BABES-BOLYAI UNIVERSITY OF CLUJ NAPOCA
FACULTY OF PSYCHOLOGY AND EDUCATIONAL SCIENCES
DOCTORAL SCHOOL – "EDUCATION, DEVELOPMENT, COGNITION"

DOCTORAL DISSERTATION

INTERACTIVE TEACHING AND LEARNING IN PRIMARY SCHOOL

Applications in the curricular area "Mathematics and sciences"

SUMMARY

Scientific coordinator
Univ. Prof. Dr. VASILE CHIŞ

Ph. D. candidate
DRAGOŞ VIOREL

Cluj Napoca
2011

CONTENTS

Key words:
Interactive training; Teaching, Learning; Cognitive constructivism; Didactic strategies; Curriculum; Curricular products; Focusing on student; Competence centering; Interactive methods; Problem solving; Learning by discovering; Problem-situations; Standards of performance; Performance descriptors and indicators; Schooling performance.

Introduction

Dynamics of instructive processes determine the permanent development of concepts in the ways they actually happen. Theoretical and practical approaches in training phenomena, due to their complexity, would comprise a large scale of perspectives through which they may be analyzed.

Educational politics today are more and more oriented towards a pedagogy which expects the student to be directly involved in learning. This kind of pedagogy which is situating the student right in the middle of its preoccupations is an active and interactive pedagogy urging those who try to learn to discover the new elements. Experimenting the pedagogical strategies, inspired by the interaction and constructivist approaches concerning knowledge, is focusing on the students' personal construction of knowledge. Permissiveness of interactive pedagogy is facilitating actions focused around the students' individual activities by which they acquire basic skills and develop their competences.

Solving of actual problems in everyday life, regardless of their complexity, involves appealing to knowledge, to skills and competences that may not be delimitated within only one single subject or another. This aspect is enabling us to approach this question, advanced for research, from the perspectives of the curricular area of "Mathematics and Sciences". Competences which proved to be vital for solving everyday situations are the ones connected to understanding and utilization of specific notions and concepts, as well as the ones linked to the capacities of exploration/investigation of realities and the solving of problems.

Therefore this study conceived as a doctoral dissertation entitled ***"Interactive teaching and learning in primary schools. Applications in the curricular area of Mathematics and Sciences"*** is analyzing in detail the significant aspects, specific for interactive teaching and learning, from the perspective of improving school performances in primary schools. Our intention is to obtain results ensuring the interface between the recent theory of interactive instruction and educational practices targeting the development of interactive strategies, a practice still situated on a quite modest level in our country.

Scientific undertaking in this respect is following the tendencies of developments in didactics during the last decades. The interest shown in the field by researchers, along this period of time, concerning activating strategies and participation has been determinant in delineation of a complex register of conceptual approaches in interactive instruction. Therefore we shall analyze some of these concepts, relevant for our research, stressing the involvement of connected concepts, aiming at a more clear understanding of the interactive teaching-learning phenomenon.

Approaching didactic methodology, as a main factor sustaining al types of instructive-educative types of activities, is stressing the importance of the quality of all didactic strategies contributing to the increase of schooling performances. Following the insight into the literature of the instructive phenomenon, we may say that didactic methods lay at the basis of optimizing any didactic undertaking. In connection with this we have delimitated two fundamental methods, "problem solving" and "learning by discovery", according to the literature, taken into account here as being significant for an interactive approach of the teaching-learning process. From the perspectives of valorizing the interactive potential of the two methods, we hereby do approach other methods, techniques and didactic procedures as well.

Streamlining interactive didactic strategies may not be accomplished without an adequate adaptation to the actual learning activities. Correlating the strategies with factors detaining an important role in any didactic undertaking constitutes a necessity that may not be neglected. In this respect we have identified and described several of them, here considered to be relevant for optimizing

the teaching-learning process. Planning of didactic activities, forms of organizing such activities, their informational support, the curricular products are elements envisaged, analyzed and aimed at highlighting their influence in the didactic acts.

Investigations initiated have found and developed aspects mainly from the didactic perspective, in the sense of identifying several landmarks concerning the possibilities of increasing learning performances in mathematics and sciences by students of primary school level.

Taking the steps aiming at developing and implementing of models of didactic activities, starting from a pedagogical approach of interactive training strategies have the role of helping students to improve their learning efforts in a more consistent way.

In order to achieve an essay based on a consistent and coherent structure we organized the material in two parts. The first part would deal with theoretical substantiation, and in the second part our experimental trial is presented. Each part would contain several chapters in which we tried to verify an established assumption and consequently enounce the relevant information in a pragmatic and logical approach.

In addition to these, the Conclusion has the role of synthesizing the main theoretical and practical directions identified, while the annexes and the bibliography represent the proof of the accomplished introspection.

The first part entitled **Theoretical Foundation**, contains four distinct chapters which present several fundamental theoretical landmarks in order to understand interactive teaching-learning problems, by explaining specific special terminology, intercepting several models developed to sustain interactive training. In this context we have considered as being advisable to mark several specific components of instruction at the primary level.

The second part contains the **Experimental Undertaking** and is made up of two chapters that describe the stages of the experimental undertaking envisaged to validate the established assumption.

In Chapter I, entitled **Theoretical landmarks concerning interactive instruction** we have described several representative models, advanced by interactive pedagogy, as well as psychological theories that sustain interactive instruction.

Approaching the educational models advanced by interactive pedagogy has been made from two perspectives:

1. The perspective of reconsidering the status of elements within the pedagogical triangle.

The student is looked at in terms of his/her potential and capacity of learning, of being active and of becoming autonomous. *Knowledge* is looked at in terms of support and pretext in building up and developing of new acquisitions by the students themselves. *The teacher* has the role of organizing learning situations, imagined as pretexts for instauration of interactions and dynamic relations between the student and the content of learning (Bocos, M., 2002).

2. The perspective of the opportunity of analysis and reformation of the nature and contents of learning experiences, of the teacher-student, teacher-teacher, student-student relations, as well as the necessary connections between the school, education and real life experiences. The fundamental aim of these educational models is to optimize a tridimensional integration: "pedagogical action – interpersonal relations and real life" (Chis, V. 2005, p.17). Interactive learning has three main types of interactions. The first one is student-content, in which the student interacts with facts, readings and information. The second type of interaction is student-teacher, where the student interacts mainly with his/her teacher. While in the third one, in a student-student format, the students collaborate with each other in order to construct knowledge.

Cognitive and constructivist theories are considered to be fundamental in interactive instruction development. The process of instruction is achieved in the best way when the learning experiences are created starting from the students' needs and expectations rather than from being exposed to information and later being evaluated, the teacher considering the amounts that his/her students must assimilate. As students reflect more and more on their own experiences they would discover that their ideas are gaining influence and complexity and they are able to develop more and more powerful abilities in integrating the new information. One of the most important roles of the teacher becomes encouraging his/her students passing through this process of learning and reflection.

The second chapter, entitled ***Methodology of interactive teaching-learning***, is dedicated to developing the theoretical aspects concerning interactive didactic strategies, which from a pedagogical

point of view are granting didactic methodology the value of a systemic and praxeological theory, which is able, at the level of the teaching-learning-evaluating to engage into a set of techniques meant to streamline the actions of instruction.

The importance of methodology in the process of instruction as a concept is significant in emphasizing the following theoretical and practical contributions:

a) Orienting of the complex action of technological management of instruction by means of methods, procedures and didactic means, permanently related to the objectives of the teaching-learning-evaluating activities;
b) Continuous improvement of didactic activity planning by adopting the most efficient methods, under the conditions of permanent changes appearing at the level of the correlations subject-object, teacher-student;
c) The operational development of all resources engaged into didactic activities.

The priority of interactive teaching strategies is convincingly demonstrated by means of recent research which shows us that when the student is in the situation of actively participating to the teaching-learning process, school performances become evident.

In the same time, we have considered to be advisable to highlight, in this chapter, the methodological orientations, the relatively new ones, advanced by contemporary pedagogy, of sustaining methods that contain large resources in putting students in action, in successfully achieving a primarily positive-formative instruction.

In this context, problem solving and learning through discovery, are the (inter)active appanage of education which mainly contributes to transforming the instructive-educational process from a passive reception of knowledge into an act of permanent search, of probing already accumulated knowledge, in order to be able to formulate an answer to a certain requirement.

Accumulated pedagogical experience in different subjects distinguishes two important aspects concerning the implementation of problem solving in teaching:

1. Diversified pedagogical ways in capitalization of problem solving. This aspect is determined by the variety of types of problems and problem-situations, as well as the various methodical possibilities of combining problem solving with all the other didactic methods.
2. The possibility and necessity of adapting problem-situations and problems to the specific features of subjects and educational contexts.

Teaching of various subjects is strongly influenced by the tendencies to appeal to experiences of discovering new knowledge, which the students later will incorporate into their cognitive structures. The teacher is not presenting the contents that must be acquired by students in a final form, it is the students who must discover this content through their effective intellectual engagement. Such an approach in the status of discovery during the training, in which the definition of learning through discovery is in opposition with learning by reception is to be found in D. Ausubel and Fl. Robinson (1981).

Starting from two circumstances, one being that problem solving and discovery are components of the same heuristic undertaking: problem solving considered to be as a starting point and discovery the point of finish; the other circumstance takes into account the cyclic training process, by means of which construction of new knowledge is ensured based on what has been acquired previously, we may say that the relation between problem solving and discovery is an *inductive relation*, which means that an unfolding learning activity through problem solving being performed induces/generates discovery of new knowledge, which open new perspectives of cognition, new questions arise, new problems or problem-situations, which means that unfolding of discovery induces/generates problem solving. This inductive process by which problem solving and discovery are mutually "generated" may ensure an ascendant course to learning, noticeable through the evolution of capacities and attitudes acquired by students. We consider that the efficiency of this mechanism concerning the students' performances under different aspects is achievable if didactic activities are subordinated to an interactive training system.

Chapter three, *Specific nature of training processes in primary education*, is intentioned to have an insight into several aspects of organizing didactic activities, as well as the curriculum of primary education.

Organizing didactic activities is aimed at improving the teacher-student relations, which during different periods of time have developed in accordance with improvements recorded in pedagogical thinking and in school institutions.

Ever since founding the system of organizing didactic activity in classes and lessons by Comenius (1975), developments until nowadays have been engaged into numerous advanced experiments within the paradigm of specific research in traditional, modern and post-modern pedagogy. This is how we can explain the continuous enrichment of organizing forms of didactic processes, which are still subjected to a multitude of attempts even in the present times. (Ionescu M., Radu I., coord., 2004).

The taxonomy of forms of organizing didactic activities infers inducing specific criteria, with relevant pedagogical values.

Such criteria envisage:

1. ratio of frontal, group and individual action within the structure of didactic activity organization;
2. ratio of communicating, research, experimenting and application methods engaged in didactic activities;
3. ratio of in-school and out-of-school resources involved in achieving didactic activities.

These three aspects of the forms of organizing / structuring instruction will never be found in a pure state, they will be set by dominance, by extension which they may gain in a certain moment.

The problems of curriculum in primary education, as treated in this chapter, are especially appealing to the curricular products. Our analysis in which the frame planning offers a solution in improving a time budget, for mathematics and sciences, is based on the expressed opinions of 93 teachers who work in primary education.

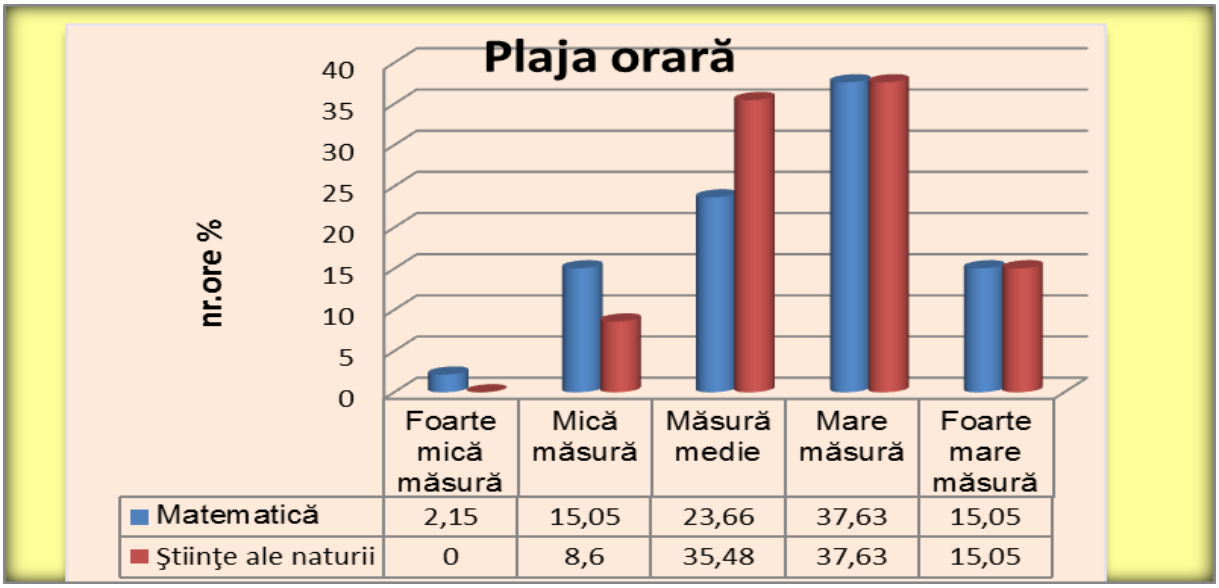

Diagram 1. Degree of optimizing the relation time budget – school syllabus

The great majority of teachers consider that the number of classes assigned by the timetables for these subjects is more than sufficient.

The situation presented about the correlation between the frame planning and syllabus is leading us towards challenges that may be synthesized into questions like: Why does a percentage situated between 10% (for sciences) and 17% (for mathematics) allow / or doesn't allow to cover the syllabus within the assigned limit of time ?; Which are the proceedings ?; How much do the degree of professional training and experience weigh in optimizing the relation between the time budget and the school syllabus ?; Wow does the minimal / maximal number of periods provided in the timetable influence covering of school syllabus in a bearable rhythm for the students ?, etc.

The frame planning in primary education allows introduction of optional subjects. Each school would decide its curriculum thus facilitating modernization of its didactic activity by conceiving themes, modules and trans-disciplinary projects. Their contents are built by the teachers of each class depending on the particularities of his/her group of students.

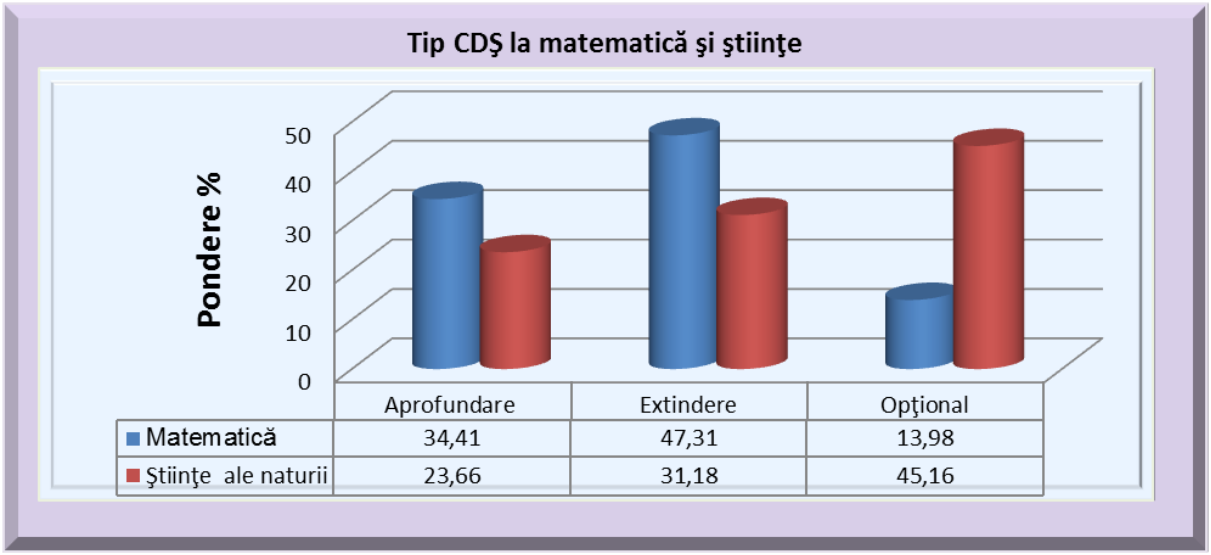

Diagram 2. *Analysis of CDS types used in the subjects Mathematics and Sciences*

The comparative analysis of the types of CDS used in primary education for mathematics and sciences reveals that the priority lays in extending the objectives and the contents (almost half, 47.31% of those who use the maximal number of available periods within the frame planning); one third (34.41%) would consider the CDS as being useful for diversification of learning activities aimed at reaching the objectives provided by the syllabus. This shows us that there are a sufficient number of students who need supplementary support to reach the minimal level of objectives. In Sciences we can see a better positioning on the percentage scale of time allocation concerning optional CDS (45.16%), in comparison with the extension (31.18%), respectively with thoroughness (23.66%). Using up a significant number of periods provided in the frame planning for the subject of Sciences in the optional type CDS indicates the presence of readiness and higher interest of the teaching staff in approaching contents in inter and trans-disciplinary ways, a readiness to approach an integrated curriculum in this field.

Chapter four, Findings related to optimization of didactic undertaking in primary education, presents several components of the teaching process, namely, the material and informational resources, instructive actions, didactic methods and means, which in our opinion integrate as factors of optimization in didactic activities, especially in the subjects of Mathematics and Sciences. Knowing these factors will help teachers in their role of urging students to use new ways in their work, more inciting, which will be the basis of their efforts, in order to acquire durable cognitive gains, achieved by lower energy consumption and better accomplishment.

Our findings based on the analysis of primary school teachers' opinions are revealing an increasingly positive attitude towards efficiency in the teaching process.

Organizing and performing some efficient didactic activities may depend on didactic design. Anticipation and implementation of operational didactic undertaking are influenced by the importance granted to didactic activities previous to designing, to diagnostic evaluation, to identification of aspects contributing to learning success, to the students' psychological potential, resources, to suggestions of learning activities within the school syllabus.

The instrumental value of contents is recognized by teachers, and exploitation and capitalization of informative and formative valences of contents are actually starting points in interactive training.

Adequately using the methods has a considerable contribution in didactic activity efficiency. "Any method may have a formative potential and a specific intrinsic activating potential" (Bocos, M., 2002, page 79), which may be exploited, capitalized and turned into interactive valences.

Teaching-learning is a process with a complexity built on concerted actions of several broadly diverse components with various characteristics or features. This is not a short term process, it takes time, it takes conveying knowledge, building up and developing abilities, aptitudes, capacities, competences. Modifying positively these variables, in the way in which knowledge may be applied in practice, is favorably influenced by a frequent use of interactive methods in didactic activity.

Understanding involved mechanisms in training processes helps teachers in a better management of the process by developing the abilities of a more balanced distribution of learning targets for the students, taking into account the student's present level of development, the student's individual and age particularities, the type of material to be newly introduced or the objectives suggested in the respective activity. Building up an instructive-educative undertaking efficiently, relevant for the growing of quality in acquiring knowledge and development is strongly imprinted into the ways in which the informative aspect - specific for learning - is combined with the formative one.

The second part of our essay, **"Experimental undertaking",** in which we detail the steps of experimental undertaking contains two chapters.

Chapter V, entitled **"General coordinates of research",** is presenting the conceptual and methodological foundations of research, the theoretical circumstances of research, the goal, objectives and hypothesis of research, details concerning subject and content samples contained in our research.

The experimental research led in order to optimize didactic undertaking in primary education envisages two correlated components:

A practical-applicative component in our research was done on a sample of 93 teaching staff employed in primary education and a sample of 208 students. The fundamental goal in this component was a fact-finding mission, to lead us to an easier and more efficient selection of samples of subjects and contents. This is actually the fact-finding stage of the pedagogical research which connects theoretical founding to action within the research.

Action-research envisages efficiency in interactive strategies of training by means of experimenting several didactic undertaking in primary education, systematically using learning by discovery and problem solving. Unfolding of our research was guided by a series of systematic findings resulted in micro-research and in capitalizing accumulated experience throughout a thirty year didactic career.

Optimizing instructive and educative processes, improving school performances depend mainly on the used methods. Using didactic methods on a larger scale, following the criterion of opportunity and adaptation of learning situations will take us to efficient solutions in learning activities and to implicit better student performance.

Know-how and using a diversity of didactic methods, as important instruments at the teachers' hands, correlation of these facts with the students' particularities, as well as with the objectives aimed at, will contribute to efficiency in the instructive-educative process, will facilitate a permanent engagement of students in their sustained intellectual effort and their endowment with necessary capacities in a productive learning activity. The students are not looked at through their deficiencies and failures, but rather through the perspectives of their potentials, their capacity to build up new knowledge, to learn, to become independent. Fitting didactic strategies to concrete instructive processes will require certain conditions contained by the teachers' professional skills, the national curriculum by information ant temporal resources.

Romania's position according to international evaluations, among the countries of low performances recorded by its students, with most decreasing tendencies in performances obtained by our students in pre-university education, discloses a reality in Romanian education, with a lot of weak points which need improvement. Measures to be taken are depending on national education policies, on implementing a flexible curriculum centered on competences necessary in personal development. On the other hand, but not least important, changes are necessary in the teachers' professional attitudes, by means of further improvement in initial and later trainings. Teachers should prove their professional competences in applying the new trends of contemporary pedagogy, practicing an efficient instruction.

One certain situation, which deserves attention, is the fact that once the students gradually pass through the curricular cycles, their motivation and interest concerning the fundamental subjects like mathematics and sciences are more and more reduced. The reasons are multiple and we will not expose them now, however we do find that an efficient capitalization motivating valences and interactive methods will take to new developments in learning appetite and will be able to improve durability of acquired knowledge through a more active implication and the students' own intellectual effort. Getting students in a situation of looking for and finding solutions to different problems in everyday life will surely contribute to their success in school.

Starting from the above-presented circumstances, we have done our research which meets the requirements of experimental researches, practical-applicative, of development with a prospective value, in the category of action-research. We do consider that using a two stage design, quantitative research preceding the qualitative one, will be more efficient.

Pedagogical research in its undertaking would appeal to a methodological system in which we would find: the pedagogical experiment, the method of direct talk, the questionnaire inquest, the sociometric test, the study of products resulting from curricular design and the content analysis of student activity production, direct observation, evaluation testing, statistic analysis.

Unrolling of this experiment has been organically integrated in the process of education, respectively into the process of teaching-learning in grades 3rd and 4th, observing the official curriculum.

The main objective of our action-research was to highlight the advantages and limits of interactive methods in building up and developing proficiency by means of teaching-learning subjects within the curricular area of "mathematics and sciences" for primary school students.

The pedagogical experiment, subordinated to this goal, envisages two aspects:

1. the efficiency of interactive methods, problem solving and discovery in teaching-learning of subjects within the curricular area of "mathematics and sciences";
2. verifying of correlation between the systematic usage of methods linked to problem solving and discovery and improving the students' performances.

Operational objectives within the experiment have been achieved in two ways:

1. objectives envisaging teaching staff activities;
2. objectives envisaging students' activities;

1. Objectives envisaging teaching staff activities.

Teaching staff participating to the experiment should:

- be aware of the role they must detain as organizers of learning situations and of control over learning;
- encourage the students' involvement, finding and making up problem-situations, to ask questions from students and from themselves, urging their will to find solutions of their own;
- organize knowledge "highly structured" in a way in which the students may progressively and fully go through;
- deliver types and variations of lessons centered on the students' own activities, preferring student focused didactic activities;
- draft didactic activity plans adapted to the followed goals;
- ensure a formative feed-back for further undertakings, if necessary in order to eliminate failures and difficulties in learning.

2. Objectives envisaging students' activities:

Students taking part in sample groups should:

- participate in didactic activities not only answering to questions asked by the teacher, but also to ask questions and make up problem-questions based on observing phenomena, later to be solved by themselves, and which must lead them to discovering new knowledge (eventually collaborating with other classmates under the guidance of their teacher);
- discover and recognize simple correspondent successions of things, phenomena or associated numbers following given rules;
- explore means of making mathematical operations using different types of representation;

- use instruments and standard and nonstandard units of measurement for different amounts in various situations;
- observe and name the effects of certain phenomena in nature and use a specific language to describe objects and phenomena in the environment;
- formulate a proper and efficient intellectual working style, to be adopted in solving mathematics and sciences problems and eventually use them in other subjects.

In formulating our research hypothesis we have started from our personal observations corroborated with theoretical aspects concerning the dependence between using interactive methods and the students' learning performances.

General hypothesis (GI): ***Systematic use of interactive methods in teaching-learning of subjects within the curricular area of "mathematics and sciences" significantly contributes to improvement of learning performances.***

Approaching didactic activities in our experiment was achieved from the perspective of verifying specific hypotheses to be found in a ratio of derivation with the general hypothesis.

Specific hypotheses:

1. Systematic usage, in didactic activity, of problem solving and discovery methods would significantly influence building-up of competences in mathematics: the capacity of understanding and use of specific concepts in the ways in which they correspond to the necessities of individual life and the capacity of exploring / investigating and solving problems.

2. Systematic usage, in didactic activity, of problem solving and discovery methods would significantly influence building-up of competences in mathematics: the capacity of understanding and use of specific terms and concepts in sciences and the capacities of experimenting and exploring / investigating reality, using specific instruments procedures.

3. Usage of problem solving and learning by discovery, combined in the best way, would significantly influence efficiency in didactic activity management.

Starting from the statement of the general hypothesis, in the case of our experiment we should establish the following **variables**:

Independent variable: *planning and performing learning activities which have as a basis problem solving and learning through discovery; systematic use of problem solving and learning through discovery in didactic activities;*

Dependent variable 1: *level schooling results;*

Dependent variable 2: *attitude towards the school and towards learning.*

In the second part of the chapter we present details concerning the samples of subjects and of contents.

Ascertaining research envisaged the involvement of two categories of subjects, each having a well defined role. In our research we used groups of primary school students from urban and rural areas together with their teachers.

Selecting the lot of teaching staff, directly or indirectly involved in the experiment has been done in two stages. In the first stage two questionnaires were issued for the primary school teachers, which were distributed to 93 persons. In the second stage we centralized, processed and analyzed the answers to items contained in those questionnaires. The purpose in doing the selection of samples was to finally obtain a representation of the reality we have in primary education, in such a way that didactic activity performed along our experiment be able to follow attaining of objectives targeted in our research and also to verify the hypothesis of the experiment. Selecting the teachers was based on the following criteria: readiness to be involved responsibly in the research; knowledge of types / variations of lessons and frequent organizing of the ones used in interactive training; practicing an adequate style to suit the age particularities of students; sustaining and encouraging positive motivation in developing abilities, capacities and competences; an activity oriented towards achieving learning competences which observe the principles of accessibility, individualizing and differentiating in the teaching process; knowledge and systematic usage in learning activities of the "problem solving" and "learning by discovery" methods.

Experimental and control student samples were selected according to the criteria established during the preliminary ascertaining research, following discussions we had with primary school

teachers, findings resulting from assistances during classes of mathematics and sciences, the study of school documents, the analysis and interpretation of the students' records obtained in written evaluating tests, the analysis of psycho-pedagogical files made by the teachers for each student.

Structure of subject samples

Sample of subjects			
Experimental		Control	
Number of classes	Number of students	Number of classes	Number of students
4	**88**	**6**	**120**
Classes in all		Number of students in all	
10		**208**	

Describing the control and experimental samples is structured on the psycho-pedagogical characteristics of students and envisages three aspects:

1. students' learning activities at home and at school;
2. cognitive capacities;
3. primary and secondary capacities of processing information.

Selecting a content sample has been done starting from the potentials of these contents to capitalize interactive valences in didactic methods (mainly problem solving and learning through discovery), as well as its facility offered in attaining the objectives of gaining new knowledge, in forming abilities, in forming and developing competences.

The efficient usage of informational support (curricular products used in over 80% of all learning activities) and optimizing learning activities by which the new acquisitions are built up and developed are to be achieved by intra- and inter-disciplinary connections, transfers, practical applications, by preparing the student's actions in various situational contexts, by inter-human relations.

We do consider that the sample of content is representative for learning mathematics and sciences in primary school, requiring the organization of various learning activities, stressing more the problematic contexts which are able to favour the development of capacities involved in the study of our named disciplines and which should stimulate collaboration, interest and motivation in applying mathematics and sciences in everyday life.

In **chapter VI** entitled **"The operational dimension of the research"** we present the formative experiment dedicated to the research, in which intervention is being done, implementation of interactive methods, problem solving and learning through discovery, in didactic activities. Evaluation of samples is done throughout all the stages by application of tests. In order to have the most clear and objective overview upon the evolution of the subjects' school performance, during the experiment we have proceeded to tests structured on the techniques used in the PISA evaluation program. In this way, capacities/competences are investigated from the functional perspective of the students' acquired knowledge in the fields of mathematics and sciences, essential in everyday life.

By means of such an approach in evaluation we succeeded to obtain a basic profile of the subjects' knowledge and skills and to identify tendencies in school performance following the way in which results change throughout the formative experiment.

The subjects' evolution regarding their school performance along the experiment has been determined according to two general competences:

1. The capacity of understanding and using specific concepts in mathematics and sciences, in the ways in which they correspond to necessities of individual life;
2. The capacity of exploring / investigating and solving problems.

These competences have been formulated in accordance with frame objectives and objectives of reference included in the school syllabus for primary schools, effective today.

Results and recorded data in every stage of our experiment have permitted a comparative quantitative and qualitative analysis of our subjects' evolution, taking into account the following criteria:

1. Evolution of each student in each subject:
   a. For each general competence
   b. From one stage of the experiment to the other
2. Evolution of each sample in each subject:
   a. For each general competence
   b. From one stage of the experiment to the other
3. The level of attaining the competences by students during the intervention.

The formative experiment was designed in such a way that its unrolling was integrated into the normal teaching process, observing the school syllabus and the number of hours assigned for each discipline. We have also taken into account the calendar planning of teaching units done by the teachers of the respective classes.

Pedagogical experiments are of the collective type, run in the natural context of classes having a familiar make-up. Samples are independent, made up by entire classes of students, in the way they normally attend school, thus offering the possibility of using the techniques of equivalent groups.

Didactic activities organized and unrolled with experimental samples have taken 24 hours/periods for mathematics and 20 hours/periods for sciences. Distribution of these activities according to fundamental objectives is the following: 1. activity for gaining new knowledge, in mathematics 45.83% and in sciences 40%; 2. for teaching and gaining new knowledge in mathematics 16.66% and in sciences 10%; 3. forming intellectual abilities in mathematics 33.33% of the activities; 4. forming intellectual and practical abilities in sciences 50% of planned activities.

School performances recorded by the students along the formative experiment have been measured through formative evaluations. Evaluation had in view both the behavior and the attitude of students towards learning and the formation and development of certain capacities as resulting from the efficiency of learning by frequently using problem solving and discovery.

Curricular standards have been adapted to the school syllabus for each subject (mathematics and sciences) according to envisaged competences, as *dependent variables* in our research.

The comparative qualitative and quantitative analyses are divided into four categories, determined by the number of classes and disciplines:

1. A comparative analysis of school performance in Mathematics grade III;
2. A comparative analysis of school performance in Mathematics grade IV;
3. A comparative analysis of school performance in Sciences grade III;
4. A comparative analysis of school performance in Sciences grade IV;

In all four categories of analyses we have used the same pairs in comparing tendencies:

a. in control samples;
b. experimental sample from rural area with the one from the rural area
c. control sample with experimental one from rural area;
d. control sample with experimental one from urban area;

The average tendency of growth of school performances, during the experiment was obtained by comparing the results of pre-tests with the ones from the tests of knowledge T.C.1 and T.C.2. Tendency of growth in performance recorded in this stage by experimental samples is defined by a percentage of 17.33% for the urban area and of 13.67% for the rural area, in comparison with the control samples which had a tendency of growth situated between 5.67% and 8.67%.

The analyses of results in post-tests and their comparison with the other results are relevant for the evolution of experimental and control samples, having as references the different stages of the research (pretest, knowledge tests from the experimental stage). This comparative analysis enables us to establish significant differences between results obtained by the experimental samples and the control ones. The existence of a considerable gap between the school performances of the experimental sample compared to the ones of the control samples clearly marks the efficiency of our used methods and thus confirms our hypothesis.

The analysis of averages per samples, resulting from post-tests and pre-tests, has recorded a positive evolution of our students in the given interval of time. Values that define characteristic

evolutions of each sample demonstrate the rapidity of growth in average school performance. Comparing the evolution of the pair samples we found that performances recorded by experimental samples, as an average, are 4.54 times bigger than the ones recorded by the control samples.

Interpretation of recorded results followed by our scientific undertaking is based on a set of analyses:

Intergroup comparative qualitative and quantitative analyses made on pairs of samples measured in obtained school performances in mathematics;

Intergroup comparative qualitative and quantitative analyses made on pairs of samples measured in obtained school performances in sciences;

The analysis of the degree of association between the scores of the samples in mathematics and sciences;

Intergroup qualitative and quantitative analyses for control and experimental samples, by averages recorded in each competence, between pre-test and re-test and between post-test and re-test;

A quantitative and qualitative analysis of existing relations between school performances recorded by students taking part in our experiment and the psychological factors influencing learning activities;

The comparative quantitative and qualitative analysis by pairs of samples made on main evaluative components of our pedagogical experiment lead us to the following conclusions:

1. In the case of all pairs of control-experimental samples made up according to the three criteria: subject (mathematics and sciences); grade (grade III and grade IV); area (rural and urban), *values taken by t for the differences between obtained averages by subjects are statistically not significant, in the first two evaluative components, in the pre-test and the knowledge test. In the stages of post-test and re-test the averages of experimental samples are significantly higher than the averages of the control samples, a finding that is statistically validated by the value of t, at a level of significance lower than 0.04. This fact makes us believe that the hypothesis according to which the difference between averages obtained are determined by random factors and not by our experimental intervention has a probability of less than 4%.*

2. In the case of pairs of samples taken from classes working in the *step by step* system and the experimental samples we found that in the first two stages of the experiment, the differences between averages are statistically significant, ($p<0.05$), in favour of step by step samples, after which, during our experimental intervention, differences appear again between the averages, but this time in favour of experimental samples. This is due to the fact that school performance dynamics in the experimental sample determines a reduction in difference between averages, going until it reaches an inflexion point, after which the difference between the averages intensifies in favour of the experimental sample. Qualitative and quantitative comparison between the step by step sample and the experimental samples confirms that the ascendant evolution of school performance in experimental samples is strongly influenced by the experimental intervention.

3. The horizontal qualitative and quantitative comparison, by means of the t test, between samples of the same type (experimental and control), does not result in significant differences, between averages, statistically validated, which means that differences are influenced by random factors, so they are not due to experimental intervention, leading to an approximate parallelism for the evolution of school performance at samples of the same type.

Following our experiment and the interpretation of data obtained in the stages of pre-testing, post-testing and come-back, and established objectives, at the end of our complex enterprise , we may formulate several statements as conclusions. These will be presented in groups, according to their degree of generality, respectively taking into account the social category involved in the educational system, following the configuration generated by formulating our objectives.

The experimental investigation we carried on has as a starting point our intention of verifying how the interactive didactic methods based on “problem solving” and “learning by discovery” in teaching mathematics and sciences in primary school, may influence obtaining superior performances by students due to the positive impact of these methods applied in conscious and efficient learning, as well as our intention to identify the exigencies and limits in using these methods.

Our research approaches a present day issue, to be found among the new tendencies of contemporary pedagogy, preoccupied to replace the flattening, non-natural methodologies with the differentiating, individualizing or personalized methodologies in the teaching process, giving equal chances to each student, promoting methods with grater formative potentials which may be able to move things towards optimization of active undertakings by the students themselves in learning.

Our undertaking the present experimental research was meant to be clarifying and argumentative, supporting the idea that problem solving and learning by discovery, if systematically promoted and relevantly introduced in didactic activity would have a favourable effect upon the students' school performances.

The analysis of the results in this research confirms that teaching mathematics and sciences in primary schools through problem solving and learning by discovery has a significant positive effect both formatively and informatively.

Planning and unfolding of our pedagogical experiment were made from the perspectives of optimizing the teaching – learning process of mathematics and sciences in primary schools, of using systematically problem solving and learning by discovery in achieving and developing fundamental competences in mathematics and sciences and for the positive influence upon the dynamics of school performances.

Pedagogical intervention has been done within the normal framework of didactic activities in mathematics and sciences, on experimental samples chosen from both rural and urban areas. The samples were selected according to the pedagogical research methodology and observing the compatibility requirements imposed by the objectives and the hypotheses of formative experiments. Delimitation of the content sample has been made taking into account its potential in capitalizing the formative values of problem solving and discovery as didactic methods, in the way that their contents can contribute to the formation and developing of the capacity of understanding and using the concepts and terms specific to mathematics and sciences, using the capacities of exploration-investigation and problem solving. The sample covers an important part of contents in mathematics and sciences.

Evolution of samples along the experiment, the dynamics of school performance recorded by the students are described in comparative, quantitative and qualitative analyses following the application of tests in various steps along the experiment. For the tests applied in each evaluative reference point (pre-test, test of knowledge, post-test, re-test), which marks the tendencies of school performances of the samples, the contents and structure of knowledge were established according to the school syllabus; processes necessary to produce performance; contexts in which the knowledge and competences may be applicable.

Quantitative and qualitative analyses are aimed at the aspects which conduct to the validation of specific hypotheses in our formative experiment. Actually, the analyses are relevant for the tendencies of school performances recorded by the control and experimental samples, in the subjects of mathematics and sciences, between the evaluative components. The pre-test is the reference component to which the obtained results of the students are later compared to, all along the intervention until its end, as well as the results of distance checking.

The experimental stage of the pedagogical research is characterized by the effects produced by the experimental intervention, at the level of understanding capacities and usage of terms and specific concepts to mathematics and sciences and of exploration/investigation of reality and of problem solving. Comparative quantitative and qualitative analysis and statistical interpretation of recorded scores by the samples during the evaluative stages of the experiment permit us to evaluate the amounts of positive school performance tendencies, which are determined by the independent variables, problem solving and discovery.

The formative experiment is the main stage of the pedagogical research, during which didactic activity was performed in classes of mathematics and sciences with students from grade III and grade IV, according to the planned intervention. Processing and interpretation of data by means of comparing and relating to specific hypotheses enabled us to outline our conclusions in three major directions:

1. Systematic usage in didactic activity of suggested methods, namely problem solving and discovery, is significantly influencing formation and development of competences in mathematics: the capacity of

understanding and using specific concepts in mathematics in ways corresponding to necessities in individual life and capacities of exploring/investigating and solving problems.

Forming of elementary mathematical notions, in primary school, has an outstanding importance because they are notions with which man operates along all his life and which stay at the basis of the construction of a whole system of necessary acquisitions in developing a creative logical thinking, coherence, and working skills.

Mathematical competence has a complex character which assumes the capacity of developing and applying mathematical thinking in order to solve problems arisen in everyday life. Engaging in solving short exercises, individually, in a limited time, will positively influence the flexibility and fluency of our students' thinking.

School performance recorded by the subjects of our experimental sample in mathematics was strongly influenced by the usage on interactive didactic strategies, mostly by the usage of problem solving and discovery, but also by the usage of other methods meant to capitalize the potential and formative valences of the two fundamental methods.

Efficiency in using these methods during our experimental intervention is validated by the level of competence attained by our students, having in view operating with the basic mathematical elements for which the most important things are the capacity and availability of students to use types of logical (mathematical) thinking and modalities of presenting concrete situations which need to be solved.

Systematic use of interactive methods in didactic activities, respecting the particularities of the young students, with a correct thinking, facilitates, on one hand, building up of a sound intuitive basis, necessary for the construction in the students' minds of notions and concepts specific to mathematics, more and more abstract, and on the other hand, formation and development their accumulating capacity of new knowledge based on experience and previously acquired knowledge.

The solidity of knowledge and competence acquired through interactive learning activities is validated by the results obtained by subjects in the re-tests.

A strongly marked field by the usage of interactive methods is mathematical counting. Organizing of learning activities based on problem solving and discovery have favoured, by oral counting, the mental effort of the students in solving an exercise which implies mobilizing the available knowledge and experience, and by written counting, formation of automatism based on a series of algorithms necessary for solving situations not encountered so far. We have noticed that doing calculations with natural numbers becomes more interesting, for students of primary levels, if they are required in solving a problem, and counting helps to understanding problems.

The higher standard of command over the counting techniques and specific language used in mathematics to be found among subjects of the experimental sample due to experimental intervention is validated by the answers to items in the post-tests and re-tests in which they were asked to compose their own problems with realistic contents.

Introducing some topics of day by day activity, taken from real situations as a support for drafting texts in their problems, have largely contributed to understanding notions like "problem", solving a problem" and ways of solving them. Activities organized to compose and solve problems, improved by interactive didactic strategies, are the best way to acquire the notions related to mathematics, in developing logical thinking, in building up modeling abilities in mathematical realities, and in the same time they are a fertile basis in cultivating and educating inventiveness and creativity.

Tasks of composing problems containing phenomena and facts drawn from daily life situations will develop the students' creative capacities, which may be capitalized in learning situations based on discovery and/or problem solving, thus directly and actively involving them the stage of wording and issuing questions. This kind of involvement will lead to the increase of interest and a better motivation in searching and finding various results. An active participation from the students' part to his/her own process of teaching-learning is largely influencing good results in pre-established educational objectives, as students have the possibility and conditions to contribute in building up their own knowledge starting from what they already know.

2. *Systematic usage in didactic activity of suggested methods, namely problem solving and discovery, is significantly influencing formation and development of competences in sciences, the capacity of understanding and using specific concepts and terms in sciences as well as the capacity of experimenting and exploring / investigating reality, using specific instruments and procedures.*

School performance with a significant increase from one stage to the next, recorded by the subjects of the experimental sample, are proving the efficiency of problem solving and discovery methods in our didactic undertaking to develop competence and using concepts specific to sciences, in exploring the environmental reality.

Optimization of the didactic results is demonstrated by the active-participating character of interactive didactic strategies, capable to induce and sustain an efficient learning of sciences.

Teachers involved in our experiment have adapted this undertaking to the students' age and to the subject's specific requirements by offering adequate working tasks according to the levels of complexity already to be found among the students' knowledge and experience. The simple description of features in some objects, organisms, phenomena and events based on certain criteria given through drawings, schemes and grids and using some simple equipments in order to observe some phenomena or performing some measurements with conventional or unconventional instruments in making adequate comparisons between phenomena or between earlier results and predictions of their own, were some of the tasks asked from the students, all meant to improve learning by discovery and problem solving.

Using some simple equipments in making observations upon phenomena or making measurements with conventional or unconventional instruments in order to get some adequate comparisons among phenomena or between earlier results and predictions of their own encourage and support students in accomplishing their learning tasks; they have the opportunity to capitalize their creative potential in applying previously acquired knowledge in exploring novel situations (learning by discovery and problem solving).

Involving students in learning activities of the interactive type induced the development of competences in the field of sciences by applying intellectual and practical abilities, thus ensuring an efficient learning and making it easier to acquire knowledge in the field of sciences.

The analysis of the degree of association between the scores of samples in sciences and mathematics have shown a positive correlation between the school performance in sciences and school performance in mathematics in the evaluating stages of post-testing and re-testing, which means that there is a strong and direct relation between the two variables. This aspect is validating the opportunity offered by interactive strategies concerning transferability of both knowledge in mathematics and sciences and competences developed by teaching-learning mathematics and sciences.

3. Usage of problem solving and learning by discovery, combined in the best way, will significantly influence the management of didactic activity.

Interactive teaching-learning didactic activities in studying mathematics and sciences are able to offer the most favourable context for students to familiarize with the specificity of these disciplines. Using in tandem problem solving and learning by discovery may be a powerful factor that favours the efficiency of the methods both regarding acquisition of knowledge as provided by the syllabus, ensuring representative interdisciplinary approaches and regarding development and formation of fundamental capacities in finding best solutions to various problems encountered in everyday life.

Optimal combination of problem solving and learning by discovery, in didactic activities dedicated to mathematics and sciences, doubled by an adequate coordination and guidance of students in their situations of learning, let it be individual or in groups, from the perspective of attaining targeted goals, have led to a superior capitalizing of informative but mostly formative valences, being at hand in both methods. We have found that the tandem of problem solving together with discovery, used whenever the objectives and activities make it possible this way, would better ensure the experimental character of learning, combining knowing with action and the theoretical-explanatory character with the practical-applicative one. In these situations, a better capitalizing of the operational, instrumental and functional character of knowledge has significantly contributed in developing the capacity to solve theoretical and practical problems, a fact which was confirmed by the students' results through tests applied during the experiment.

Therefore we consider that the combined usage of problem solving and discovery in learning activities must start from the idea that "materials to be learned" is not presented to the student in its final form, but it must first require from the student a certain mental activity. Under these circumstances it is quite difficult to admit that by means of only one single method the student will be able to build up his new knowledge. Learning activities should be organized in such a way that didactic strategies be oriented towards learning by discovery. In this sense, problem solving and discovery have been utilized successfully in terms of school performances through the didactic activities performed within our experiment.

Lessons organized and performed this way have become more interesting, their efficiency being demonstrated by the fact that our students succeeded to achieve substantial and fundamental judgments, better understanding the contents they should apply in real life. In addition, by means of the learned skills in these conditions, they are able to construct their own correct scientific thinking, they familiarize with self-oriented learning, they make up their own personality, they gain control over their civic conduct and they change their view and approach to learning. The teachers' preoccupation to ensure an equilibrium among the intuitive methods, action and problem solving, have made their didactic activities along the experiment to be based not too much on intuition, on formal learning, with no modeling support in which notions and concepts specific to mathematics and sciences be not left without sufficient intuitive retrospection or without the opportunity using them in solving problems encountered in everyday life.

Because the interactive methods in general, and problem solving and discovery in particular, have a significant input in generating inherent motivation, and also in diminishing the pressure generated by the teacher's personality, they make even the more reticent students, who have a weaker opening to adapt to learning activities, who have less resistance to efforts, who do not always fulfill their tasks in learning and can not concentrate too much their attention thus are determined to participate in building up their own knowledge.

Problem solving and learning by discovery enables to link logically and naturally the old and the new knowledge; didactic units are not separate sequences, they are interdependent in the situation of learning and therefore contribute to better understanding, since they capitalize and activate previous experiences and knowledge.

The process by which the students are building up their new knowledge, by their own effort, based on previously acquired experience, is a cyclic process, with the duration of one learning activity. Evolutions of modification in knowledge are the result of the inductive phenomenon manifested by problem solving and discovery. This phenomenon of *mutual induction* is produced between acquisitions gained through problem solving and acquisitions gained through discovery.

Learning activity starts by formulating a problem or a problem-situation. Conjugated activities of both teacher and students then lead, by finding variations of solutions and choosing the correct one, to the discovery of new knowledge, which actually will finish the learning activity. These newly discovered knowledge then open multiple perspectives of knowledge, at a superior level. From among these perspectives some are used for restarting another training cycle, a new step is taken towards a new learning activity. This means that each teaching unit produces acquiring knowledge in the students' minds. Fluidity of knowledge is ensured by mutual induction taking place between problem solving and discovery, and the value and level of acquisitions acquired in such a way are influenced by objective and subjective factors that come up during the teaching process.

The multitude of knowledge resulting from learning activities, added together, constitutes the basis of gaining and developing capacities and competences, which are not isolated entities, and which actually establish relations of interdependence and causality. The set of correlated capacities contribute to a space system, dynamic and open, specific to each individual. Space is given in terms directions as a multitude of actions in which demonstration is made on capacities; dynamics is determined by the rapidity in changing occurred in the level of knowledge, of capacities and competences, as they come into the instructive process; the system is an open one since it permits a flux of challenges in both ways, creation and response to challenges in everyday life.

An important feature of the system of capacities/competences made up in this way is flexibility. The more components and the more developed an individual system would be an easier effort would it take to solve all the challenges. The flexibility of the system will influence the degree of amortization

of the bump produced by solving a problem of everyday life. If a person has a reduced system of competences containing less value, the impact of everyday problems is supported with greater difficulty.

The system and mechanism of functioning, described above, are having an important theoretical and practical importance. Knowing and accepting, from the teacher's side, of such a system associated to each student, will facilitate the planning of efficient didactic activity, having in view the forming and development of competences, as a gradual process, assuming the capacities to react to environmental challenges, gained as operational objectives of learning activities.

Organizing and performing learning activities are to be meant to attain pre-established goals. It is quite obvious that only the training in which teaching-learning offers the opportunity of organizing a thorough pedagogical learning, in an easy and pleasant way and with a stressed active-participative character from the part of the students is going to offer possibilities of efficient cooperation and communication. Systematic usage of modern methods also involves efficient and constructive communication relations in which all the participants would gain cognitive, affective-emotional, attitude, social and practically applicative benefits.

At the end of the instructive activities schooling results do not refer only to the students acquisitions in the cognitive area, they broaden to the whole range of behaviours.

The results of our experimental investigation finally prove that interactive didactic strategies offer beneficial occasions in pedagogical organization of a thorough learning, easy and pleasant, with a strong active-participative character enjoyed by the students, with possibilities of cooperation and efficient communication. A systematic use of interactive methods presumes efficient and constructive communicative relations within which the students obtain significant cognitive, affective-emotional, attitude, social and practical applicative benefits. Acquisitions of students both in the cognitive sphere (knowledge, abilities, capacities) in the fields of mathematics and natural sciences and in their behavior, envisaging developments of personality, acquired through interactive methods have proved to be stable and profound in time.

The experimental perspective upon interactive teaching-learning has enforced the conviction that problem solving and learning by discovery are important strategies that may be easily incorporated into didactic activity. Theoretically, this means mastering specific methodological principles, and practically, this means to apply these principles in accordance with the objectives and contents of the subjects in view, together with the particularities of the teaching-learning process according to school level, of a denominated group in which we work and with the students individual particularities.

Quantitative results, observations and interpretations made on the occasion of our pedagogical experiment have revealed the complex and subtle character of the teaching-learning process. The great number of operational variables in the teaching-learning process and the relational fields in which they are to be found will only reduce the chances of an exhaustive approach in the field dealt with. Continuation and deepening of study are made necessary in this way, because they may be able to open new perspectives of investigation.

The pragmatic aspect of the experiment lies in the structuring of relevant information, specific to optimization in the teaching-learning process, offering a model of efficient program of intervention in this field, elaboration and adaptation of several investigation instruments specific to the age group we had in view.

As it was foreseeable, proceeding to this experimental research we realized that new possible perspectives will be generated for other (sub)themes, in targeting new objectives, other working hypotheses, new evaluation instruments and other techniques of statistical data analyses, whereas collecting and analyzing the data have offered us the opportunity to discover certain limits of our research.

Our dissertation contains 306 pages, 76 grids and 78 diagrams, a bibliography list containing 200 titles (Romanian and foreign authors), a rich webography, as well as a number of 18 annexes (for questionnaires, psycho-pedagogical files, tests, projects, grids of test results, synthetic analyses).

BIBLIOGRAPHY

1. Aebli, H., (1973), *Didactica psihologică. Aplicaţii în didactică a psihologiei lui J. Piaget,* EDP, Bucureşti
2. Ainscow, M. (ed.), (1991), *Effective Schools for All*, David Dulton Pbl., Londra
3. Alan J., Bishop, Stieg Mellin-Olsen, (1991), *Mathematical Knowledge: Its Growth Through Teacging, Kluwer* Academic Publishers, The Netherlands
4. Albulescu, I., (2008), *Pragmatica predării. Activitatea profesorului între rutină şi creativitate,* Editura Paralela 45 Piteşti
5. Albulescu, I., Albulescu, M., (2006), *Pedagogia comunicării. Procedee discursive didactice*, Editura Napoca Star, Cluj-Napoca
6. Allal, L. (1979), *Stratégies d'évaluation formative: conceptions psycho-pédagogique et modalités d'application*, în "L'évaluation formative dans un enseignement différencié", L. Allal, J. Cardinet, P. Perrenoud (Ed.), Peter Lang, Berne
7. Amegan, S. (1993), *Pour une pédagogie active et créative*, 2e édition, Presses de l'Université du Québec
8. Anca, M., Ciascai, L., Ciomoş, F., (coord. 2007), *Dezvoltarea competenţelor didactice şi de cercetare în ştiinţele naturii*, Editura Casa Cărţii de Ştiinţă, Cluj-Napoca
9. Armstrong, T. (1994), *Multiple Intelligences in the Classroom*, Alexandria, VA: Association for Supervision and Curriculum Development
10. Astolfi, J.P., Develay, M., (1991), *La didactique des sciences,* 2e edition, Presses Universitaires de France, Paris
11. Ausubel, D.P., Robinson, F.G. (1981), *Învăţarea în şcoală. O introducere în psihologia pedagogică*, Editura Didactică şi Pedagogică, Bucureşti
12. Avends, I.R., (1994), *Learning to teach, third edition*, Mc Grow-Hill, Inc. SUA
13. Babanski, I. K. (2003), *Optimizarea procesului de învăţământ*, EDP, Bucureşti
14. Băjău, D., (2001), *Descoperirea dirijată – metodă de organizare a învăţării*, Revista de fizică şi chimie „Delta" nr.1, Ed. Radical
15. Bârzea C, (1993),*Curriculum Reform in Central and Estern Europe*, J. C. van Bruggen, Enschede
16. Bârzea, C, (1982), *La pedagogie du succes*, Presses Universitaires de France, Paris
17. Bârzea, C., (1998) *Arta şi ştiinţa educaţiei*, Editura Didactică şi Pedagogică, Bucureşti
18. Beamon, G.W. (1997), *Sparking the Thinking of Students, Ages 10-14. Strategies for Teachers*, Corwin Press, Inc. A Sage Publications Company Thousand Oaks, California
19. Berar, I., (1991), *Aptitudinea matematică la şcolari*, Editura Academiei Române, Bucureşti
20. Bernat, S.-E. (2003), *Tehnica învăţării eficiente*, Editura Presa Universitară Clujeană, Cluj Napoca.
21. Birch, A., (2000), *Psihologia Dezvoltării*, Editura Tehnică, Bucureşti
22. Bloom, B.S., (1971), *Taxonomy of Educational Obiectives,* Handbook I: Cognitive Domain, David McKay Comp., Inc., New York
23. Bocoş, M., Jucan, D., 2007, *Teoria şi metodologia instruirii şi Teoria şi metodologia evaluării,* Casa Cărţii de Ştiinţă, Cluj – Napoca
24. Bocoş, M. (2002), *Instruire interactivă. Repere pentru reflecţie şi acţiune, ediţia a II-a, revăzută*, Editura Presa Universitară Clujeană, Cluj Napoca
25. Bocoş, M. (2007). *Teoria şi practica cercetării pedagogice*. Cluj-Napoca: Editura Casa Cărţii de Ştiinţă
26. Bocoş, M. (2008), *Didactica disciplinelor pedagogice. Un cadru constructivist*, Editura Paralela 45, Piteşti

27. Bocoş, M. (2008), *Teoria curriculum-ului. Elemente conceptuale şi metodologice,* Casa Cărţii de Ştiinţă, Cluj – Napoca
28. Bocoş, M. (coord.), Jalba. G., Felegean, D. (2004), *Evaluarea în învăţământul primar. Aplicaţii practice*, Editura Casa Cărţii de Ştiinţă, Cluj Napoca
29. Bocoş, M., Catalano, H., coord. (2008), *Pedagogia învăţământului primar şi preşcolar,* Editura Presa Universitară Clujeană, Cluj Napoca
30. Bocoş, M., Ciomoş, F. (2001), *Proiectarea şi evaluarea secvenţelor de instruire*, Editura Casa Cărţii de Ştiinţă, Cluj-Napoca
31. Bonboir.,A., (1974), *Une pedagogie pour demain*, Presses Universitaires de France, Paris
32. Bontaş, I., (2001), *Pedagogie tratat,* Ediţia a V-a revăzută şi adăugită, Editura BIC ALL
33. Broad, M., Newstrom, J. (1992), *Transfer of Training*, Jossey-Bass, San Francisco.
34. Bruner, J. S., (1970), *Pentru o teorie a instruirii*, Editura Didactică şi Pedagogică, Bucureşti
35. Bruner, J. S., (1970), *Procesul educaţiei intelectuale*, Editura Ştiinţjfică, Bucureşti
36. Bruner, J.S, (1991), *Acts of Meaning,* Harvard University Press
37. Bruner, J.S. (1997), *L'éducation, entrée dans la culture*, Cols. Psihologie, Retz, Paris
38. Caine, R., Caine, G. (1991), *Making connections: Teaching and the human brain*, Alexandria, VA: Association for Supervision and Curriculum Development
39. Calin, M., (1996), *Teoria educaţiei. Fundamentarea epistemică şi metodologică a acţiunii educative,* Bucureşti
40. Călin, M., (2001), *Filosofia educaţiei*, Editura Aramis, Bucuresti
41. Cardinet, J. (1991), *Évaluation scolaire et mesure*, Bruxelles, De Boeck-Wesmael.
42. Catalano, H., (2009), *Educaţie şi formare,* Editura Karuna Bistriţa
43. Cerghit, I. (2008), *Sisteme de instruire alternative şi complementare. Structuri, stiluri şi strategii,* Editura Polirom Iaşi
44. Cerghit, I.(coord.), (1983), *Perfecţionarea lecţiei în şcoala modernă,* E.D.P.,Bucureşti
45. Cerghit, I., (2006), *Metode de învăţământ*, Editura Polirom, Iaşi
46. Cerghit, I., Neacşu, I., Negreş-Dobridor, Pânişoară, I., (2001), *Prelegeri pedagogice,* Editura Polirom Iaşi
47. Chircev, A., Radu, I., Roşca, Al., Zörgö, B., (1975), *Psihologie Generală,* Editura Didactică şi Pedagogică, Bucureşti
48. Chircev, S., (1967), *Psihologia pedagogică*, Editura Didactică şi Pedagogică, Bucureşti
49. Chiş, V. (2001), *Activitatea profesorului între curriculum şi evaluare*, Editura Presa Universitară Clujeană, Cluj-Napoca.
50. Chiş, V. (2003). *Provocările pedagogiei contemporane.* Cluj-Napoca: Editura Presa Universitară Clujeană
51. Chiş, V. (2005), *Pedagogia contemporană, pedagogia pentru competenţe,* Editura Casa Cărţii de Ştiinţă, Cluj Napoca
52. Chiş, V., Şerdean, Gh.. Chiorean, M., (2001), *Gidul profesorului de matematiă,* Editura Dacia, Cluj-Napoca
53. Ciolan, L., (2003) *Dincolo de discipline. Ghid pentru învăţarea integrată /crosscurriculară*, Centru educaţia 2000+, Bucureşti
54. Ciolan, L., (2008), *Învăţarea integrată – fundamente pentru un curriculum transdisciplinar,* Editura Polirom, Iaşi
55. Cîrjan, F., (1999), *Strategii euristice în didactica matematicii,* Editura Paralela 45, Piteşti
56. Comenius, J.A. (1975), *Arta didactică*, Editura Didactică şi Pedagogică, Bucureşti
57. Cosmovici, A., Iacob,L., (1999), *Psihologie şcolară*, Editura Polirom, Iaşi
58. Creţu, C, (1997), *Psihopedagogia succesului*, Editura Polirom, Iaşi
59. Creţu, T., (1994), *Psihologia vârstelor*, Ed. Universităţii din Bucureşti, Bucureşti

60. Crişan, Al, (1995), *Curriculum şcolar. Ghid metodologic*, CNC, Bucureşti
61. Cristea, G., (2008), *Mangementul lecţiei,* Edirura Didactică şi Pedagogică, Bucureşti
62. Cristea, S., (2000), *Dicţionar de pedagogie*, Editura Litera, Bucureşti
63. Cristea, S., (2003), *Managementul organizaţiei şcolare*, E.D.P, Bucureşti
64. Cristici V., Arghirescu A., Fierăscu A., Lapoviţă A., (2004), *Matematica - clasa I*, Editura Petrion, Bucureşti
65. Cucoş, C. (2000). *Educaţia. Dimensiuni culturale şi intercultural*, Editura Polirom, Iaşi
66. Cucoş, C. (2001), *Istoria pedagogiei. Idei şi doctrine pedagogice fundamentale*, Editura Polirom, Iaşi
67. Cucoş, C. (2006). *Informatizarea în educaţie. Aspecte ale virtualizării formării*. Ed. Polirom, Iaşi
68. Cucoş, C., (2006), *Pedagogie*, Ediţia a II-a, revăzută şi adăugită, Editura Polirom, Iaşi
69. Dăncilă, E., Dăncilă, I., (2002), *Matematică pentru bunul învăţător*, Editura Erc. Press, Bucureşti
70. Davitz, J. R., Ball, S., (1978*), Psihologia procesului educaţional, E.D.P, Bucuresti*
71. *De Bartolomeis, F. (1981), Introducere în didactica şcolii active, Editura Did*actică şi Pedagogică, Bucureşti
72. De la Harpe, B., Kulski, M., & Radloff, A. (1999). *How best to document the quality of our teaching and our student's learning?* In *Proceedings of the 8th Annual Teaching and Learning Forum: Teaching in the disciplines/learning in context* (pp. 108-113). Perth, WA: Centre for Staff Development. UWA; sursa: **http://www.ascilite.org.au/content/files/hardy1_2.pdf**
73. De Peretti, A. (1993), *Controverses en éducation*, Hachette, Paris
74. Debesse, M., (1970), *Psihologia copilului,* Editura Didactică şi Pedagogică, Bucureşti
75. Debesse, M., (1981), *Etapele educaţiei*, E.D.P, Bucuresti
76. Delors, J. (coord.), (2000), *Comoara lăuntrică*, Editura Polirom, Iaşi
77. Dembo, M.H., Eaton, M.J. (1997), *School learning and motivation*, în "Handbook of Academic Learning: Construction of Knowledge", Ed. G.D. Phye, Academic Press, Inc.
78. Develay, M. (1989), *Sur la méthode expérimentale*, în "ASTER", N^{o} 8, "Expérimenter, modéliser", INRP
79. Dienes, Z. P., (1973), *Un studiu experimental asupra învăţării matematici*, Editura Didactică şi Pedagogică, Bucureşti
80. Doudin, P.A., Martin, D. (1992), *De l'intérêt de l'approche metacognitive en pédagogie*, Laussane, Centre Vandois de Recherches Pédagogiques
81. Drăgan, I., Nicola, I., (1993), *Cercetarea psihopedagogică*, Editura Tipomur, Târgu-Mureş.
82. Dragoş, V., (2010), *Utilizarea metodelor interactive în ciclul primar*, în Dezvoltări pedagogice în învăţământul contemporan, Editori Boar, N., Dragoş, V.,Kosinsczki, S., Presa Universitară Clujană, Cluj Napoca
83. Dragoş, V., (2010), *Valenţe interactive ale auxiliarelor curriculare*, în Dezvoltări pedagogice în învăţământul contemporan, Editori Boar, N., Dragoş, V.,Kosinsczki, S., Presa Universitară Clujană, Cluj Napoca
84. Dragoş, V., (2010), *Valorificarea valenţelor formative ale investigaţiei prin studiul ştiiinţelor,* în Cercetări şi aplicaţii în ştiinţele educaţiei, coordonatori Chiş, V., Albulescu I., Casa Cărţii de Ştiinţă, Cluj – Napoca
85. Dumitru, I.Al. (2000), *Dezvoltarea gândirii critice şi învăţarea eficientă*, Editura de Vest, Timişoara
86. Fabre, M. (1993), *De la résolution de problème à la problématisation*, în "Les sciences de l'éducation", nr. 4-5

87. Farris, P.J. (1996), *Teaching, Bearing the Torch*, Brown & Benchmark Publishers, USA
88. Ferrière, A. (1973), *Şcoala activă*, Editura Didactică şi Pedagogică, Bucureşti
89. Feurerstein, R. (2002), *Experienţa învăţării mediate în clasă şi în afara acesteia,* Imprimeria "Arddealul", Cluj Napoca
90. Fischbein, E., (1965), *Concept şi imagine în formarea gândirii matematice*, Editura Ştiinţifică, Bucureşti
91. Fluieraş, V., (2007), *Paideia şi gândirea cxritică,* Editura Casa Cărţii de Ştiinţă, Cluj Napoca
92. Fluieraş, V., (2007), *Teoria şi practica învăţării prin cooperare*, Editura Casa Cărţii de Ştiinţă, Cluj Napoca
93. Gabriela, C. (2008), *Mangementul lecţiei,* Edirura Didactică şi Pedagogică, Bucureşti
94. Gagné, R. M., (1975), *Condiţile învăţării*, E.D.P., Bucureşti
95. Gagné, R. M., Briggs, L.J.,(1997), *Principii de design ale instruirii*, E.D.P.,Bucureşti
96. Galperin, P., (1975), *Studii de psihologia învăţării*, EDP, Bucureşti
97. Gardner, M., (2006), *Inteligenţe multiple*, Editura Sigma, Bucureşti
98. Gavenea, Al., (1975), *Cunoaşterea prin descoperire în învăţământ*, E.D.P,Bucuresti
99. Georgescu, D. (1999), *Reforma învăţământului – o şansă pentru schimbarea de mentalitate*, Editura Trei, Bucureşti
100. Gheorghiu, A., Popovici, M., (1983), *Elemente de tehnologie didactică*, E.D.P, Bucuresti
101. Gherman, A., (2004), *Culegere de exerciţii şi probleme de matematică pentru clasele I-IV*, Editura Elis, Bucureşti
102. Glava C,(2009), *Formarea competenţelor didactice prin intermediul e-learning*, Casa Cărţii de Ştiinţă, Cluj – Napoca
103. Glava, A. Glava C,(2002), *Introducere în pedagogía preşcolară,* Ed. Dacia, Cluj Napoca
104. Golu, P., (1985), *Învăţare şi dezvoltare*, Ed. Ştiinţifică si Enciclopedica, Bucuresti
105. Hilgard, E. R., Bower, G. H., (1974), *Teorii ale învăţării*, E.D.P, Bucureşti
106. Honey, P., Mumford, A. (1982), *The Manual of Learning Styles*, Peter Honey, Maidenhead, adaptat de la ***http://www.ucd.ie/teaching/good/per3.htm***
107. Ionescu, M. (1979). *Previziune şi control în procesul didactic*. Cluj-Napoca: Editura Dacia.
108. Ionescu, M. (2000), *Demersuri creative în predare şi învăţare*, Editura Presa Universitară Clujeană, Cluj-Napoca.
109. Ionescu, M. (2007). *Instrucţie şi educaţie*. Arad: Editura Universităţii de Vest "Vasile Goldiş".
110. Ionescu, M., Bocoş, M. (coord.) (2009). *Tratat de didactică modernă*, Piteşti: Editura Paralela 45.
111. Ionescu, M., Chiş V. (coord.), (2001) *Pedagogie. Suporturi pentru pregătirea profesorilor*, Editura Presa Universitară Clujeană, Cluj-Napoca.
112. Ionescu, M., Chiş, V. (coord.) (2001). *Pedagogie. Suporturi pentru formarea profesorilor*. Cluj-Napoca: Editura Presa Universitară Clujeană.
113. Ionescu, M., Chiş, V., (1992), *Strategii de predare şi învăţare*, Editura Ştiinţifică, Bucureşti
114. Ionescu, M., Chiş, V., (coord. 2009), *Fundamentări teoretice şi abordări praxiologice în ştiinţele educaţiei,* Editura EIKON, Cluj-Napoca
115. Ionescu, M., Radu, I., (2004) *Didactica modernă*, Editura Dacia, Cluj – Napoca
116. Ionescu, M., Radu, I., Salade, D., (2000), *Studii de pedagogie aplicată,* Editura Presa Universitară Clujeană, Cluj-Napoca

117. Iucu, R., (2001), *Instruirea şcolară. Perspective teoretice şi aplicative,* Editura Polirom, Iaşi
118. Jinga, I., Negreţ, I., (1999), *Învăţarea eficientă*, Editura Aldin Bucureşti
119. Jinga, I.,Gavota,M., Petrascu, A.,Stefanescu, V., (1999), *Evaluarea performanţelor şcolare*, Editura Aldin Bucureşti
120. Johnson, D.W., Johnson, R.T. (1991), *Classroom instruction and cooperative learning*, în H.C. Waxman, H.J. Walberg, eds., "Effective teaching: Current Research", Berkeley, CA: Mc Cutchan Publishing,
sursa: **http://www.texascollaborative.org/Collaborative_Learning_Module.htm**
121. Joiţa, E., (1998), *Eficienţa instruirii, Fundamente pentru o didactică praxiologică,* Editura Didactică şi Pedagogică, Bucureşti
122. Jurcău, N. (coord.) (2001), *Psihologia educaţiei*, ediţia a IV-a, Editura U.T. Pres, Cluj-Napoca.
123. Ken, R., Philip, C., (2007), *Teste psihometrice*, Meteor Press, Bucureşti
124. Kieran, Egan, (2008), *Predarea ca o poveste*, Didactica Press, Bucureşti
125. Kolb, D.A. (1984), *Experiential Learning*, Englewood Cliffs, NJ: Prentice-Hall.
126. Kommers, P.A.M., Jonassen, D., şi Mayes, T., (1992), *Cognitive Tools for Learning*, Heidelberg: Springer
127. Kuliutkin,I.N., (1974), *Metode euristice în structura rezolvării de probleme, E.D.P, Bucureşti*
128. Lemeni, G. (2001), *Strategii de învăţare*, în "Consiliere educaţională. Ghid metodologic pentru orele de dirigenţie şi consiliere", coord. A. Băban, S.C. Psinet S.R.L., Cluj-Napoca.
129. Lupu, C., Săvulescu, D., (1999) *Metodica predării matematicii,* Ediţia a III-a, Editura Paralela 45, Piteşti
130. Maior A., Călugăriţa A., Maior E., (2006), *Matematica - Clasa a IV-a*, Editura Aramis, Bucureşti
131. Maliţa, M., (1987), *„Predarea si însuşirea ştiinţelor*", în Forum, nr. 2
132. Marc, Bru, (2007), *Metode în pedagogie,* Editura Grafoart
133. Marcus, S., (1999), *Competenţa didactică*, Editura All, Bucureşti.
134. Marga, A. (1994), *Explorări în actualitate*, Biblioteca Apostrof, Cluj-Napoca.
135. Marga, A. (2000). *Anii reformei*, Editura Fundaţiei pentru Studii Europene, Cluj-Napoca:
136. Matei, N. C., (1982), *Educarea capacităţilor creative în procesul de învăţământ*, Editura Didactică şi Pedagogică, Bucureşti
137. Miclea, M. (1998), *Învăţarea şcolară şi psihologia cognitivă*, în "Educaţia şi dinamica ei", coord. M. Ionescu, Editura Tribuna Învăţământului, Bucureşti.
138. Miclea, M., (2003), *Psihologie cognitivă, Metode teoretico – experimentale*, Polirom, Iaşi
139. Mih, V. (2001), *Creativitatea şi stimularea comportamentului creativ*, în "Consiliere educaţională. Ghid metodologic pentru orele de dirigenţie şi consiliere", coord. A. Băban, S.C. Psinet S.R.L., Cluj-Napoca.
140. Mihaela, N., Mioara, M. (2007), *Metodica predării matematicii în ciclul primar*, Polirom, Iaşi
141. Neacşu, I., (1990) *Metode şi tehnici de învăţare eficientă*, EDP, Bucureşti
142. Neagu, M., Mocanu, M., (2007), *Metodica predării matematicii în ciclul primar*, Editura Polirom, Iaşi
143. Negreţ, D., I., Pânişioară, I., O., (2005) *Ştiinţa învăţării,* Editura Polirom, Iaşi
144. Nicola, I. 2003, *Tratat de pedagogie şcolară*, Ed. Aramis, Bucureşti
145. Noel, E., (1981), *Styles of Learning and Teaching:* An integrated Outline of Educational Psyhology for Students, Teaching, and Lectures, John Willey & sons, New York

146. Noveanu, E., (coord. 1983), *Model de instruire formativă la disciplinele fundamentale din învăţământ,* EDP, Bucureşti
147. Okón, W. (1978), *Învăţământul problematizat în şcoala contemporană*, Editura Didactică şi Pedagogică, Bucureşti
148. Opre, A. (2002) *Inconştientul Cognitiv*. Ed. ASCR: Cluj-Napoca
149. Pacearcă Şt., Hogoş M. (2005), *Matematica - clasa a III-a*, Editura Aramis, Bucureşti
150. Pădureanu V., Piţilă T., Mihăilescu C., (2005), *Matematica - clasa I,* Editura Aramis, Bucureşti
151. Palmade, G., (1975), *Metodele pedagogice,* Editura Didactică şi Pedagogică, Bucureşti
152. Pânişoară, I. O., (2006),*Comunicarea eficientă,* Ediţia a III-a, revăzută şi adăugită. Editura Polirom, Iaşi
153. Pârâială V., Pârâială D., Pârâială C. G., (2003), *Matematica - clasa a II-a*, Editura Euristica, Iaşi
154. Pârâială V., Pârâială D., Pârâială, C. G., (2005), *Matematica - clasa a III-a*, Editura Aramis, Bucureşti
155. Pârâială, D. Pârâială V., (2006), *Matematica - clasa I*, Editura Euristică, Iaşi
156. Pârâială, V., Pârâială, D., (2000), *Matematica - manual pentru clasa a IV-a*, Editura Aramis, Bucureşti
157. Paun, E., Potolea, D., (2002), *Pedagogie, fundamente teoretice şi demersuri aplicative*, Editura Polirom, Iaşi
158. Perrenoud, Ph. (1997), *Construire des compétences dès l'école*, ESF éditeur, Paris.
159. Petrovici, C., Neagu, M., (2006), *Elemente de didactica matematicii în grădiniţă şi învăţământul primar,* ediţia a 2-a, Editura Pim, Iaşi
160. Philip, C., (2008), *Teste de inteligenţă şi psihometrice,* Meteor Press, Bucureşti
161. Piaget, J. (1972), *Psihologie şi pedagogie*, Editura Didactică şi Pedagogică, Bucureşti.
162. Piaget, J., (1976), *Construirea realului la copil*, E.D.P, Bucuresti
163. Polya, G., (1965), *Cum rezolvăm o problemă?*, Editura Ştiinţifică, Bucureşti
164. Polya, G., (1971), *Descoperirea in matematică. Euristica rezolvării problemelor*, Editura Ştiinţifică, Bucuresti
165. Postelnicu, C., (2000), *Fundamente ale didacticii şcolare*, Ed. Aramis, Bucureşti
166. Radu, I. (1974), *Psihologie şcolară*, Editura Ştiinţifică, Bucureşti.
167. Radu, I., Ionescu, M. (1987). *Experienţă didactică şi creativitate*. Cluj-Napoca: Editura Dacia.
168. Răduţ-Taciu, R., R., (coord. 2004), *Pedagogia Jocului de la teorie la aplicaţii,* Casa Cărţii de Ştiinţă, Cluj – Napoca
169. Rotariu, T, Iluţ, P. (2001*), Ancheta sociologică şi sondajul de opinie*, Editura Polirom, Iaşi.
170. Şchiopu, U., Piscoi,V., (1982), *Psihologia generală şi a copilului*, EDP, Bucureşti
171. Şchiopu, U., Verza, E., (1981), *Psihologia vârstelor*, EDP, Bucureşti
172. Schwartz, B., Reisberg, D. (1991), *Learning and memory*, New-York: Norton.
173. Semenova, M. (1991), *La formation théorique et scientifique de la pensée des écoliers*, în "Après Vygotski et Piaget. Perspectives sociale et constructiviste. Écoles russe et occidentale", textes réunis par C. Garnier, N. Bednarz, I. Ulanovskaya, De Boeck-Wesmael, Bruxelles
174. Siebert H., (2001), *Învăţarea autodirijată şi consilierea pentru învăţare. Noi paradigme postmoderne ale instruirii*, Institutul European, Iaşi
175. Şoitu, L., Cherciu, R., coord. (2006), *Strategii educaţionale centrate pe elev*, Bucureşti

176. Someşan, E., Buta, I., (2005), *Aritmetică. Probleme pentru copii isteţi* , Editura Casa Cărţii de Ştiinţă, Cluj-Napoca
177. Stan, C. (2001), *Autoevaluarea şi evaluarea didactică*, Editura Presa Universitară Clujeană, Cluj-Napoca
178. Stan, C., (2001) *Teoria educaţiei. Actualitate şi perspective*, Editura Presa Universitară Clujeană, Cluj Napoca
179. Stan, E., (2004), *Pedagogie postmodernă,* Editura Institutul European, Iaşi
180. Stanciu, M., (1999), *Reforma conţinuturilor învăţământului. Cadru metodologic,* Polirom, Iaşi
181. Stoica, A. (coord.) (2001), *Evaluarea curentă şi examenele. Ghid pentru profesori*, Editura ProGnosis şi SNEE (Serviciul Naţional de Evaluare şi Examinare), Bucureşti
182. Stover, S.T., Neubert, G.A., Lawlor, J.C. (1993), *Creating interactive environments in the secondary school*, Washington, D.C.: National Education Association
183. Templu, C., J. Steele, Meredith şi K. (1997) *Proiect LSDGC: Metode suplimentare privind Gândire critică: Ghid IV.* New York
184. Thorndike, R., Hagen, E. (1969), *Measurement and Evaluation*, în "Psychology and Education", ed. a 3-a, Wiley, London
185. Tice, J. (1997), *The Mixed Ability Class*, Richmond Publishing
sursa: **http://www.teflcert.com/downloads/bibliography.doc**
186. Tomescu, V., Popa, F., Gheorghe A., G., Stan, L., Gheorghe, C., (2001), *Metodica predării geografiei şi ştiinţelor naturii în ciclul primar,* Ed. Gheorghe Alexandru, Craiova
187. Triantaphyllou, A. (1999), *Les échanges scolaires, quelle pédagogie ?*, în "Cahiers pédagogiques", nr. 378.
188. Ulrich, C.,(2000*), Managementul clasei de elevi – învăţarea prin cooperare,* Editura Corint, Bucureşti
189. Ungureanu, D., (1999) *Educaţie şi curriculum*, Ed. Eurostampa, Timişoara
190. Văideanu, G. (1988), *Educaţia la frontiera dintre milenii*, Editura Politică, Bucureşti.
191. Viorel, I., (2002), *Pedagogia situaţiilor educative*, Editura Polirom, Iaşi
192. Voiculescu, F., Todor, I., Voiculescu, E.,(2004) *Managementul timpului – o abordare psihopedagogică*, Risoprint, Cluj Napoca.
193. Weiner, B. (1990), *History of motivational research in education*, în "Journal of Educational Psychology", 82 (4).
194. Zajchowski, R., Martin, J. (1993), *Differences in the Problem Solving of Stronger and Weaker Novices in Physics: Knowledge, Strategies or Knowledge Structure ?*, în "Journal of Research in Science Teaching", vol. 30 (5).
195. Zlate, M. (2006), *Fundamentele psihologiei*, Editura Universitară, Bucureşti
196. Zlate, M., (1973), *Empiric şi ştiinţific în învăţare* , E.D.P., Bucuresti
197. Zörgö, B., (1967), *Creativitate, modele, programare*, Editura Ştiinţifică, Bucureşti
198. Zörgö, B., (1974), *De la acţiuni pe modele obiectuale la operaţii cu simboluri*, în "Revista de pedagogie", nr. 2, p. 219.
199. *** (1997), Committee on Undergraduate Science Education, *Science Teaching Reconsidered: A Handbook*, Copyright 1997 by the National Academy of Sciences.
200. *** (2002), Ministerul Educaţiei Naţionale, Consiliul Naţional pentru Curriculum, *Curriculum Naţional. Programe şcolare pentru ciclul primar* Aria curriculară: matematică şi ştiinţe ale naturii, Bucureşti.
201. *** (2002), Ministerul Educaţiei şi Cercetării, *Standarde profesionale pentru profesia didactică*, coord. L. Gliga, POLSIB SA, Sibiu.

202. **** Psihopedagogie pentru examenele de definitivat şi grade didactice, 2005, Ed. Polirom, Iaşi.
203. *** (2003), Ministerul Educaţiei şi Cercetării, *Programa şcolară, clasele I şi a II-a*, Bucureşti
204. *** (2004), Ministerul Educaţiei şi Cercetării, *Programa şcolară, clasa a III-a*, Bucureşti
205. *** (2005), Ministerul Educaţiei şi Cercetării, *Programa şcolară, clasa a IV-a*, Bucureşti
206. *** (2005), Ministerul Educaţiei şi Cercetării, *Programa activităţilor instructiv-educative în grădiniţa de copii. Ediţia a II-a revizuită şi adăugită*, coord. Viorica Preda şi Magdalena Dumitrana, Editura V&I Integral, Bucureşti
207. *** (2005), Soft educaţional *Matematica, înmulţirea şi împărţirea*, Editura Erc Press Educaţional, Bucureşti