

## **The interdisciplinarity, the main direction of the renovation of the activity for teachers of Sciences – A case study. Romania**

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The third millennium frontier was crossed so the interconnection of the sciences in the vast process of being aware about the nature represents an important step in the development of the Romanian teaching reform.

The approaches towards this direction should accomplish the correlation of the different school programs but also the formation of a new way of teaching thinking, in connection with the evolution from the autonomous sciences to the boundary and interdisciplinary sciences and also in connection with the acknowledgement of an interdisciplinary and scientific language.

So, the interdisciplinarity is a principle which must be applied, a way of thinking and acting which appears from the evolution of the science and of the social life.

In the national curriculum, the contents of the school subjects were traditionally conceived with an emphasized independence of some subjects towards other, this means every subject should be independent.

In the national syllabus, the school subjects were grouped based on the curricular areas, for the entire preuniversity educational system. The selected curricular areas according to the finalities of teaching and taking into account the importance of different cultural domains which structure the human personality as well as the immediate connections: Language and communication, Maths and Nature Sciences, The human being and the society, Physical education, Conciliation and orientation.

The organisation of the subjects on curricular areas offers a lot of advantages: the possibility of integration the actual unidisciplinary approach in an interdisciplinary frame, the equilibration of the observation regarding different domains and school subjects, the agreement with the present theories concerning the process, style and the rhythm of learning, the continuity and the integrity of the didactic approach along the school cycles of every student.

In the Romanian educational system, the interdisciplinarity is included in the national curriculum in the category “Environment knowledge” and “Sciences” in the primary cycle, subsequently appearing through the teaching possibilities of Curriculum at School Decision in the secondary school and high school system and coming back to being an integrated subject again in the superior cycle of high school in theoretical high

schools(philology section) and vocational ones(pedagogical, theological sections, etc.). According to this idea we need a lot of horizontal and vertical correlations in the creation of the new Romanian educational system. From our point of view, a new form of the curriculum in the higher educational system is required, a form which should generate specialists in interdisciplinarity based on the initial training of the teachers, specialists which are required in the new trend of the European teaching system.

The knowledge that the pupils often acquire represents a number of isolated items which lead to a static knowledge of the world. These aspects find themselves in contradiction with a large variety of the connections and interactions between the phenomena and their dynamic character.

In nature sciences, the interdisciplinarity is absolutely compulsory taking into account the direct practicability of knowledge.

In order to accomplish this thing, a series of exigencies from teachers are required:

- To have a vast knowledge;
- To know the methodology of that subject but also of the other subjects from the same curricular area;
- To make the pupils conscious of the existence of the school subjects interdisciplinarity;
- To take part in training courses which are concerned with the themes with an interdisciplinary character;
- To use the instruments through which the acquired knowledge allows correlations, abstractions and generalizations;
- To promote the development of thinking in a systematic manner, emphasizing the team work.

In the human spirit evolution, the promotion of the interdisciplinarity is one of the most important features of the progress of the contemporary science. There are a lot of interdependent arguments which belong to the ontological, epistemological and social order. The dynamics of the social life phenomena is following the coordinates of the same logic of complexity but also of the integration of the different spheres and categories. The processes of socialization of nature with consequences more or less predictable as well as the issues of contemporary world require an interdisciplinary thinking.

The interdisciplinary perspective must help the pupil to create an unitary image of reality, to learn an unitary methodology of research and to develop an integrating thinking.

Physics, chemistry and biology, which belong to the category of Sciences, are not only subjects to talk about but they also represent a way of thinking, processing the knowledge about nature and they must be presented to our pupils not as processes but as finished products. Disciplinary references could be accomplished only when there

are common structural theoretical and functional elements of those specific school subjects. The knowledge must be organized according to an unitary point of view, every school subject maintaining its gnosiological autonomy, specialization and independence. We must find methodologically the way of development of the interdisciplinary attitudes through the application of the methods with a high level of generality (the experiment, the demonstration, the modelling, etc.). The pupils must become open spirits, being able to notice the novelty, to include it, to make different approaches, to be flexible in thinking.

So we can accomplish such contents based on the promotion of the interdisciplinarity starting from the following premises:

- The context of the present teaching system allows the promotion of the interdisciplinarity( still at the beginning in Romania because of the relatively limited possibility of approaching the interdisciplinary themes through Curriculum at School Decision);
- The existence of many school subjects which can be treated from an interdisciplinary point of view;
- The appearance of the boundary sciences and the development of the bidisciplinary and multidisciplinary research;
- The school curriculum must facilitate the approaches of the interdisciplinary sciences.

All these things require the revision of the issues on learning as well as the existence of a modern teaching system because the interdisciplinarity represents a way of organizing the contents of teaching, having effects on the whole strategy of designing the curriculum, which offers us an unitary image of phenomena and studied processes in different school subjects and which facilitates the contextualization and the application of school knowledge in different life situation. – Carmen Cretu, *The content of teaching process, an element of the curriculum.* ( Polirom, Iasi, 1998).

Our approach is centred on the analysis of the interdisciplinary problem from the teachers of Sciences (Physics, Chemistry and Biology) point of view, teachers of schools from the whole county of Iasi, including both areas, rural and urban.

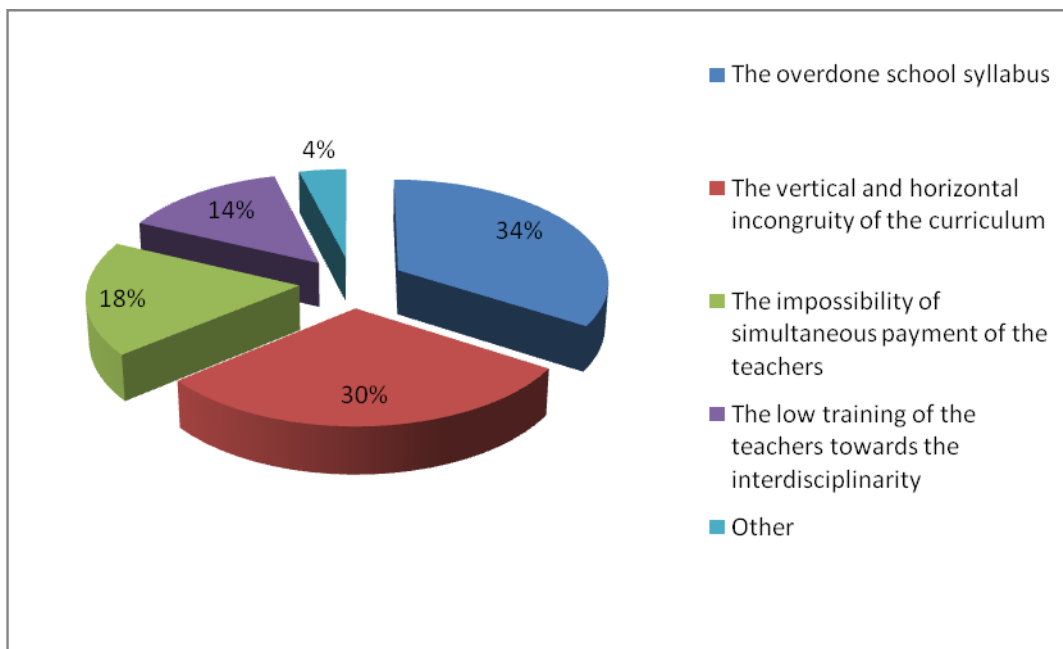
The pedagogical inquiry started with the application of a questionnaire in which the people answered three questions regarding the interdisciplinary teaching, the difficulties met by teachers in dealing with the interdisciplinary approach of the experimental sciences, the frequency of using the methods in their teaching process in the classroom (annex 1). The sample was made up of 200 teachers of Physics, Chemistry and Biology, representing 25% of the total number of teacher of Sciences from the county of Iasi, from the rural and urban area, from secondary schools and high schools(theoretical, technological and vocational).

Regarding the approach of the interdisciplinary teaching, 50% of the teachers consider that they follow a teaching process according to that spirit; only 17% accomplish the teaching-learning process without the help of the interdisciplinarity. The school curriculum was done in a constructive manner so it allows the disciplinary interferences.

From our point of view, the difficulties appear from the unidisciplinary qualification of the teachers and their refusal to accept the modernity in teaching. We can also find

an explanation, you can look for, in the school syllabus which is based on a single subject, having moderate horizontal and vertical correlations, in the complexity of contents and the low motivation of educational actors in order to acquire the practical knowledge.

Starting from the identification of the main difficulties met by the teachers in the interdisciplinary teaching and with their hierarchy, we can say that the overdone of the school syllabus and the horizontal and vertical incongruity of the curriculum represent, in almost the same percentages, the main impediments in the interdisciplinary approaching of sciences. Furthermore, we consider that the disfunctions of the remuneration system related to many teachers of the same class contribute to minimizing the desire to involve themselves in the interdisciplinary teaching of Sciences. Last but not least, teaching Sciences in a systematic view requires a thorough training of the teacher, unidisciplinary (his basic school subject) and multidisciplinary, in order to cope with all the challenges created by the interdisciplinarity.

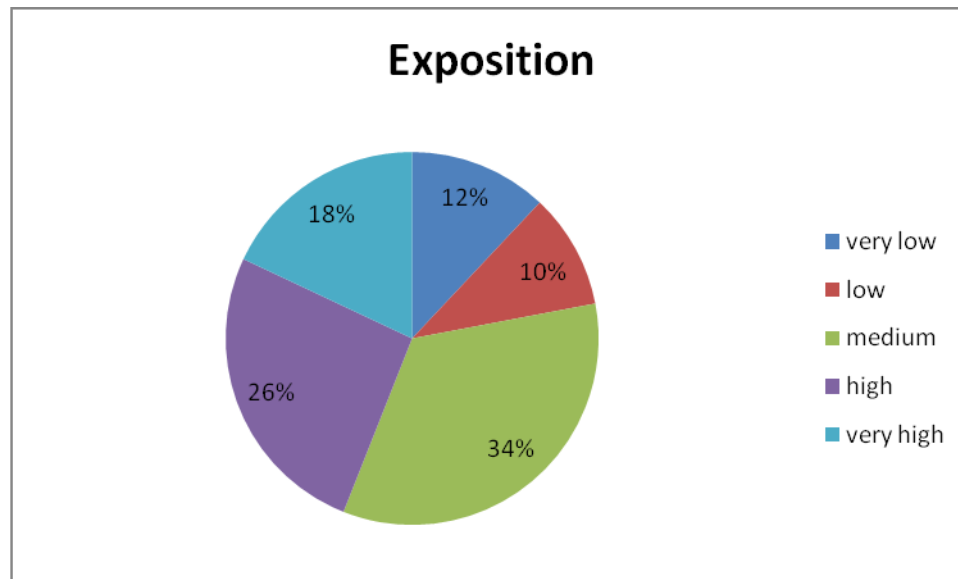


**Fig.1** - The hierarchy of problems in the interdisciplinary teaching

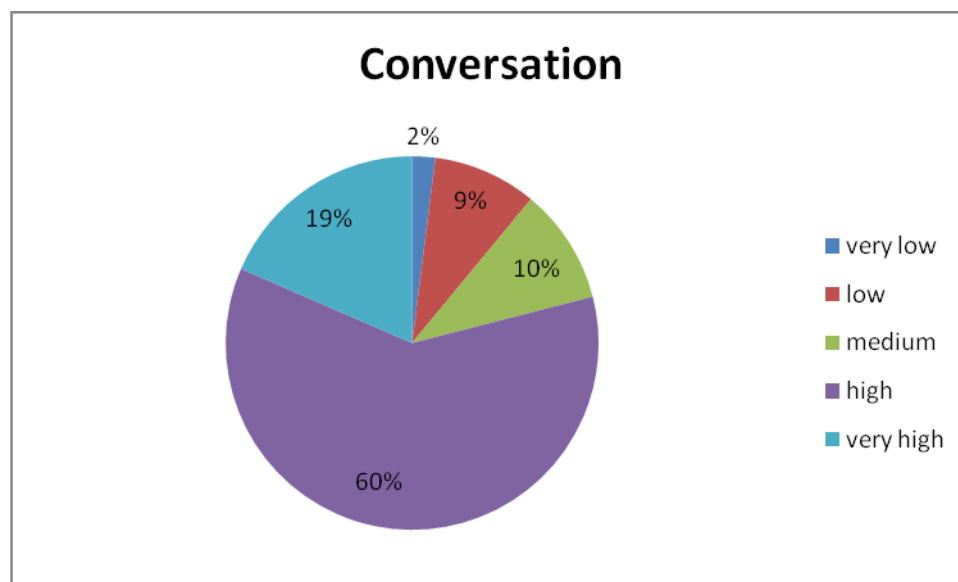
Regarding the most usable method in Sciences, from the analysis of the obtained data we can conclude that the traditional methods coexist with the modern ones, the percentages being based on the school environment or pupils' specialisation. Most of the secondary school teachers use oral communication methods based on the question-answer dialogue, this thing helping them to achieve the objectives of communication, covering the heuristic function of reevaluation of knowledge, the function of elucidation, of profound study, of consolidation, of planning, of check up or control.

From a formative point of view, it is very useful for the teacher to create as many ask and answer situations as possible, to give the pupils the possibility to make a selection of the work possibilities. The heuristic learning requires the integration of the convergent questions in the teaching process, questions which put the pupils face to face with the situation in which they have to analyse, to make comparisons and ask

divergent questions in order to train the pupils' thinking towards the discovery of the new ways of actions as well as evaluation questions which require the pupils' judgements.



**Fig. 2** The percentages of using the exposition as a method



**Fig.3** The percentages of conversation as a method

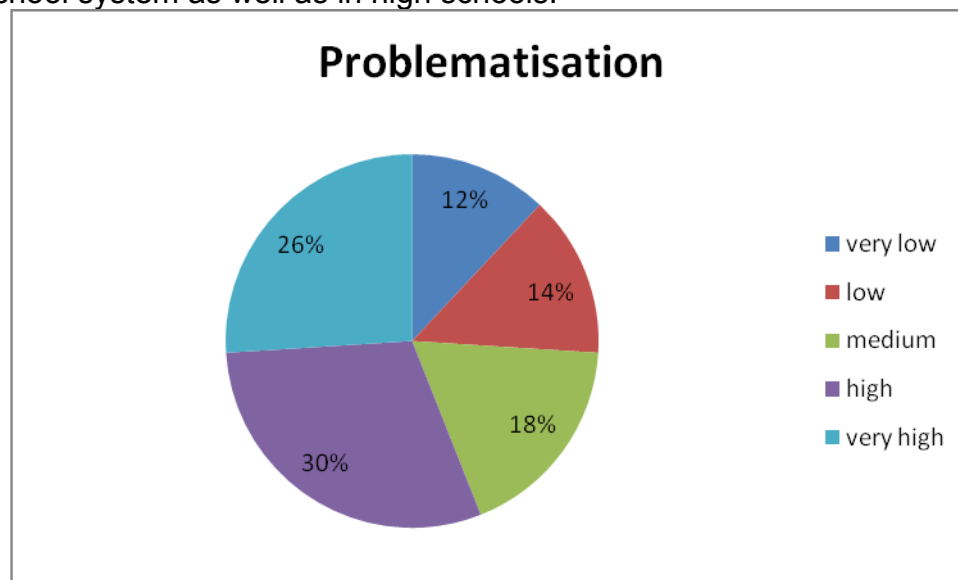
The problematisation is a very often used method by teachers of Sciences because with the help of the oral communication, they improve the problem situations and it has an heuristic and efficient potential. The cognitive conflicts generated by the

problem-situations urge the pupils to search, to discover and oblige them to create a relation between the situations and the well known experiences and the elements of novelty.

Every of these two important moments in problematisation - the presentation of the problem situation and the formulation of the question have a formative value because they stimulate the exploration and investigation spirit and they encourage the consolidation of a cognitive structure, they develop the autonomy and courage of the pupils in expressing opinions, expressed due to an effect of a process of searching the solutions, they acquire the habit of self evaluation and prognosis.

The problematisation has formative qualities to all sort of ages but the efficiency and the frequency of the problematisation moments increase as it is applied as a method in teaching.

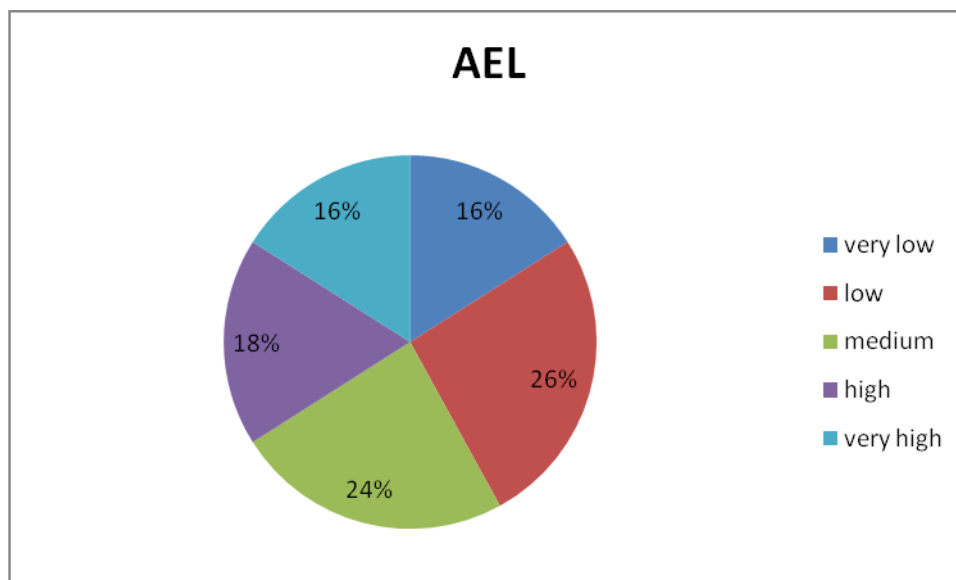
The obtained statistics based on the questionnaire, shows that the teaching based on problem solving has a high percentage in the sciences of nature in the secondary school system as well as in high schools.



**Fig. 4.** The percentages of problematisation as a method

The introduction of the educational package in the AEL system which means the use of technology of information for the purpose of having a better knowledge of phenomena and especially the relations between the phenomena, allow detailed analysis of the studied phenomena but also comparisons, abstractions, general conclusions which have the purpose to ensure a systematic and progressive thinking, to generate meditation, to help the creativity and novelty in the teaching activity.

Starting from 2001, the Romanian Ministry of Education and Research has initiated a SEI programme which stipulates besides many other things, the endowment of all the high schools from Romania with a 25 computer laboratory and a server. AEL is the backbone of the SEI programme, offering support for teaching – learning, evaluation and marking, administration and monitoring the contents. AEL allows the visualisation and the administration of vast types of contents as well as interactive materials, tutorials, exercises, simulations and educative games.

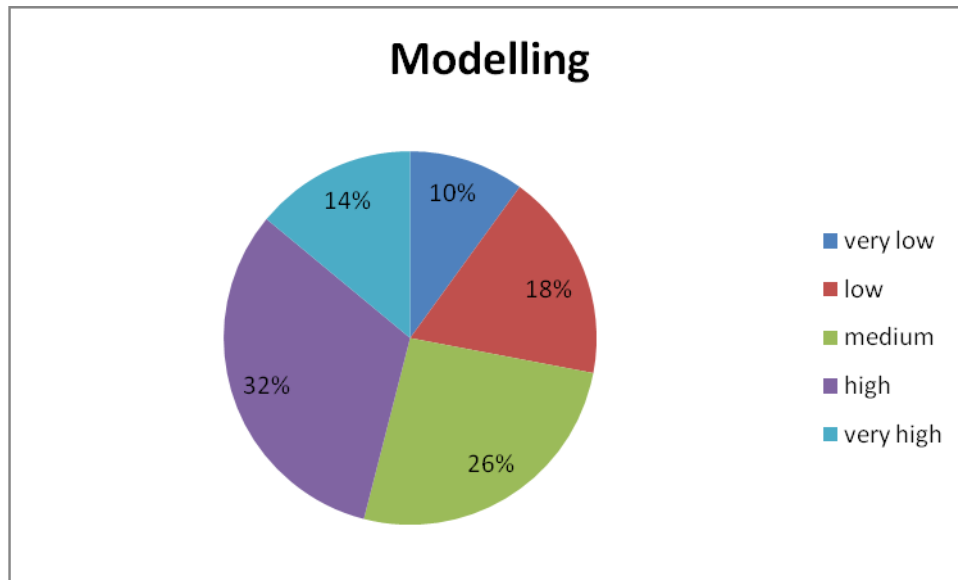


**Fig .5.** The percentages of the AEL system in teaching-learning Sciences

The advantage of using AEL in teaching and learning Sciences is huge but the work itself encounters some problems (given by the existence of a single AEL laboratory in a school and this is the point from where the difficulty of allocation for different subjects starts). Furthermore, in the schools from the rural areas, problems regarding the insufficient training of the teachers appear or those regarding the poor endowment of the computer Science laboratory. According to this pedagogical inquiry, 34% of the teachers use AEL a lot in the teaching – learning process but also a huge percentage remain sceptical about this system.

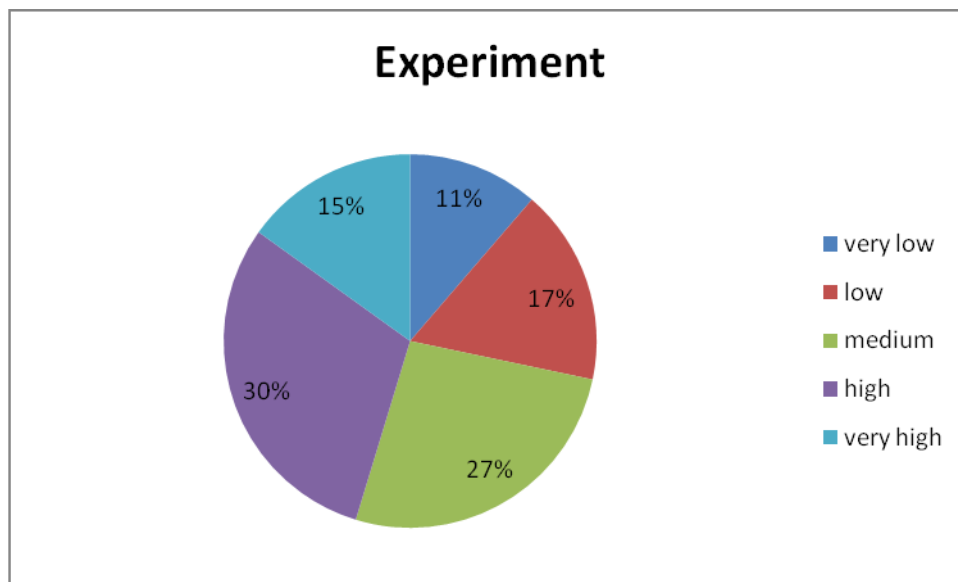
AEL has a lot of direct benefits for the Romanian teaching system: interdisciplinary approach of education, the innovative aspect of the teaching process, the assurance of the efficiency and the accomplishment of teaching, teaching and evaluating, the prevention of school abandonment, a higher attraction for pupils.

The modelling, a research and good method for acquiring information about complex systems, hardly accessible and which are not approachable quite easily, has good results in the elaboration of some simplified and essential representations of the objects, processes and real systems. It represents the easiest way to reflect the reality and to create the most adequate frame for showing the results.



**Fig. 6** – The percentages of modelling as a method

Over 40% of the teachers showed that the modelling represents a method with a great potential of activity and also with efficiency in research. It becomes a method used in the background, when the teaching and learning are stimulated with the help of AEL lessons.

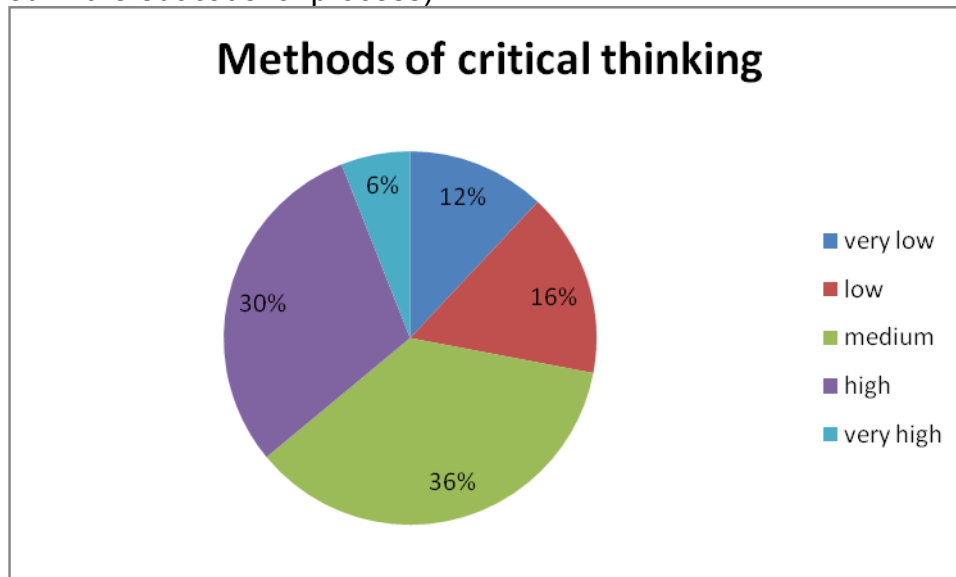


**Fig. 7** – The percentages of experiment as a method

The experiment, a learning method with a huge potential of activity, is successfully used by the most of the teachers, representing a way of adaptation to the real conditions of the society and a way of developing the creativity. Giving up the experiment or replacing it with other methods, in order to ensure the acquirement of knowledge, does not happen very often.



The interest for using the critical thinking methods has increased, as many training programs took place, for primary school teachers, for the teachers from secondary schools and high schools(36% use very often the methods to stimulate the critical thinking while 6% use these methods taking into account the particularities of the groups involved in the educational process).



**Fig.8** – The percentage of using methods of critical thinking

The obvious conclusions, based on such an analysis, refer mainly to the area of the curriculum. The people who decide these things should try to attach our curriculum to the other educational systems from Europe, especially on the interdisciplinarity domain. Furthermore, the Sciences syllabus for the higher education will have to be adapted in such a way, that the initial development should generate skills for the interdisciplinary approach of the Sciences of nature, a challenge that all the teachers and actors involved in education should answer successfully.

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## ANEXX 1- Questionnaire

**1. To what extent do you apply in your lessons the interdisciplinary teaching (Chemistry – Physics – Biology)?**

<b>insignificant</b>	<b>occasionally</b>	<b>significant</b>	<b>often</b>	<b>Very often</b>
12	32	20	104	32

**2. Make a hierarchy using just once the numbers 1,2,3,4 and 5 for the difficulties met by the teachers in the interdisciplinary teaching of the experimental sciences.**

- The vertical and horizontal incongruity of the curriculum
- The overdone school syllabus
- The impossibility of simultaneous payment of the teachers
- The low training of the teachers towards the interdisciplinarity
- Other.....

**3. Which is the frequency of using the following methods in your teaching process from the classroom?**

<b>Method</b>	<b>very low</b>	<b>low</b>	<b>medium</b>	<b>high</b>	<b>very high</b>
<b>Exposition</b>	24	20	68	52	36
<b>Conversation</b>	4	18	20	121	37
<b>Problematisation</b>	24	28	36	60	52
<b>Case study</b>	12	16	92	44	36
<b>Methods of critical thinking</b>	24	32	72	60	12
<b>Using the course book</b>	28	44	52	60	16

<b>Experiment</b>	24	36	56	64	32
<b>AEL</b>	32	52	48	36	32
<b>Didactic drawing</b>	16	44	64	60	16
<b>Modelling</b>	20	36	52	64	28
<b>Other.....</b>	8	32	68	72	20

**Subject:**            Biology             Physics            Chemistry

**Experience in teaching:**    1 - 10 years             10 - 20 years             over 20 years

**Area:**             Urban             Rural