects. The function of maximum generality of instruction expresses the objective dimension of education and instruction to which any teacher has to relate. It is about the function of permanent development and formation of each student through the respective subject. The objective dimension should be reported to the subjective dimension of education and instruction expressed through the concept of finality. The finalities are proposed by the teacher, who guides the student's activities. From this point of view the author of the didactics of the discipline has a great responsibility in the way the general and the specific objects of the discipline are projected or in the way they are transported on the level of syllabi.

This axiom of the didactics of the discipline confirms the necessary independence in the process of instruction between the central function which aims at the information and development of the student's personality and the subjective diversity of the instruction which aims at the way the teacher directs the respective activities. We should emphasize the fact that the teacher has the chance to assume positively his subjectivity owing to the fact that a school subject has it own

operational resources which are very strict and efficient in any context.

3. The third axiom refers to the basic structure of instruction which should be in the centre of the didactics of the discipline. This structure sees the construction of the correlation between teacher and student. The realisation of this correlation is done by all the component parts of education and instruction. These components, which support the correlation between teacher and student, can be grouped according to three coordinates:

- the coordinate of the teacher's action which projects instruction;
- the reference to the central function concerning the macro structural functionalities realised through the elaboration of a curriculum project combining methodology, content and evaluation in a favourable way;
- the dimension of the pedagogical message which combines the action of teaching and learning including a common register elaborated by the teacher taking into account the context ;
- the student's dimension of learning and self -assessment, action led by the teacher, permanently improved through different mechanisms of internal and external connexions.

This axiom takes into consideration the connection between the teleological side of instruction and the technological side which is self regulating. Taking into account the fact that the basic structure follows the first basic function of education and instruction, the correlation between teacher and student is the functioning structure of any activity. All the three actions, teaching-learning-evaluation, are needed.

4. The fourth axiom refers to the contents and general forms of instruction. They are similar to the contents and general forms of education adapted to the specificity of instruction. In this way, any instructive activity determines general, intellectual, technological and psychophysical contents.

The didactics of the discipline presented in a curriculum should have all the 3 general axioms. For example, the didactic transposition of the contents implies the anticipation of positive formative effects on the moral, technological, aesthetic and psychophysical plan. The general formulae of education can be found on the level of instruction: formal instruction, non-formal instruction, informal instruction.

This axiom of the didactics of the discipline takes into account a reconsideration of all the contents and general forms of education, which gives to the process of teaching, learning and evaluation in Mathematics rigour, opening, coherence, consistency, precision and adaptability.

The fifth axiom refers to the internal and external context in which the instructive activity takes

place. The didactics of the discipline built in agreement with the syllabus will take into account its development in an open context.

The external context refers to the social system in which education and instruction take place, the economic, cultural, demographic, political, community background.

The didactics of the discipline refers to the educational environment of the class dependent on the quality of space, the pedagogical available time and the style adopted by the teacher. The axiomatic of the didactics of the discipline implies, besides the presentation of the axiomatic definition and analysis of the instruction, the pointing out of the norms regulating the activity of instruction in the process of education, too. The instruction norms focus on the level of two categories of principles applicable to the entire teaching process (Cristea, 2003): the pedagogical principles which regulate the norms for designing and conceiving the concrete activities in the process of teaching; the principles of didactics which regulate the operative development of concrete activities in a physical space (the classroom) and actual time (50 minutes).

The pedagogical principles

The pedagogical principles represent “the categorical imperatives with an axiomatic value in the projection of the didactic and educative activities. They can be identified on the level of functioning of the model structure of education being valuable in conceiving the three actions of education “teaching – learning – assessment” (Pastiaux, 1997, p. 81). The General Theory of Education speaks about the following pedagogical principles, which also apply to the discipline of Didactics:

a) The principle of pedagogical knowledge refers to designing the teaching-learning activity, which will have its finality in a curricular construction of the didactic message. In didactic terms, this is called didactic transposition.

Actually, any teacher or author of the didactics of the discipline should take into consideration the scientific knowledge selected as scientific basic knowledge with a positive formative value in accordance with the student’s age and the sequences of the planned instruction. This principle draws attention to the differences between the scientific knowledge and knowledge with a pedagogical value. At the same time, the realisation of this principle of projection implies familiarization with the student’s personality and with the school, social, cultural and educational resources.

b) The principle of pedagogical communication refers to the changing of the action of teaching suggested by the teacher into the action of effective teaching of the student, which can be immediately evaluated by the teacher. The principle has as an axiomatic demand the elaboration of a common viable repertoire between teacher and students.

c) The principle of pedagogical creativity refers to the realisation of a permanent self adjustment of the activity on the level of some positive feedback circuits, made by the teacher for the self improvement of the instruction in close connection with the students' results and the context. This principle denotes a continuous evaluation characteristic of curricular projection. This principle condemns any tendency of routine which proves to be inefficient because the situation in class changes continuously.

The principles of didactics are operational on any lesson plan if they have been previously supported by the axiomatic theory of the principles of projection. In other words the teacher, through a correct projection of the learning unit, creates the premises for the efficient realisation of a normative framework for each lesson. In the Didactics of Mathematics, there are 8 didactic principles which should be obeyed during the lesson.

1. The principle of positive formative orientation of the lesson - selection of exercises which stimulate the development of mathematical thinking.

2. The principle of systematisation of a Mathematics lesson - systematization in accordance with the previous present and future contents, connexions between knowledge theory and practice, teaching-learning-assessment connexions between consolidation exercises which lead to solving problems. For example, teaching the notion of number at the 1st grade is realised according to the following steps: building a set of objects having as many elements as the latest known number; building an equipotent set to the previous one; adding to the second set a new element; making pairs and highlighting the fact that the new set has one extra element; building other equipotent sets; specifying the number of elements and the way of obtaining new sets; presentation of the corresponding figure of the new number.

3. The principle of accessibility. For example, the activities in which students are familiarized with the notions of number and operations are realized using sets. The process of teaching the numbers should not be done in a mechanical way, but through exercising the correspondence of elements belonging to the set of objects. Teaching addition of a number with hundreds, tens and units is realized gradually: firstly, a number consisting of tens, then numbers consisting of hundreds and tens, and in the end numbers with hundreds, tens and units. The teacher will design

the lesson through efficient methods and accessible contents adapted to the grade.

The principle of optimum participation is closely connected to the conditions, knowledge, experience and skills of students. The principle involves: dynamization of the student's activity throughout the stages of learning; understanding the content to be learnt; raising the student's awareness of the need to take part in their own instruction. The awareness of learning is realised through solving exercises and examples presented during the lesson.

The principle of interdependence between intuitive knowledge and logical knowledge. For example, in primary school the notions are presented logically, through many examples. Teaching the notion of natural number should be done through exercises of forming equipotent sets, drawing the connection between quantity and number, and between number and quantity, counting, establishing the neighbours of numbers, addition and subtraction.

6. The principle of interaction between theory and practice. In Mathematics, this principle is connected with the modulation of the reality phenomena and their study. In primary school, practice comes after the presentation of the solving methods. In secondary school, it is done by solving problems applied to equations and systems of equations and, especially, geometry problems of calculating distances, volumes, and areas.

7. The principle of assessing the students in a certain class. The initial assessment will be realized through tests, in order to identify the knowledge students acquired through diagrams and grids.

8. The principle of permanent self regulation. The results of the previous tests will be analysed and the lessons in the first term will be planned and projected in accordance with the results.

Conclusions

It is worth mentioning some considerations concerning assessment in secondary and high school. The tests for initial assessment for the 5th and 9th grade are very important because they give the Maths teacher the possibility to obtain information about the level of knowledge and abilities the students need to be successful in their next instructive stage. Taking into account the way the students learn Mathematics, their difficulties and their gaps in acquiring knowledge, the teacher organises and realises the teaching learning tasks of the students.

The axiom of the didactics of the discipline should be built by combining the two landmarks. The axiomatic landmarks are necessary to define instruction as a psychosocial activity, its finalities, contents and general forms, all these acting in an internal and external context. Some of the

normative landmarks have a higher generalizing degree and others an operational character. All the elements which act between the two landmarks should be complied with in the didactics of the discipline. Certain elements are particularly relevant, for example the changing of mathematical knowledge into pedagogical knowledge requires the principle of the connection between theory and practice.

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