THE TEACHER ACTING AS MEDIATOR IN NEW TECHNOLOGIES USE: A CASE STUDY IN PHYSICS TEACHING

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ABSTRACT

Nowadays, the new technologies challenge the educational practices. When teachers face this new teaching and learning pattern they need to adopt a different attitude: of a mediator, in which one its main role is to experience and mediate processes of learning construction proportioned and encouraged by the increasing inclusion of New Communication and Information Technologies (NCTIs) at schools. This paper presents the results obtained in a research which objective was to evaluate the use of different methodologies and resources in the teaching and learning process in Physics, questioning the approaches used in the Physics teaching, their pedagogical inferences, didactic resources and the teacher's role when using these new technologies as well.

KEYWORDS

Learning process, educational softwares, Physics.

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1. INTRODUCTION

The world changes fast and constantly and school goes on with its traditional classes in disagreement with reality and necessity of students. So, according to Toffler [Toffler 1990], the society in this century turn is distinguished like the knowledge society in which the information and innovations are processed very quickly. To live in such society it is necessary to educate up date, creative and flexible people with capacity to learn how to learn.

Unfortunately, a great number of schools still live in the past [Schrum 2002]. The educational pattern is based in the transmission of knowledge, lack of resources and in a deficient formation of the teacher in which the student is conceived as a passive being without reflexive and discernment capacity. "...the professional with this ability will have few chances to survive in the knowledge society. In fact, we are creating obsolete students and professionals" [Valente 1993].

Nowadays, when teaching Physics, the pattern adopted for many teachers tend to obey to the traditional method of simple content repassing in which classes are based in chalk, blackboard and didactic book with emphasis in the Mathematics language devoid of an experimental well-founded without relation to the contents and their possible connections to every day events.

This way, this article presents a search work that had the objective of investigating, through a case study, the use of the computer and other teaching-learning Physics contents resources as well their results, their use implications concerning the students and teachers.

In section 2, we discuss the Physics teaching-learning problematic; in section 3 we present an educational software that is being developed as a help resource to this discipline; in section 4 we describe the methodology adopted in the search; in section 5 some results obtained are reported and finally, in section 6 the conclusions are presented.

2. PHYSICS DISCIPLINE

In search results published in Yager [Yager 1991] it is verified by didactic investigation that a certain number of students got disinterested with the Physics discipline (and the other sciences) along school period. Since a great number of them have difficulties with the assimilation and comprehension of the physical phenomena [Fiolhais 2002].

Maybe this fact is related to the kind of teaching presented to them where many times the concepts worked out are very far from the practice, present few or no one relation to day by day events and are short of the use of adjusted didactic resources that motivate and help learning.

According to Heineck [Heineck 1999] Physics classes with the help of experimental methods, organized and adapted provide incentive, propitiate learning and increase the expectations that students develop investigation techniques emphasized by Vygotsky like the proximal development zone [Vygotsky 1984].

Therefore in this case the experiment is considered as a tool for the concepts comprehension, principles and specific Physics laws. According to Vinchiguerra [Vinchiguerra 2001] the advantages offered by the experimental teaching enlarge the possibilities of teacher-student and student-object interaction when expecting to obtain efficiency in the teaching-learning process.

Going on, Fiolhais [Fiolhais 2002] assures that the experimentation has an important role when talking about Physics teaching, then, only through real experiments or simulations we can offer to students a unique and rich environment from the pedagogical view that help us to substitute theoretical concepts for scientific observations.

However, unfortunately, most of schools do not have or cannot acquire materials for the Physics laboratories because they have a high cost or do not offer physical space for their setting and use. They do not even make use of their didactic resources that simulate physical phenomenon and allow experimental realizations like educational softwares.

Such difficulties generally induce teachers to adopt traditional methodologies in which they simply repass the contents (using resources like blackboard, chalk and didactic books) and do not make use of methodologies in which students can test theoretical concepts resulted from the contents and, this way, to build their own learning.

Consequently, according to Vinchiguerra [Vinchiguerra 2001] Physics teaching has been done by concepts presentations, laws and formulas in a dislocated way getting very far from the real world where students and teachers live, always that favor the theory and abstraction, emphasize the use of formulas in artificial situations turning aside Mathematics language from its real meaning; persist in repeating solutions of exercises, developing a learning by automation and memorizing and not for the construction of the knowledge.

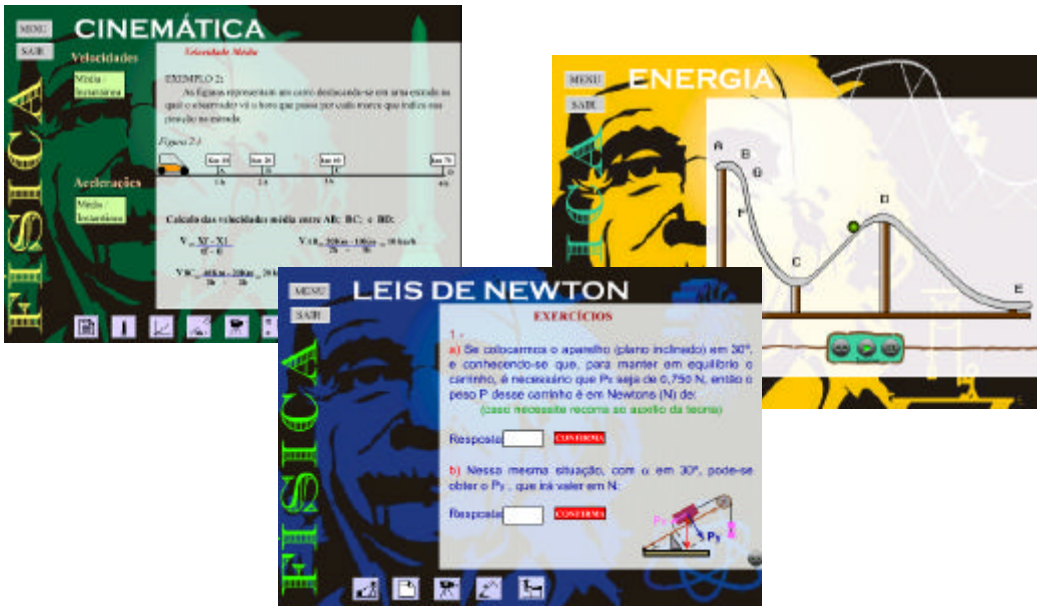
This way, the realization of experiments, the use of audiovisual resources and utilization of suitable educational softwares can, not being the unique reason for success, facilitate the teaching-learning process of the contents.

3. PHYSICS EDUCATIONAL SOFTWARE

In a way of making practicable this search the first step of this work was to develop an educational software that approached conveniently (with the real necessity and students expectations) some Physics contents.

This educational software was developed in association between the Physics and Information Technology areas and is about a multimedia application (built with flash), composed of Physics contents (based in the equipment and experiments produced in laboratory) and organized in different parts. Each module has specific conceptual explanations about the content studied; additional information related to the content (considered like knowledge requirement for the comprehension of the current content); a video with explanation that reproduce the equipment and experiment made in laboratory; an interactive experiment based in the experimentation realized in the video and content interpretation and comprehension exercises.

Following this structure, the screens presented (in picture 1) show how the modules related to Newton's Laws content, Cinematic and Energy, are organized.



Picture 1: Screens related to Newton's Laws, Cinematic and Energy

As the Physics topics that would be worked out in the software were chosen it were listed pedagogical and methodological facts that could contribute to the comprehension of these contents. Thus, for example, in Newton's Laws the objective was to develop parallel to these contents with the objective of assuring that its analysis was accessible to the student.

Then, it was necessary to have in the software some pre-requisites such as: a) trigonometric functions in which was available a trigonometric circle with its angles, senos, cossenos and quadrants (all disposed in a detached and comprehensible way in order that students can distinguish the values and its signs); b) the kinds of bigness and their definitions; c) the analysis of the vectors and its representation.

Also operations with vectors were presented matching them to the angles bigness between the vectors to obtain the resultant. On the opposite of the resultant obtaining, the decomposition of the vectors was developed for the reason that students could visualize the relations of proportion.

Through an icon (entitled video) students can study, for example, Newton's Laws theme by the experimental method, recorded in video and available in the software through the inclined plan equipment (in which the relation between angle and weight components, normal power and parallel power to the plan is presented) and by different situation that involve questions like: what can happen if the angle is enlarged? Or if change this angle, what happen to its weight? Or how remains the components that keep the body in balance on the plan?

Another resource available in all modules was the development of virtual experiments in which students can interact inferring data, making relations and realizing their concluding analysis.

Also there is available in each software module some exercises to evaluate the acquired knowledge about the worked contents. This way, students answering certain questions can know their score or rethink their answers.

Therefore, in the current phase of development of this educational software it is tried to provide students a considerable quantity of knowledge and necessary resources in order they understand Newton's Laws theme, Cinematic and Energy. Consequently, it is expected to be supplying schools with one more didactic resource to the Physics teaching-learning contents with the use of experimental methods.

4. APPLIED METHODOLOGY IN THE SEARCH

Essentially, this work had the objective of verifying through evaluation applied to students and teachers the proceeding results from a traditional teaching (only making use of resources like didactic books, blackboard, chalk and theory) and of a kind of teaching that makes use of an educational software (multimedia in cd-room, with inferences of students and teachers in the results to be obtained.

Questioning the methodologies and resources used in the Physics teaching and its pedagogical inferences it was taken as a study subject a teacher of the Physics discipline in a target-school as well as, students of three groups in the same grade of the aforesaid institution.

This search was not only to get quantitative data because they are insufficient to reach the essential that is how teachers see their formation and how it interferes in their pedagogical practice. Then it was proposed to accomplish a study centered in the teaching practice in a qualitative approach that "goes back over to non frequencial indicators susceptible of allowing inferences"[Ludke 1986].

So, the search activities realized at the target-school occurred in the following way and under such conditions:

1) The search target was three groups of high school in the same grade and in the same institution.
2) In group A, the teacher of physics discipline taught the content making use of only traditional methodology (blackboard, chalk, bookish and theorization);

3) At the same, the same teacher of Physics taught in group B the same content but using the educational software with her students (however, without mediating its use);
4) At the same time, the same teacher of Physics taught in group C the same content making use of the educational software (but mediating its use).
5) After the three groups have worked the same content, with the same teacher but making use of different methodologies and didactic resources, the data collect with the Physics teacher and students from three groups was accomplished;
6) Terminated the data collect with the teacher and the three groups of the target-school the analysis of the content of such information was made.

The instruments of the data collect were characterized for contain 10 guided questions that had the objective of collecting information about the following categories (see table 1): the use of the didactic resources adopted in classroom, the comprehension of the taught content, the influence of different methodologies adopted about the same theme by the teacher and the relation to the Physics contents with the daily routine.

Table 1 – Categories

Category	Items to be questioned
Didactic resources adopted by Physics discipline	-Needed resources to the improvement of the Physics teaching -Suggestions of the didactic resources to the improvement of the teaching of this discipline -Relevant facts of the didactic resource adopted -The importance of the use of didactic resources to the Physics discipline
Physics teaching developed and its comprehension	-Assimilation of the treated theme in the Physics discipline -Suggestions to a better comprehension of the treated subjects in the Physics discipline
Adopted methodology	-Help that the used resources provide -Which suggestions can be pointed to the next Physics theme -Necessity of searching for help as pre-requisite to the faced problems
Relation of the Physics contents to the quotidian	-The way of development of the discipline and its relations to the students quotidian

5. RESULTS

As this research had the objective of collecting information about 4 (four) distinguished aspects: 1) the use of didactic resources adopted in the classroom, 2) worked content comprehension, 3) the influence of different methodologies adopted about the same theme by the same teacher and 4) the relations to the Physics contents to the quotidian; many data and results were obtained (which ones are published in [Valiati 2001] [Valiati 2002] [Heineck 2002]).

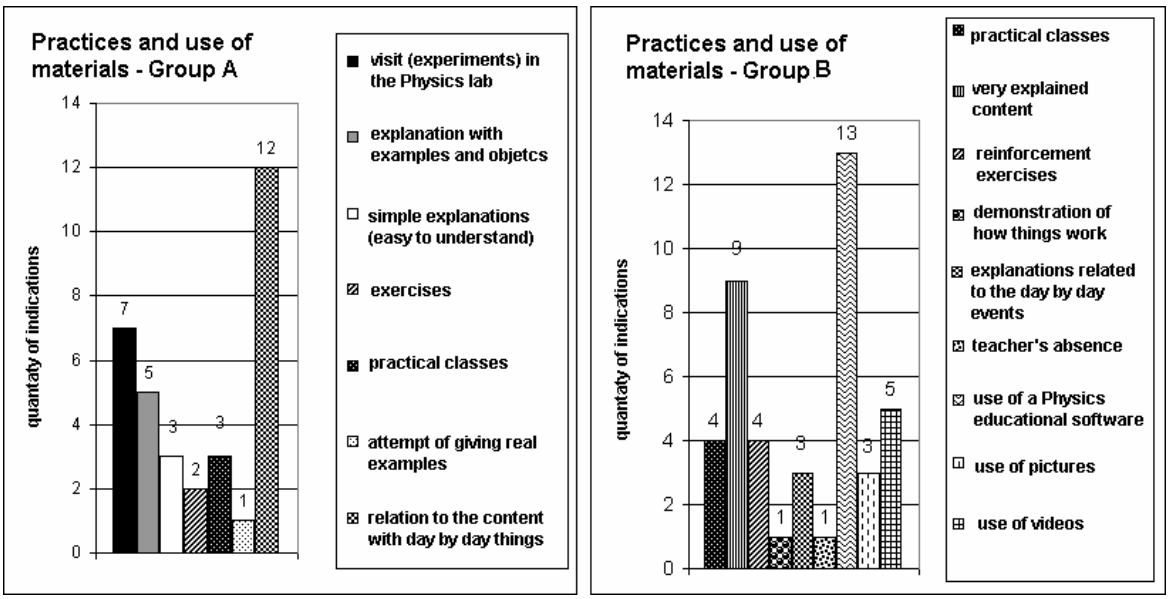
Among several collected data in this article is presented a synthesis of the obtained results related to the use of didactic resources and adopted methodology in the classroom through the analysis of the following questions asked to students during the search:

Analyzing data related to question 2 "*Which relevant facts utilized in the Physics discipline called your attention the most during the development of the classes that treated about Newton's Laws (or Cinematic) contents?"*, according to graphics of pictures 2 and 3 we can notice that:

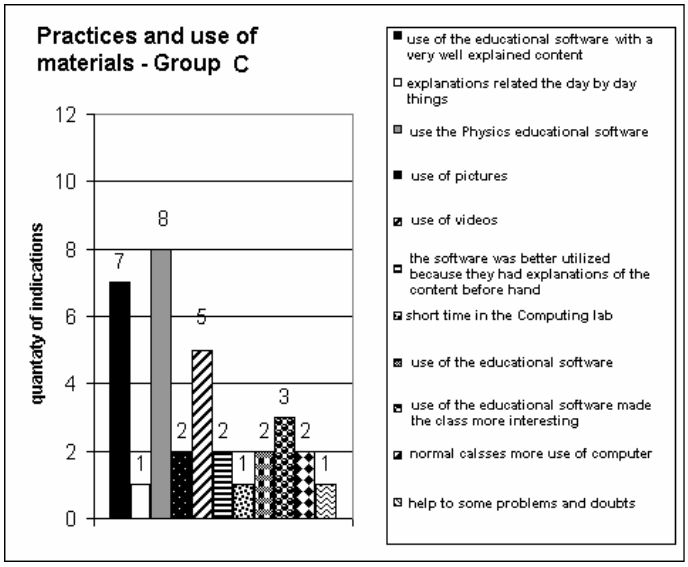
- Facts mentioned by all students were related to a unique category: practice and use of materials;
- In group A, most of students answered this question expressing how positive were the teacher efforts in order to make the content taught more pleasant in words like: "with practical classes it is easier to get the content", "the classes developed were practical, this way they were better assimilated", "with such different classes, we learn more...", "the way the content was presented

and explained". Given a great distinction to the movement to the Physics lab and the excellent explanations by the teacher with examples and relating the content to the quotidian.

- In group B, the most expressive facts were the use of the educational software (with a rich and very well explained content, with examples related to the quotidian) as well as video, pictures, exercises and different ways of interaction. However, some students (6) described their difficulty in getting the content meaning through the software reporting the following: "difficulty of comprehension. In spit of being a very important content", "the difficulty of comprehension", "...we should vary going to the lab and in the classroom", "...the classes were very demanding, we had to solve problems without explanation", "the difficulty of comprehension...we had to be alert to the details", "very complicated dialect";
- in group C, just like in group B, most of students mentioned as the most expressive fact the use of the educational Physics software saying that it presented the content in a very explained way (with pictures, graphics, videos, formulas, etc.) making the class much more interesting, so they could better understand the subject. It is also opportune to point out some students' account where they relate the important fact that the teacher tried to use the software mediating its use: "the software was better utilized because we had preview explanations of the content"; once this was the main objective of the experience in applying and evaluating the use of this educational software in group C;
- it can notice through the group A accounts and answers of other questions that the Physics teacher (along this search) tried to make the classes in group A more interesting and practical, ignoring the routine of her practice maybe due to the influence of the methodology that she was applying in group B;
- concerning group B reports it can notice the difficulty of the content comprehension (even with the software use) expressed through the words like dialect, comprehension, to solve...what induced us and go on inducing us to the necessity of experiencing the applicability of other methodologies (like the use of a mixed methodology of resources and strategies) through the application and evaluation of the use the software in group C (in which it was requested to the teacher that she tried to utilize the software mediating the process. In other words, that she did not teach the content only through the software but that the teacher utilized it with other resources and strategies mediated the teaching-learning process), since the content itself is kind of difficult, specially when there is no the teacher interference in the use of this technique.



Picture 2: Question 2 - mentioned facts by groups A and B

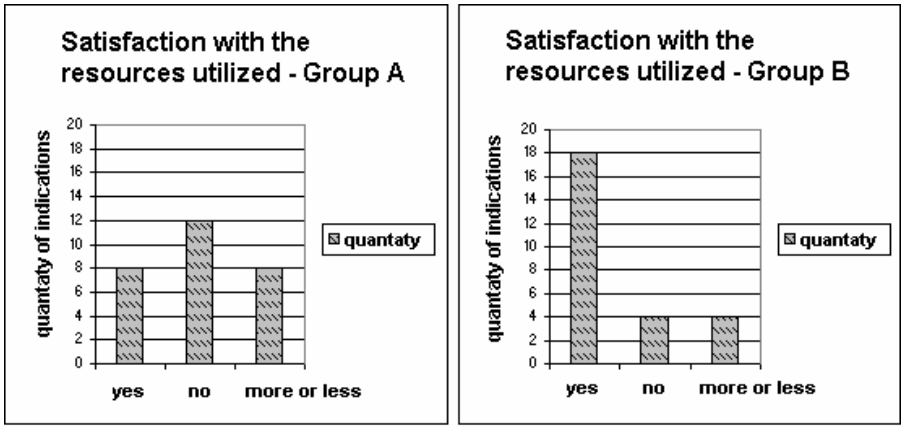


Picture 3: Question 2 – mentioned facts by group C

Analyzing data related to question 6 *"Did the resources used to the development of the Physics discipline in classes about Newton's Laws (or Cinematic) please you? Why?"*, according to graphics of pictures 4,5,6,7,8 and 9 it can notice that:

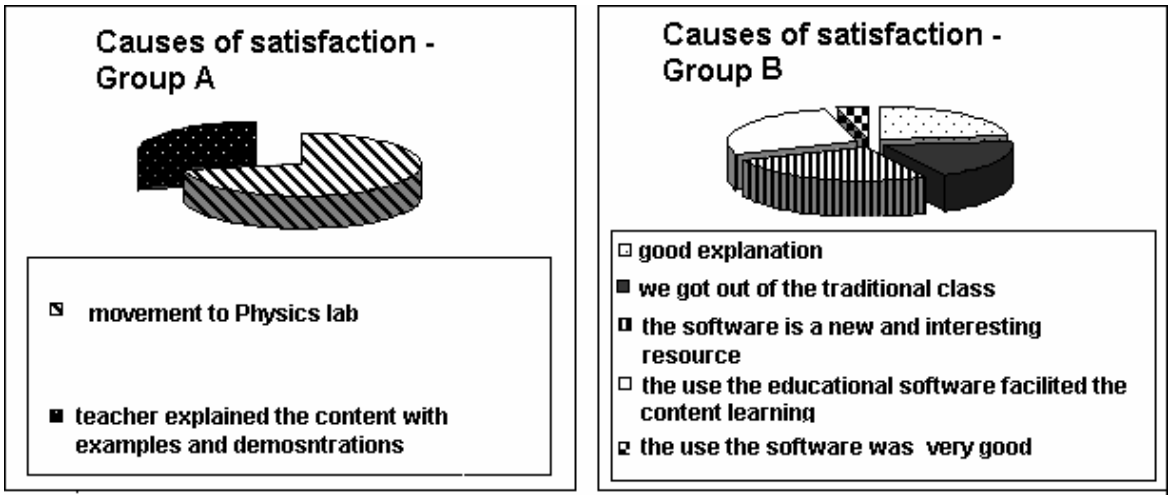
- the categories inferred through the material exploration were: satisfaction with the utilized resources, reasons of the resources that pleased and reasons of they did not.
- in group A for 44% of the students the resources did not please, for 28% of them pleased more or less and to the other 28% the resources pleased them completely. In group B these content tables were very different, for 70% of the students the resources pleased them completely, for 15% of them more or less and for the other 15% the resources did not please. This reflects, considerable, the good approval in the use of the educational software concerning students of group B. This also can be observed in group C, where the resources used pleased 80% of students, more or less 17% of them and did not please only 1%.
- in relation to the reasons of the resources had pleased in group A students related the movement to the Physics lab and the way the teacher conducted the content explanation, with explanations, examples and demonstrations. In group B the reports were divided among the following opinions: the educational software is a new and interesting resource, it facilitated us to learn, the resource offered a good explanation of the content then it was possible get out of traditional classes; basically the same accounts can be observed in group C;
- in relation to the reasons of the resources had not pleased, in group A students got divided among several opinions: monotonous classes, lack of practical classes, it is necessary to utilize other resources, it is necessary to utilize both, the Computing and Physics lab. In group B among the causes of the resources had not pleased are: lack of intervention (help) of the teacher and the educational software (for some students) seemed to be of difficult assimilation. In group C the use of the resources did not please 1% of the students due to the short time they had to utilize the software and lack of better explanations.
- it can conclude, taking into consideration the answer of this question that students in group A were not satisfied with the resources utilized in this discipline, reporting in general (not only referring to the classes about Newton's Laws) the reasons for this non acceptation, as well as, showing through their answers the good acceptation of the movement to the Physics lab during the classes that treated about Newton's Laws. In relation to group B, it can notice that the excellent approval of students in the use of the educational software expressed in different ways, as well as, the wish of counting with the help and teacher intervention during the use of this resource. This confirm

and justify the results obtained in group C, in which 80% of the students got satisfied with the use the educational software as a didactic resource only emphasizing like negative facts the teacher's lack of devotion and explanation.

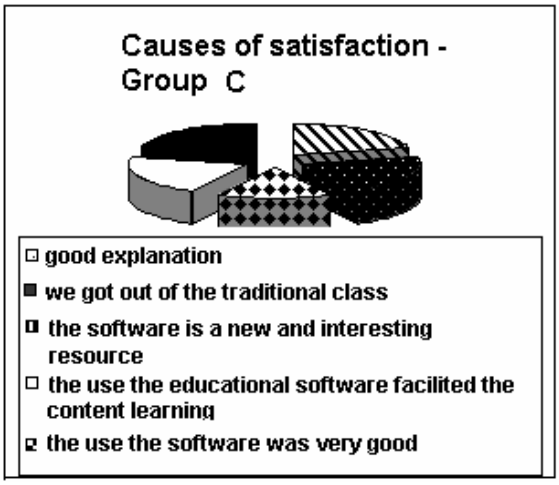


Picture 4: Question 6 – Levels of satisfaction with the utilized resources in Group A and B

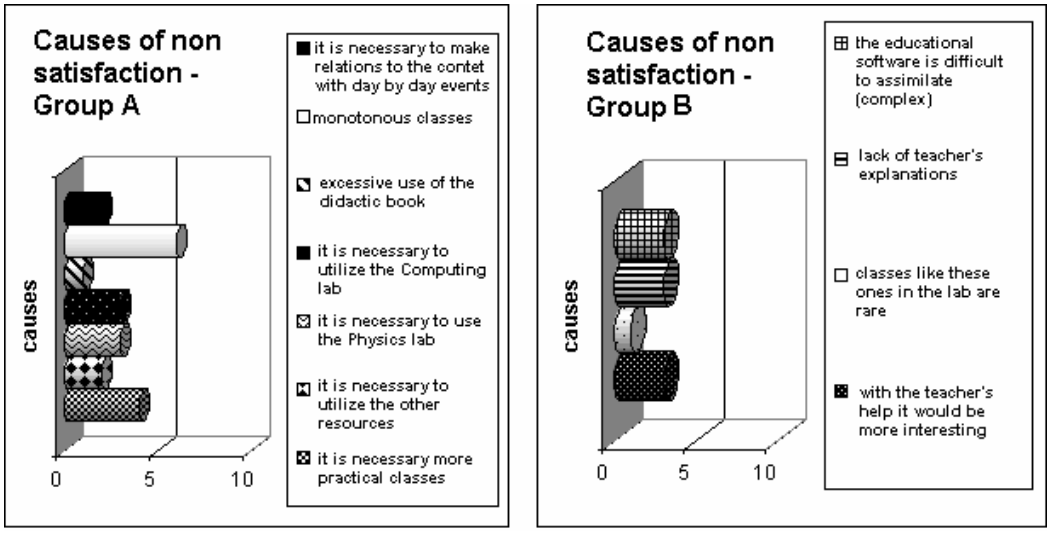
Picture 5: Question 6 – Levels of satisfaction with the utilized resources in Group C



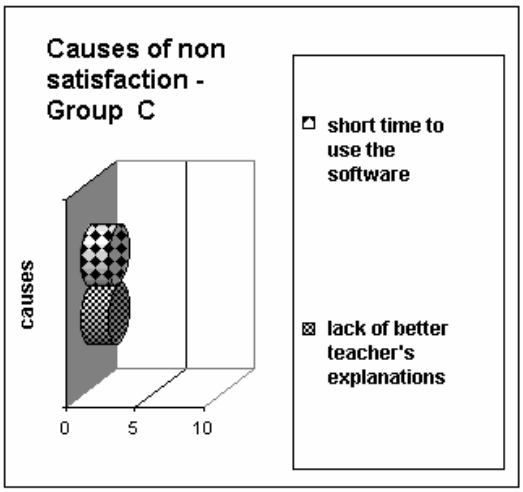
Picture 6: Question 6 – causes of the resources had pleased groups A and B



Picture 7: Question 6 – causes of the resources had pleased group C



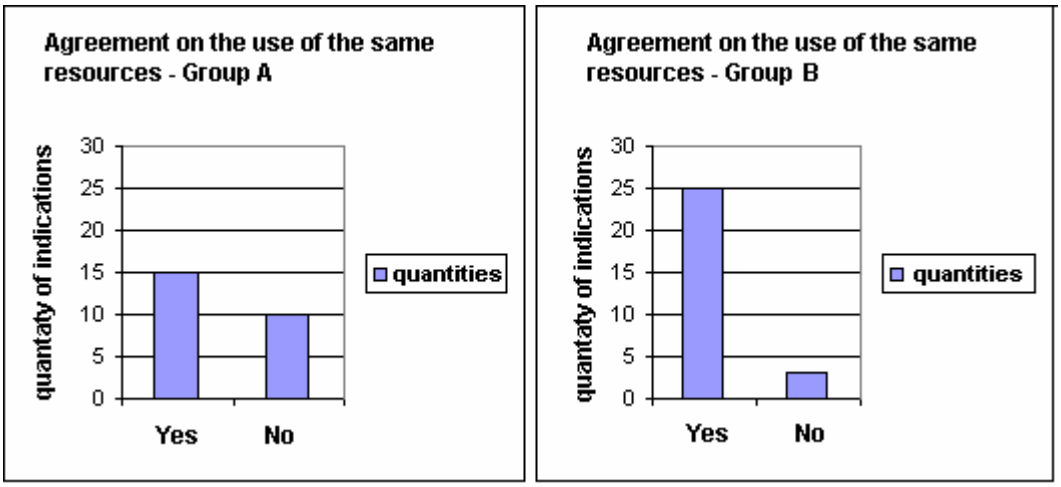
Picture 8: Question 6 – causes of the resources had not pleased in groups A and B



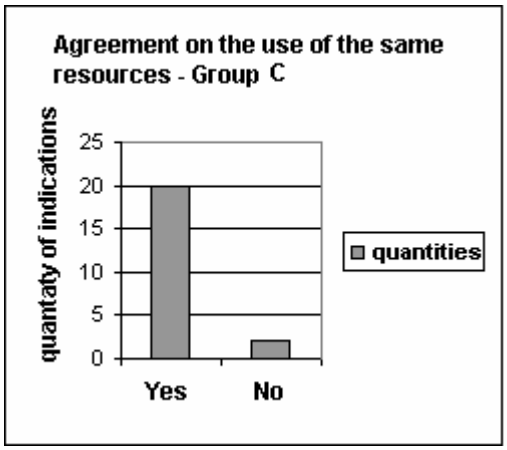
Picture 9: Question 6 – causes of the resources had not pleased in group C

Analyzing data related to question 7 *"Do you suggest that the next Physics classes be developed this way? Which suggestion could give?"*, according to the graphics of pictures 10,11,12 and 13, it can notice that:

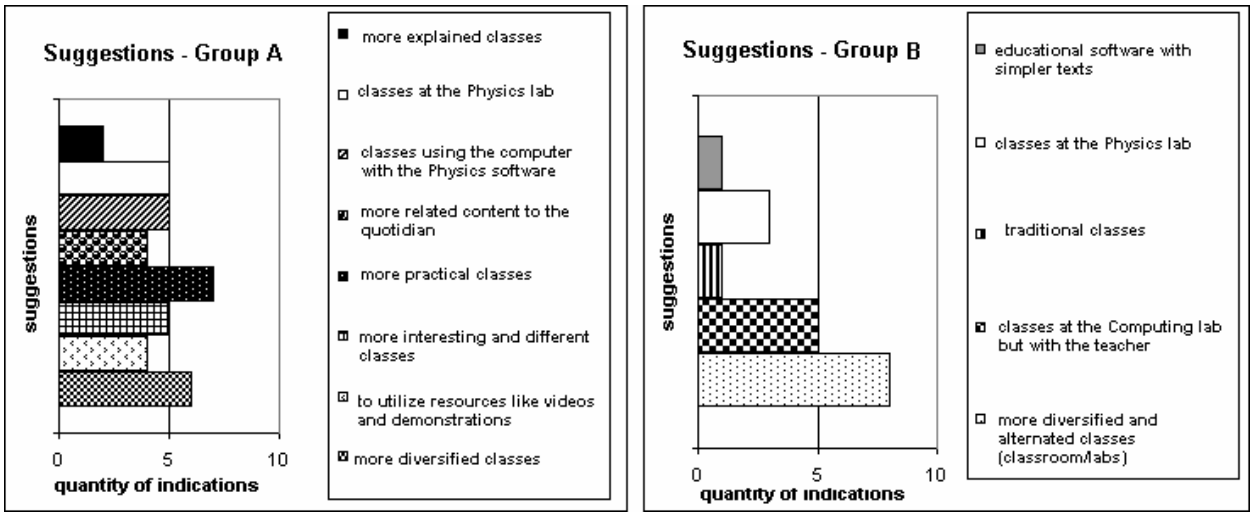
- as expected, answers related to question 7 originated two categories: level of agreement in the use of the same resources and suggestions;
- with relation to the level of agreement in the use of the same resources, in group A 60% of the students answered that they would like that the next Physics classes were developed in the same way and 40% answered that they do not suggest they go on developing this way. In group B 90% of the students expressed that they would like the next classes were developed in the same way and only 10% answered that they did not. Similar results obtained in group C, in which 91% of students expressed that they would like that the next classes were developed in the same way and only 9% answered that they did not.
- we can verify, then, that in group B and C there was a significant index of acceptation of the used methodology (Physics educational software resource) by most of students, expressed by the intention that next classes also be developed in the same manner.
- in group A the most pointed out suggestions were more practical, diversified, interesting classes, utilizing the labs (Computing and Physics); in group B the most relevant suggestions were diversified and alternated classes (in the classroom/labs), classes in the Computing lab (but with the teacher interference) and classes at the Physics lab. In group C, the students suggested more explanations and dedication concerning the teacher performance, more interesting and different classes, as well as, diversified and alternated (between classroom and the use of Physics and Computing labs).



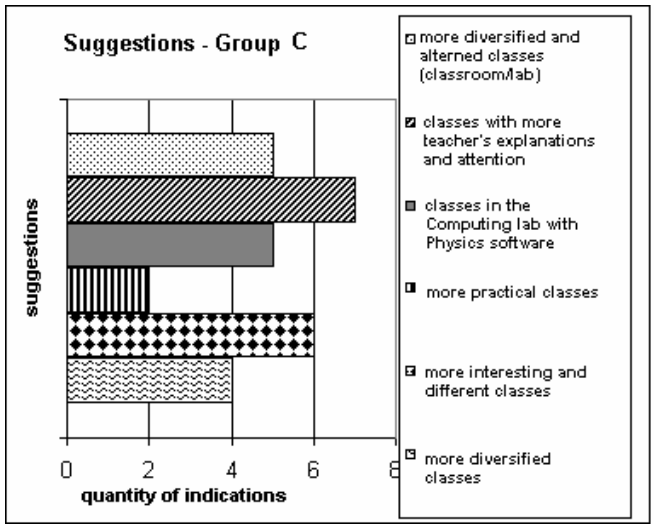
Picture 10: Question 7 – levels of agreement on the use of the same resources presented by Groups A and B



Picture 11: Question 7 – levels of agreement on the use of the same resources presented by Group C



Picture 12: Question 7 – suggestions given by students of groups A and B



Picture 13: Question 7 – suggestions given by Group C

6. CONCLUSIONS

Among several results obtained, the most significant ones through this search are the following:

1) most students, of the three investigated groups, were unmotivated concerning Physics discipline with relation to the methodology and resources utilized in classroom;
2) the teacher conducted the classes, in general, with many theoretical explanations and formulas, little practice and utilization of experiments, demonstrating a very strong dependence of methods and traditional didactic resources (didactic book, blackboard, chalk);
3) These indicators, above mentioned, certainly are not the reality only in relation to the Physics discipline, but it a question of a more extensive problematic that involve the teaching- learning process of many other areas of knowledge in the teaching network, that for its turn it is seen in a more accentuated way in public schools;
4) Punctually, in group A, it clearly noticed that the teacher influenced by the classes in groups B and C or worried with the search result about her practice in three groups, tried during the development of this content to improve her performance in class, explaining better the content (with examples that allowed students made its relation to the quotidian) and utilizing experiments in classroom and Physics lab. This, in a certain way permit us to verify that this experience made the teacher, at least, rethink her practice;

5) Although, specifically analyzing groups B and C that have utilized the software in a more effective way, to the teaching of Newton's Laws and Cinematic, respectively, it noticed that:
   - there were more motivation and interest, concerning all students, in learning these contents;
   - in group B, some students could assimilate the content very well and others presented learning difficulties using the educational software without the teacher mediation.
   - in group C, most of students assimilated the content very well, utilizing the software with the teacher mediation;
   - a considerable number of students, from the three groups, draw to the utilization of a hybrid approach (of methodologies, resources and laboratories), coming up again indicators to that these questions (among others) be investigated.

Based in these conclusions is fundamental to recognize that the current teaching has not been consonant to the real necessities of the society where we live in and that, therefore, it is not sufficient to modernize a saturated teaching paradigm. It is necessary and urgent, to transform the educational standard in order to the knowing and performing process be stimulating, challenging and suitable to the present-day world. And the computer can contribute to set up this new paradigm [Schrum 2002].

The inclusion of new technologies in schools does not discard the teacher presence but implicate the necessity of a new attitude and in the appropriation of new abilities concerning the educator.

So, it is necessary not only to modernize schools or equip them with all the resources available, but rethink the knowledge dynamics in a broad way and, consequently, the new teacher's role like a mediator of this process. Mainly, taking into consideration that the results of this search were obtained in a school where there was not deprivation physical resources appropriate to the development of the discipline in question.

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