„BABEŞ- BOLYAI" UNIVERSITY CLUJ-NAPOCA
FACULTY OF PSYCHOLOGY AND SCIENCE OF EDUCATION

THE ELABORATION AND USE OF THE EDUCATIONAL SOFTWARE FOR DIFFERENTIATED INSTRUCTION IN PHYSICS IN HIGH-SCHOOL

- ABSTRACT OF DOCTORAL THESIS -

Scientific coordinator,
PROFESSOR MIRON IONESCU PhD

PhD Candidate
Coşeriu (Lung) Liliana Dana

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SECTION B: PRESENTATION OF THE DIDACTIC RESEARCH ON THE SUBJECT „THE STUDY OF THE EFFICIENCY OF THE DIFFERENTIATED INSTRUCTION IN PHYSICS IN HIGH-SCHOOL (9TH AND 10TH GRADES) BY MEANS OF THE EDUCATIONAL SOFTWARE OF OWN CONCEPTION

Key words: differentiated instruction, e-learning, m-learning, educational software, software for interactive instruction, electronic records for self-instruction, didactic design, IT design, formative (self)evaluation, pedagogic tests of knowledge, matrix of specifications, research- action, formative experiment, physics, LabVIEW.

Synthesis of the main parts of the doctorate thesis

The doctorate thesis entitled "The elaboration and use of the educational software for differentiated instruction in physics in high-school" consists of two sections: Section A „Theoretical background" and Section B „Presentation of the didactic research on the subject: The study of the efficiency of the differentiated instruction in physics in high-school (9^{th} and 10^{th} grades) by means of the educational software of own conception"

The chapter I, „From programmed instruction to m-learning", the chronological evolution of the virtual teaching between his two extremes is pointed out. We do not suggest a simple linear evolution, i.e. of the previous stage/stages, but, on the contrary a spiral-like evolution which supposes surpassing, sometimes entirely, the material previously acquired. The progress concerns, from a technical point of view, the teaching means used, the form of presenting and processing the contents, the access to the information and the communication possibilities, namely the exchange of information between teacher and students and the different stages, from the programmed instruction to the virtual one, the student is dependent or independent from the teacher in different educational contexts. The autonomy is presented as: the possibility to get information, to process them and to use the IT applications and even to modify or create educational software.

In section B of the thesis a formative experiment is presented, in which educational software of own conception is applied. The contents transposed into multi-branch IT programme follow the national curriculum; the IT devising and the didactical one integrate interactive formative strategies, which provides a partial autonomy of the student from the teacher. The informatic applications are used in a formal surrounding, the classroom. We consider the experience of applying the software described above, as belonging to the e-learning category; the computer is not only the instrument on which the learning of the students is based, but also the background with which they actively interact and which mediates the communication with the teacher, offering feedback according to the behaviour adopted.

In chapter II the differentiated instruction and the frontal one are comparatively approached. Some psycho pedagogical aspects of the two forms of organizing the process of

teaching, as well as the relationship teacher-student, are described. We point out the advantages and limits of the two types of instruction. Following the factors of decision used in planning and implementing the differentiated instruction, some considerations from the perspective of the discipline are presented by illustrating concrete modalities of applying the strategies of the differentiated instruction during the class of physics.

The elaborated educational software to be applied at the stage of the experiment, is included in a didactic strategy focussed on the student. The activity is organized individually, the student can choose between two routes of learning, differentiated by the way of processing the contents, by the number and complexity of the work task, adopting the one which better suits him according to the level of cognition, taking into account the teacher's prescription.

Chapter III is dedicated to the educational software. Starting from definitions from the literature of speciality a synthetic definition of the educational software is put forward. Taking into account the principles of the educational software we mentioned some directions of approach followed when accomplishing it, which focus on the student with his cognitive capacities, his needs and interests. The stages of accomplishing the educational software are described in detail, stages which are followed while elaborating the IT applications of owns conception, and its structure. A relatively new concept, the interaction between user and computer, with its two components, the human-computer dialogue and the interface with the user, is presented from the point of view of its application at an educational level. The instructional interaction student-computer allows to diversify the didactic strategy, facilitating the student's access to wider information, more logically organized, variously structured and presented with different modalities of visualization. Not only the computer itself, as a physical object, comprising multimedia information, causes immediate pedagogical effect, but especially the quality of the created programmes and the proper manipulation of the informatic products, integrated according to the criteria of methodical efficiency into the activities of instruction, into the strategies of instruction planned in a flexible manner. In Chapter III we included taxonomies of the educational software achieved by authors well- known in this field (D. Noveanu and P. Gorny) with exemplifications from the Internet and by own conception.

The process of studying the physical phenomena accomplished by the students implies going through delimitable cognitive stages by following the logics and ways of the scientific discoveries. In the same chapter we analysed these stages step by step and identified different contributions of the educational software in the study of the physical phenomena and the possibilities of using the different types of the educational software of own conception, devised

and used for frontal and differentiated instruction in the class of physics, presenting the didactical potentialities some elements of didactic and IT devising and illustrating the interfaces with the user (the student).

These data allowed the integration of the software applications, elaborated for the differentiated instruction and implemented in the developed research-action, in the category of the interactive learning software with potentialities within a lesson of acquiring new knowledge, of developing skills and abilities, of checking or controlling and assessing knowledge and abilities, in every specific stage within the study of the physical phenomena.

Section B of the thesis, entitled „Presentation of the didactic research on the subject the study of the efficiency of the differentiated instruction in physics in high-school (9th and 10th grades) by means of the educational software of own conception" is structured into three chapters.

In chapter IV „ Coordinates of the didactic research", we present the issue subject to new research, the objectives and hypothesis of the action-research, the system of the methods and the instruments of the research and the timing of the main actions taken.

The premise of our investigation was:

Forming the competences described by the curricular documents is not possible just by using some classical strategies of teaching- learning-assessing. Individual differentiated training, level groups, by means of the educational software designed by the teacher of physics can represent a successful alternative.

The general objective proposed:

To study the impact of the systematic use of the educational software in implementing the differentiated instruction in physics, applied to a group of students from the 9th and 10th grades, from the standpoint of the interest shown by the students for this discipline as well as from the perspective of the learning results obtained by them.

Specific objectives:

O1: To elaborate, pilot and review the educational software used in the study of learning units: „Rectilinear movement of the material point", „Thermodynamic processes", „The simple electric circuit".

O2: To measure the level of the skills developed according to the curriculum for the 9th grade and the 10th grade students as a result of the differentiated instruction mediated by the educational software.

The hypothesis of the research:

The use of the interactive educational software in order to differentiate the instruction leads to a significant improvement of the student performances in the study of physics by increasing the efficiency of active and interactive acquisition of knowledge, of training skills and of the interest in learning physics.

In order to check the hypothesis two experimental didactic scenarios were conceived: one based on the experimental inter-subject design and the other based on the experimental intra-subject design for which a wide range of research methods and instruments was used.

The method of the psycho-pedagogical experiment was based on two experimental scenarios:

A. In a inter-subject experimental design the technique of parallel samples (for two classes of 10^{th} grade, 40 students) was used in order to see to what extent the independent variable - differentiated instruction in physics by means of the educational software of own design, will influence the dependent variable, the result obtained by the 10^{th} grade students in the pedagogical tests of applied knowledge. To obtain the validation of the experimental results the roles of the classes were interchanged (the experimental one and the control one) for two teaching units by the technique of the factor rotation. The results in the pedagogical tests of knowledge obtained in the post-test and the pre-test were compared to the results obtained in the retest and pre-test for the experimental class and the control one. The experiment based on the inter-subject design took place during the school year 2006-2007.

B. Afterwards the longitudinal evolution of the results of a class of students will be analized within an inter-subject design (with a unique sample), which will follow the progress registered when applying the independent variable during three teaching units, measuring the differences between the results obtained in the pedagogical tests of knowledge registered in the post-test and the pre-test. The didactic experiment with a unique sample of subjects was developped during the school years 2006-2007 and 2007-2008.

The method of tests was applied during all experimental stage. The pedagogical tests of knowledge developed and used in the pre-test, post-test and retest were equivalent, containing items with a closed answer of filling in, of association , of multiple choice answer, as well as items with an open answer with upgraded difficulty which regarded knowledge, comprehension, application, analysis, synthesis and evaluation. Their equivalence was provided by their design with the help of the matrix of specifications; starting from the key and specific competences items for each target taxonomic levels concerned were made. Five pedagogical tests of

knowledge were designed which were called: pretest1 for the learning unit „The study of the movement", pretest2 for the learning unit „Basics in thermodynamics" and posttest1 for the learning unit „Rectilinear movement of the material point", posttest2 for the learning unit „Thermodynamic processes" and posttest3 for learning unit „ The simple electric circuit" .

The method of self-observation (use at the level of the subjects of the research), the method of observation (systematic) and the method of enquiry were applied to evaluate the qualitative results of the differentiated instruction by means of the educational software. On this purpose observation records were used (Observation record 1 for the activity of the students at the observant stage and the Observation record 2 for the activity of the students at the experimental stage) and self-observation (log page, scale of classification) and the questionnaire at the different stages of the action research and for the two types of samples of subjects (the unique one and the pair one).

To validate the educational software designed we used the interview method. To evaluate the educational software from the point of view of the quality of the didactic and informatic processing, we applied the technique of the interview structured on the basis checklists, and for the experimental testing we chose the informal non-structured interview.

The didactic research was conducted in the period of September 2006 - June 2008 at Grup Scolar M.R. „Unirea" from Cluj-Napoca. In chapter IV we presented chronologically, using an adapted version of the Gantt diagram for each experimental scenario, action entreprised during the pedagogical research, planned for months and years, in correlation with the resources, subjects and contents used

The independent variable applied was:

The individual differentiated instruction by means of the educational software of own conception, applied for two level group (the group of students with lower performances and the group of students with higher performances) in the study of physics in the technological junior high-school (9^{th} and 10^{th} grades)

We also present the correlation achieved between the measured dependent variables as a result of the action research and the instruments used in measuring them.

The correlation dependent variables-instruments of research

Dependent variables	**Instruments of research**
The comparative evolution of the results in pedagogical tests of knowledge obtained by the experimental class and the control one at the three stages of the didactic experiment	pretest2 posttest2, posttest3
The evolution of the obtained results in the	pretest1

pedagogical tests of knowledge by the unique sample along the formative experiment	posttest1, posttest2, posttest3
The increase in interest of the experimental student samples for the study of physics	pretest1, pretest2 posttest1, posttest2, posttest3 Questionnaire Scale of classification Observation record 2 Log page
Dynamic of transfers from one level group to another	Observation record1 Observation record 2 pretest1, pretest2 posttest1, posttest2, posttest3

Chapter V describes the actions enterprised during the observant stage. The objectives during this stage are subordinated to the research objectives and were developed to establish the research and sampling data at the beginning.

O1 – To establish the level of knowledge, skills, abilities of the students at physics at the beginning of the research period and to establish the value structure of the classes tested by administrating the pretext.

O2 – To choose the representative sample of subjects, to select the experimental class and the control one as a result of administrating the pre-test.

O3- Stratification of the sample subjects on two levels –students with good performances and students with bad performances for the formative stage of the experiment.

O4- Establishing the sample of contents, i.e. the selection of the teaching units which one to be used in the stage of the formative experiment.

O5- Investigation by means of the structured log and of the questionnaire written concerning the interest of students for physics.

To achieve the objectives we used a wide range of methods to collect data and of research instruments. To evaluate the initial level of knowledge, skills and abilities we built two pedagogical tests of knowledge for the teaching units Study of movement from the 9th form curriculum and for Basics in thermodynamics from the 10th form curriculum. The registered results of the two tests were also used for selection of representative sample of subjects. The observational indicators from Observation record 1, together with the results in the knowledge tests from the pre-test determined the structure according to value of experimental classes and were the basis for sample stratification of the subjects during the experimental stage on two level groups.

For the inter-subjects experimental design, out of the three 10th grade classes from the Grup Şcolar M.R. „Unirea", consists of 62 students, two classes were selected (40 students) equivalent from the point of view of the calculated statistical quantities (mean, median, mode) and with a statistical distribution of the results obtained in the pre-test almost normal. The 27 9th grade students were the unique sample for the inter-subject experimental sample. When analyzing the results obtained in the stage of the pre-test we established an equivalent distribution of the students of the three classes in the two level groups: 75% (9 A), 71% (10 A), 68% (10 B) of the students belong to the group of students with poor performances, and 37% (9 A), 29% (10 A), 32% (10 B) belonged to the level group of good performances.

The selection of the contents to be processed into software was made after studying the main curricular products (syllabuses and framework plans, alternative textbooks, AEL educational resources) for the discipline of physics in the 9th and 10th grade at a technological high-school, within the context of the extremely dynamic „educational reform".

Dynamic changes in content, in terms of their quantitative correlation with the number of hours allocated to this discipline, affected in terms of quality, the educational act. Curricula focussing from contents to competences to be developed and the lack of constraints as observing the schedules for national exams, instead operates with, to order them by their internal logic or give up some themes or concepts and practise other in different learning situations. There is no coherence and connection, not even chronologically, between concepts studied at the three strongly dependent disciplines, mathematics, physics and chemistry, the „responsability" of teaching some common concepts is transferred from one nature science to another, some mathematical concepts yet unstudied are used in science.

Poor quality of some textbooks or the complexity with others in connection to the level of the students they are meant for, the lack of applicability, causes them to become for the teacher of physics a selective source that may be ultimately given up.

All these shortcoming of the learning supports are a challenge for the teacher who is willing to design and implement curricular aids (including modern interactive didactic technologies) adapted to the level of the group of students they are addressed to. The alternative of a methodic and IT processing of the contents into educational software and their application during the physics classes are steps that can lead to the improvement of the student achievement and to the increase in interest for the study of physics.

To achieve the interactive differentiated educational software adapted to the target group of students we also made a comparison between the contents studied in physics in junior high

school from the point of view the concepts and the relationship between them and we decided on the following representative learning units from three majors areas of physics: „Rectilinear movement of the material point", „Thermodynamic processes", „The simple electric circuit". We had the option for processing these equivalent themes in terms of the connection between concepts, of their complexity, of the possibility transposing into software; as the level of abstraction of the contents is higher mathematical modelling of concepts are used, experimental slides for studying causal dependences are complicated so that the students instead of observing and measuring the phenomenon , they „observe" the complexity of the experimental scenario. Instead, the concepts learned have an interdisciplinary value being used in the study of technological disciplines with high practical applicability.

Issues persued when applying the classification scale did not receive high scores by self-observation. For less than 50% of the students the lessons approached with classical methods of instruction were considered of interest while 50% of them got actively involved in knowledge discovery. The methods and mans used were not a challenge for the students and they did not get motivated for the study of discipline. The qualitative results recorded after self-observation are also reflected at the level of the overage results in the two tests applied.

The questionnaire, applied to the 40 students from the experimental class (10 A) and the witness class (10 B) during the observant stage, revealed the following; the students do not mention physics among the first 5 preferred disciplines because „it's difficult" and they „don't understand it", but 28 students consider informatics belonging to the same area, while 6 students consider that the computer assisted instruction would help them in the study of physics - the use of informatics in the study of physics is a premise for a change of the position the physics as one of those preferred by the students. The students perceiving physics as having a high level complexity (12 out of 40 students) and they also give reasons for this and there are no scores between 1 and 4 corresponding to an accessible level.

Chapter VI, „The experiment itself" is focussed on two main coordinates: development and validation of the educational software and its application in the stage of the formative experiment,

The stages of didactical and computer design were taken into consideration and differentiated software was drafted on two level groups for three representative contents: „Rectilinear movement of the material point", (5 lessons, 7 hours of interactive instructions), „Thermodynamic process" (6 lessons, 10 hours), „The simple electric circuit" (6 lessons, 10 hours). The educational software developed for each unit are collections of web pages or

presentations which guide the student by means of links to LabVIEW interactive applications in which OLE (Object Linked and Embedded) objects are inserted, as well as multimedia elements and links to a Microsoft Access data base, in which the student can systematize the concepts learnt in physics as product of instruction. All in all there were made 5 pages of web, 13 slides, 41 LabView interactive applications, 1 MS Access data base with 13 forms and 4 reports, all of own design. Multimedia elements were included: images, animations. The computer applications enabled differentiated instruction on two level groups and these routes may be followed by each student.

One of the aspects that makes this thesis differ from others on the same subject, is the involvement of the students in developing educational software. We started from the supposition that the students may become assistants to teacher in developing and using educational software for the lessons of physics. Because, during the period of the research, the framework plan and the curricula for technological high school permitted the design of interdisciplinary and multidisciplinary optionals only in the curricular area *Technologies*, disciplines that should contribute to the development of key skills through integrated specific skills, we designed the curriculum of the discipline "Virtual lab of mathematics and physics". LabVIEW graphical programming". This discipline aims to develop competences in the field of implementing programs, with view to developing interactive educational software and therefore aims to increase the interest and the level of performance in this discipline. After developing working competences with application and programming, the students organized in heterogeneous groups, made projects - interactive applications for the lessons of mathematics and physics. Learning products were used to design interactive applications used in the experimental stage. To meet the demands of educational software, the teacher inserted sequences from the projects made by the students into the educational software used by processing and adapting them to instruction on two level groups.

The experimental validation of the educational software of own conception was a necessary condition and it was developed in two stages: in the first stage we evaluated the educational software of own conception (list of control) designed for the three units that were to make the object of investigation, and in the second stage we tested the computer applications developed (pilot experiment, interview). To analyze the educational software developed we adopted standardized check lists from the literature of speciality following two main aspects: the instructional quality and the technical quality of the software developed. The results of the

interview and of the experimental testing were used for the pedagogical and informatic „adjustment" of the designed interactive applications.

The subjects of the investigation were 67 students from Grupul Şcolar M.R. ‚Unirea". Class samples were used in which a stratification on two level groups (students with poor and students with good performances) was made.

Being the single technological high school class during the school year 2006-2007, class 9 A was applied an independent variable meeting the demands of the didactic experiment with intra-subject design based on technique of the single groups. We followed the evolution of the student behaviour during the three units for which the educational software was applied, comparing the results obtained in the stage of post-test to those in the pre-test.

In the stage of the formative experiment based on the intra-subject design, the experimental sample class 9 A was applied the independent variable: the individual differentiated instruction by means of the educational software, and for the control sample classical teaching methods were used in a frontal organization of the group of students for the unit „Thermodynamic processes". For a next unit, „The simple electric circuit", the class role was changed. The results obtained by the experimental class and by the control one in the stage of the post-test and re-test were compared to those of the pre-test. Practising the application of the independent variable in different experimental context aimed at the validation of the results obtained.

We thoroughly described the activities developed in the experimental classes and we presented the educational softs. For each computer application the following structure was observed: description, elements of teaching design (differential operational objectives /assessment targets, methods, learning activities) and elements of computer design (the user interface, source, code, interaction with the computer). The differentiated routes were properly signaled on the 3 maps software. During the interactive differentiated instruction, each student fully participated in each interactive application, completed, saved the data entered, ran the application, updated the material and then saved each file. Files saved by the students and checked by the teacher were then listed for the paper portfolio of the students.

For the post-test stage we designed and applied three pedagogical tests of knowledge, summative and normative equivalent to each other and to those applied in the pre-test in terms of the taxonomic levels reffered to, of the difficulty level, and share of different types of items. The aim of their application was to monitor the evolution of the students' results in progress and the changes in behaviour which appeared as a result of the independent variable application

during the different stages of the formative experiment to check the research hypothesis. As a specific stage of the inter-subject experimental design, the retest came to reinforce the significance of the results obtained in the post-test by the experimental classes, as a result of the introduction of the independent variable, the individual differentiated instruction by means of the educational software and to establish the degree of assimilation, consolidation operationalization of concepts during the stage of the formative experiment. The assessment instrument, the pedagogical test of knowledge, applied in the re-test stage of both equivalent parallel classes, was identical to that of post-test stage.

In chapter VII, „Analysis and interpretation of the research results", we evaluated the effect of applying the independent variable in the two experimental configurations and we validated the assumptions made.

We used the following methods of measuring the research data: counting, grouped classification, comparison. We organized the results obtained in the form of analytical and synthetic statistical tables, frequency graphics, comparison diagrams and we calculated statistic indications: central tendency/value (arithmetic mean, median, mode, variance, standard deviation, confidence limits of mean, media difference, etc).We observed the significance of the difference between means, using t test for correlated samples and for independent samples, Wilcoxon test for corelated samples and the Mann Witney test for independent samples. The statistical data, were processed using SPSS (statistical size, frequency table, histograms, tests t, test Wilcoxn and test Mann Witney) and MsExcell (statistical sizes, diagrams).

For the experiment based on the inter-subject design:

1. We compared the results obtained by the two groups of students of which one was applied the independent variable. Comparisons were made both longitudinally (post-test – pre-test and re-test – pre-test) and transversely, between classes (for the same experimental stage).
2. We analyzed the effect of interchanging the status of the two classes (from experimental class into control class and vice versa).

For the experiment based on the intra-subject design:

1. We compared the results obtained by the 27 student during the 9^{th} and 10^{th} grades in the stage of post-test to the result obtained in the pre-test, seeing how their performance was influenced by applying the independent variable.
2. We studied the longitudinal evolution of the results in the stage of the post-test.

Then we made a comparative analysis of the results obtained for the two complementary scenarios (the inter-subject experimental design and the intra-subject one).

The qualitative and quantitative observations were used to formulate final conclusions.

The bibliography and web-resources used for the elaboration of our thesis are presented in its final part together with the appendixes. Appendixes include: details of establishing the value structure of classes in different experimental stages, statistical data processed with SPSS, the instruments applied in the qualitative research methods, sequences of curricula for the 9th and 10th grades for technological high-school, the project of the learning unit which made the sample of content used in the pre-test.

FINAL CONCLUSIONS

Action-research on the „Study of the effectiveness of differentiated instruction in physics in high-school (9th and 10th grades) by means of the educational software of own design" is part of the prospective, formative and diagnostic research topic for the following reasons:

- The steps undertaken in the observant stage offer details concerning deficiencies and strength of the main curricular products, the value structure of the sample of subjects the level of forming and developing competences, the interest in physics shown by the students in the 9th and 10th grades in the junior technological high-school.

- The study aimed to measure the impact of using the educational software designed by the teacher. The methods and the instruments of the research were diversified, several types of data were collected whose values were to validate the experimental hypothesis. We introduced as an independent variable the individual electronic differentiated instruction, strategy with high formative values.

- The quantitative results, measured and interpretated statistically and the qualitative ones, give a „verdict" on the school progress of the sample of students submitted to research (the 9th and 10th grade students of the technological high-school) and offer general value guidelines for the use of the independent variable introduced.

A. Conclusions on the impact of the differentiated instruction using educational software on the school performance of the students in junior technological high-school in physics.

The progress regarding the active and interactive acquisition of knowledge and of forming and developing competences was measured by the grade obtained by the students of the experimental classes in the pedagogical tests of knowledge as a result of the individual differentiated instruction with educational software.

In the inter-subject experimental design we made both an analysis of the evolution of the experimental group during the development of the research and a comparison to the results of the control group. While, in case of the experimental classes, we registered a significant difference between means in the different stages of the post-test and pre-test respectively re-test and pre-test for the control classes, the diferences between means were insignificant. The results obtained by the experimental classes measured in the post-test and the re-test are significantly higher than those obtained by the control groups. The technique of factor rotation, applied in the inter-subject design, reinforced the experimental result of applying the differentiated instruction by means of the interactive educational software. The electronic differentiated instruction has long-lasting effects, the results in physics being influenced by the independent variable introduced, even at larger time internals from the moment of the formative application. Maintaining some acquisitions for a long period of time from the moment of applying the dependent variable demonstrates the formativ aspect of the differentiated instruction by means of the educational sofware.

The method of the intra-subject experiment, applied to the unique sample comes to verify and validate the results obtained in the inter-subject design. In this case we were able to make a longitudinal analysis of the results of the group of students. We registered a continuous upwards development of the grades obtained by the unique experimental sample along the development of the intra-subject formative experiment in which three educational items of software were applied. The difference between the means in the pedagogical tests of knowledge applied during the development of the experiment was in progress and was influenced significantly by the independent variable.

The difference between means obtained in the tests of knowledge by the experimental samples of subjects was significantly influenced by a supplementary variable, i.e. the involvement of the students in designing the software. However, the involvement in designing the educational software influenced the results as much as they were also influenced by the application of the independent variable for a longer period of time (the effect of prior acquisition was shown).

The difference in means also depends on the value structure of the initial experimental groups. But despite the initial distribution on two level groups, during the experiment positive changes appeared. The changes produced as a result of the differentiated instruction by means of the educational software regarded both a movement to the right, to the area of high marks, the curve of mark distributions, and the transition of the good students to group of high

performance. The result is the increase the share of top level group and the emergence, for each experimental group, of a new level group, that of the students with very good performances, direct proportional in number with the duration of the application of the independent variable. The students with very good performances succeed in developing competences at higher taxonomic levels (synthesis and evaluation) of the cognitive domain. The group of the very good students, newly formed, reduced if we gave up the differentiated instruction by means of the educational software but it did not disappear.

Regardless of the experimental design, the strategy of instruction used for the students in the junior high-school, has an outstanding informative and formative character. Informative because acquisition of knowledge is performed with which they operate logically and make transfers (interpretation of a graphic and determination of physical quantities specific to every physical phenomenon or system, from the graphic of causal dependence, by analogy, modelling, mathematically a causative relation, the application of knowledge in solving problems, modelling the surrounding reality by means of the learnt concepts). Formative because skills and abilities are formed (organization of experimental data, techniques of analyzing them, the algorithms of solving a physics problem, working with active software and interactive applications) and attitudes (investigate - interest for developing different ways of getting informed, electronic communication, interest and curiosity for deepening knowledge, evaluative - self evaluation of both performances and behaviour during the development of the experiment).

In any experimental scenario, the differentiated didactic instruction by means of the educational software has an outstanding active and interactive character. Each student was involved directly in the process of self-instruction and discovery of new knowledge and had the control on his own activity. The students could take the most correct decision regarding the classification of a certain group level, the lesson being adapted to the general capacities of the groups identified. Initially, the subjects of the experiment needed and asked for more guidance from the teacher and in time their approach to knowledge discovery turned into one independent from or partially dependent on the application. The time dedicated to learning was more efficiently used, less dynamic students were activated (students who had less intervention during the lessons).

B. Conclusions on the impact of the differentiated instruction by means of the educational software on the interest of the students from the experimental samples for the study of physics.

Physics, as a discipline of study was situated, as a result of the didactic experiment among the top five favourite learning subjects. The subjects of the experiment perceive a lower level of complexity and give reasons why. They appreciate the mediation of instruction by the computer and the educational software.

As participants in the didactic experiment and observants of their own output the students asserted that the interactive methods and presentation of information, the high level of interaction with the program, the immediate feedback offered when reaching each operational objective and the formative evaluation were favourable to learning and made them deepen their knowledge. The result was reflected in the high marks obtained in the pedagogical tests of knowledge in the stage of the post-test accompanied by a positive dynamics of the level groups.

The high degree of activation and involvement in the decision of the instruction route, the mode of interaction with the application were sources of increasing the interest in the study of physics.

The students felt respected, put into value and gained self-confidence because the individual instructional approach had a positive result, also confirmed because they became aware that their activity was monitored and evaluated.

The results obtained by applying the e-learning solution we propose allow us to assert that the use of the educational software for the individual differentiated instruction of the students from the technological junior high-school has a positive impact as compared to significantly the classical strategies of teaching–learning-evaluation. This determines the significant progress of the students in terms of efficiency of the activity, of active and interactive acquisition of knowledge of forming and developing competences of the students interest for the study of physics.