The Axiomatic of Didactics Discipline of Education as Applied to Mathematics

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Abstract

The scientific foundation of mathematics is based on primary notions, primary relations and set of axioms. Is the science of education based on a similar structure? In my article I will present the axiomatic criteria which define the judicial framework of educational activities conceived and applied through a school subject in form of mathematics as didactics of discipline in accordance with each school stage. The axiomatic of the didactics of mathematics presupposes both presentation of the axiomatic criteria of defining and analysing the process of instruction, and rendering evident the standard framework of the instructive activity during the learning process. The specific study subject under consideration is represented by the instructive activity which is planned and realized through the discipline in the context of each school stage.

Keywords: axiomatic criteria, pedagogical principles, knowledge level, axiomatic landmarks.

1. Introduction

In pedagogy and educational practice there are a number of contradictory situations. On the one hand, the curriculum is still enough charged and teachers want to presenta much knowledge as they can without taking into account the necessity for it is pedagogical transfer mediated psychologically and socially. On the other hand, it is evident that there has been a decrease in pupils’ motivation for obtaining scientific knowledge based on the superior cognitive competences of analysis, synthesis and evaluation.

Another contradictory situation is the one which can be seen between the undergraduates scientific schooling the level of their methodological and practical formation, both of which are necessary for a future didactic career. Thus, in universities in Romania, there are few practice and didactic classes in various disciplines? Their problems are not sufficiently researched, fragmentarily without being connected to the existing evolutions in contemporary society. In schools in Romania there is a gap between the requirements of a didactic profession and material endowment, which does not allow the improvement of the pupils’ permanent learning conditions.

The pedagogical principles are analysed too. They represent those imperatives having the value of an axiom necessary in projecting the didactic or educative activities. They are identified at the level of the model of education structure being valuable in conceiving the teaching-learning-evaluation action. The principles become operational in any plan being supported previously by the axiomatic theory.

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2. Axiomatic criteria of the didactics of the discipline

The axiomatic didactics of the discipline can be deduced through analogy with what happens in education and instruction. Five axiomatic criteria specific to the didactics of the discipline are analyzed. The first axiom of defining and analysing instruction in terms of a school subject confirms its quality as a psychosocial activity which obeys and combines resources and the requirements of internal and external development.

The second axiom refers to the outcomes of the instructive activity realised through the school subject. The most general function of instruction expresses the objective dimension of education and instruction to which any teacher relates. It is about the function of the permanent development of pupils through an increase in the knowledge of the discipline. This objective dimension should relate to the subjective dimension of education expressed through the concept of finality. The finalities are proposed by the teacher who then guides the pupils’ activities. From this point of view, the textbook writer has a great responsibility as far as the specific and general objectives are concerned, and which are transposed didactically at the level of curriculum. This axiom with regard to the didactics of the discipline reinforces the necessary interdependence in instruction between the central function which envisages formation, the development of the pupil’s personality and how they are transposed on the level of the curriculum. This axiom confirms the necessary interdependence in instruction between the central function which aims at the formation of the development of the pupil’s personality and the subjective diversification of the instructive process, which means how the teacher guides the respective activities. We have to take into account that the teacher has the chance to positively assume the subjectivity, because the didactics of the discipline has very rigorous operational resources, and are very efficient in the context of the classroom.

The third axiom refers to the structure of the basic instruction, which should be at the centre of the didactics. This structure refers to the building of a relationship between the teacher and the pupil. This relationship can be achieved with the help of all the components of education and instruction.

These components which support the relationship between teacher and pupil can be grouped in terms of three aspects:
- the teacher coordinates the planning of the instruction;
- the reporting to the central function concerning the functionality ideal – the aim realized through the elaboration of the curriculum project, favourably combining methodology, content and assessment;
- the dimension of the pedagogical message which outlines the actions of teaching, and includes the common register made by the teacher in accordance with the context and the dimension of the pupils’ learning action and his/her self-assessment, and the activities guided by the teacher, permanently perfected through different mechanisms of internal and external connection.

This axiom registers the connection between the teleological side of teaching (the objectives of instruction), the curricular pedagogical content (the pedagogic message), and the technological side (the strategies of teaching, learning, assessment, and the mechanisms of internal and external connexion). Taking into account that the basic structure is the basic function of education and instruction, the teacher-pupil relationship is the functioning structure of any instructive activity. It is necessary for all three types of action - teaching-learning-assessment.

The fourth axiom refers to the contents and general forms of instruction. These are the same with the contents and general forms of education, adapted to the specifics of the process of instruction. Thus, any instructional activity determines the general, intellectual, moral, technological, aesthetic and psychophysical. The didactics of the discipline presented in curricular spirit should have the following five general axioms (even if through its mathematical nature it reflects the intellectual content):

The didactic transposition of mathematical content presupposes the anticipation of some formative positive effects on the moral level (such as the example of order and strictness offered by mathematical models), on the technological level (in terms of the numerous applications of maths in social life), on the aesthetic level (the beauty of mathematical calculations and demonstrations), on the psychophysical level (the learning regime). The general form of education can be found on the level of formal instruction (the school programme), non-formal instruction (circles, camps) and informal instruction (the spontaneous effects of learning maths).

This axiom with regard to the didactics of the discipline takes into consideration the curricular spirit of all content and general forms of education. It gives to the process of teaching-learning-assessing maths, a strictness and openness, coherence and consistency, precision and adaptability to the new.

The fifth axiom is about the internal and external context in which the activity of instruction takes place. The didactics of the discipline based on the curriculum will be based on its development in an open context. The external context refers to the social system in which education and instruction takes place - the economic, cultural,
demographic, political, and community background. The didactics of the discipline take into consideration all the requirements of the social background. The internal context refers to the educational ambiance of the form, depending on the space, quality and pedagogical time at the teacher’s disposal, and the style of the dialogue adopted by the teacher.

3. The principles of the didactics of the discipline

The axiomatic of the discipline supposes, besides the presentation of the axiomatic criteria of definition and the analysis of instruction, the making evident of the normatively of the instructive activity during the learning process. The normatively of the instruction is focused on the level of two categories of principles valuable for the whole learning process: - pedagogical principles which guide the planning and conceiving of norms of concrete activities in the learning process; - didactic principles (the name coming from the time of Comenius) which regulate the operative display of concrete activities in a concrete space (a classroom) and over a concrete period of time (50 minutes, say).

The pedagogical principles represent the categorical imperatives with an axiomatic value in planning didactic and educative activities. They can be identified on the level of the model structure of the functioning of education and are deemed to be valuable in terms of conceiving the three actions of instruction: teaching–learning–assessment.

Professor Sorin Cristea in his book ‘The Basis of the Sciences of Education. The General Theory of Education’ writes about the following pedagogical principles, valuable in terms of the didactics of the discipline:

a) The principle of pedagogical knowledge refers to the moment of planning of teaching/learning activities, which will end in a curricular construction of the didactic message. It is referred to as didactic transposition. Practically, any teacher or author of textbooks has to take into account the transposition of selected scientific knowledge and of basic scientific knowledge with a positive formative value, in accordance with the pupils’ age and planned instructive sequences. This principle draws attention to the differences between scientific knowledge and knowledge with a pedagogical value.

Scientific knowledge can become knowledge with a pedagogical value if it is didactically mediated by choosing certain forms of organisation, is processed, and for which examples are selected. At the same time, the realisation of this planning principle presupposes knowledge of the pupil’s personality, of his school, and of the social, cultural and educational resources that are available.

b) The principle of pedagogical communication refers to the transformation of the teaching action as determined by the teacher, into a pupil’s effective learning action which is to be assessed immediately by the teacher. This principle has as an axiomatic imperative in terms of the elaboration of a common register, viable between the teacher and the class.

c) The principle of pedagogical creativity means the realisation of a self-regulation of the activity on the levelof circuits in positive inverse connexion of thought by the teacher with the aim of self-improvement, in close connection with the pupils’ results and the context. This principle presupposes a continuous assessment typical of the curricular planning process. This principle also condemns any tendency towards routine didactic work, which is inefficient because the situation in the classroom is continuously changing.

The didactic principles are operative in any lesson plan if they are previously supported by the axiomatic theory of the planning principles. In other words, the teacher creates conditions for the effective norm framework for every lesson if he ensures a correct planning of the lesson. In the specific literature with regard to the didactics of the discipline, there are eight clear didactic principles which should be respected throughout the whole lesson:

1. The principle of positive formative orientation of the maths lesson. This involves selecting exercises which stimulate the development of mathematical thought;

2. The principle of systematization of the maths lesson. This involves the systematization of the lesson in accordance with what has already been taught (systematization means connections between knowledge, theory and practice, between teaching-learning-assessment, connections between consolidation exercises which lead to solving problems);

3. The principle of accessibility. This involves forms of presenting material, choosing methods, objectives, contents and assessment methods;

4. The principle of the optimal participation in the lesson. This will be in accordance with the conditions, knowledge, experience and skills of both teacher and pupil. The requirements of this principle are:
   - stimulating the pupil’s activities throughout all the learning stages;
   - understanding the content to be learnt;
- developing an awareness of the part of the pupil of the need for their participation in their own instruction. This learning awareness is realised by transposing knowledge in a mathematical language, solving the exercises and giving examples and counterexamples presented during the lesson.

5. The principle of interdependence between intuitive knowing and logical knowing. For example, the teaching of the notion of natural number may be done through exercises such as forming multitudes, equipotent multitudes, reporting the number to the quantity and the quantity to the number, counting, learning how to count, addition and subtraction with one unit exercises and problems. After all these exercises the teacher can pass on to the notion of natural numbers and operations with natural numbers.

6. The principle of interaction between theory and practice. In maths, this principle is in close connection with mathematical modelling of real phenomena, and the studying of these phenomena by solving problems using equations and systems of equations, and especially the use of geometry in terms of calculating distances, areas and volumes.

7. The principle of essential results (in assessing the class). At the initial assessment, we will realize that sociological tests are necessary for knowing the individual pupil’s level of knowledge using diagrams and grids.

8. The principle of permanent self regulation of activities. In this research, we will undertake an analysis of the previous tests and will plan and project the lessons for at least the first semester in accordance with these results. Testing the fifth and ninth forms will be a very important activity because it will give the maths teacher the possibility of obtaining the information about the knowledge and skills the pupils need to be successful in the next stage of instruction. Taking into account the way pupils learn maths and the difficulties and gaps in assimilating knowledge, the teacher will organize and realize the teaching-learning tasks needed for future maths activities of the class in each form.

The axiomatic of the discipline should be built on the joining of the two landmarks:
- The axiomatic landmarks necessary to define instruction as a psychosocial activity in terms of content and general forms, all of them acting in an open internal and external context;
- Norm landmarks, some of which have a higher generalising degree, while others have a more operational character (see the principles of didactics).

All the elements which interfere with these two landmarks should be respected in the didactics of the discipline. It should be noted that some elements have a special weight, for example, changing mathematical knowledge into pedagogical knowledge imposes the principle of the connexion between theory and practice.

4. Conclusion

The situations presented introduction imply and generate the research problem. Specifically, what are the theoretical and methodological fundamentals of the teaching-learning-assessment process of a school subject in the context of the contemporary world?

The object of the research is the process of building the didactics of the discipline, integrated and developed in the system of educational science.

The aim of the research consists of conceiving and elaborating a psycho-pedagogical paradigm concerning the didactics of the discipline (with applications and exemplifications from mathematics) in the context of the problems of education and instruction in contemporary Rumanian society, establishing the theoretical and methodological fundamentals of the domain.

In accordance with the research aim, the hypothesis of the research was formulated as an elaboration of a paradigm of the didactics of the discipline which will prove its efficiency based on the articulation of two models:
1. The model applying the general theory of education and instruction to the problems associated with the teaching-learning-assessment of a specific school subject.
2. The model reporting the problems of instruction in terms of epistemological and psychological structures of a discipline at different stages and school ages.

The objectives of the research are specific to fundamental research combined with ahistorical and comparative investigation, aimed at improving the system of instructional planning. The intention is to check the hypothesis in accordance with the aim of the research. The research objectives are as follows:
1) to make evident the theoretical and methodological fundamentals of curricular planning necessary for elaborating the paradigm of the didactics of the discipline;
2) to establish findings in the literature and to identify the existing relationships between general pedagogy and applied pedagogy functioning at the level of a planning model in the context of the teaching-learning-assessing
process of the discipline.
3) to determine the fundamentals of the applied didactics concerning the objectives, curricular contexts, methodology, assessment teaching activities, learning, assessment of the discipline and curricular planning of the activity.

The methodology of research was promoted and arrived at accordance with the specifics of the object of research and the aim and resources involved, and consisted of:
- theoretical research: research into sources, concepts, conceptions in dictionaries and in the psychological literature;
- study of relevant curricular documents: curriculum, school programmes, textbooks, teacher’s books, methods of specialities, etc;
- bibliographic method: a consideration of the theoretical sources of the didactics of the discipline;
- monographic method: used in the analysis of the socio–educational phenomenon of planning, and applying the didactics of maths in the particular cultural and economic context of educational policy, etc;
- comparative historical method: realized by investigating the evolution of the problems of mathematics education and the didactics of the discipline from a synchronic-diachronic perspective;
- method of survey: used in evaluating and undertaking theoretical validation as realised by neutral experts whose analyses and comments on the thesis were based on qualitative parameters;
- method of the theoretical modelling: used in realizing diagrams and synthetic schemes associated with conceiving the didactics of the discipline.

From the analysis of the synthetic grid of the experts’ questionnaire, we conclude that all the descriptors have a percentage of 70% and the correlation coefficient $\beta = \frac{\alpha_1 + \alpha_2 + \alpha_3 + \ldots + \alpha_n}{100} \cdot n = 0.88$ which validates the hypothesis.

References