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STUDYING ADVANCED SCIENCE CONCEPTS USING CONSTRUCTIVIST STRATEGIES IN MIDDLE AND HIGH SCHOOL*

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Abstract. Technological development based on new results of researchers in the fields of science we are exposed every day is a real challenge for all the people, especially for middle and high school students. Everybody wants to have an up-to-date device and to use it properly, but sometimes will be very hard to understand how it works. This is why students in middle and high schools need to study advanced science concepts at school such as: nanoscinces, advanced materials, magnetorezistive materials. In the context of the reform in educational system there are a lot of opportunities to involve students in formal and non-formal activities in the field of science. New instruction strategies are needed as the teachers make the course easy to follow by his students, involving them in the study such as constructivist ones.

Key words: constructivism, advanced materials, nanoscinces, magnetorezistive materials, reform in education.

1. INTRODUCTION

The future development of European science education lately, generates concern about prospective research domain in science discipline in next years [1]. More and more countries are worried about the decreasing of science learning students or those who choose a career in scientific research whereas became more and more evident the importance and economic utility of science knowledge [2].

Investigations on students' attitude regard studying science shows that the interest for science is greater in primary classes [3].

It has to attach becoming importance to the knowledge acquired by our students during science classes, but also to their feelings about these classes [4] or about how do they fell at the end of science classes [5].

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Studies developed to point out students' attitude toward science led to contradictory results: some authors shows that students' interest in science is increasing with their grade level [6], others assert reverse: their interest for studying these disciplines tended to decline while grade level increased [7, 8].

An explanation is the natural curiosity of the children for everything is new, for scientific investigation and hand on activities. As they grow up in science learning, students have to memories new terms and theoretical concepts in the detriment of experimental investigation, which decrease their interest for the study of science.

Students' interest in scientific contents to approach is based on their perceptions and expectations connected with the real life. Science teachers are recommended to exceed the resistance of traditional education and to get over misconceptions in science teaching by using constructivist strategies [9].

More laboratory activities don't lead to a deeper understanding of phenomena without teachers expound for students [10].

Organizing processes are important to build knowledge concepts networks [11].

Teachers can sustain students during organizing processes using specific techniques such as cognitive maps or conceptual maps allowing following the evolution in knowledge network making [12, 13, 14, 15].

Researchers showed that students already have anchored in their mind different concepts regarding objects and events at the entrance in a science formal background, coming from their personal experiences, previous discussions with their teachers or forgoing access to sources of documentation [16].

Some authors reveal that using internet and informatics tools lead to a better understanding of scientific concepts particularly when teacher has to teach advanced science concepts [17].

When students are involved in a new learning context, starts up a motivation for study together with previous experience in the same context [18, 19, 20].

When students' feels interested in participating to educational web activities, they are involving actively in learning science concepts. Teachers may use particular instruments: educational software [21], virtual experiments [22], and informatics tools [23, 24, 25].

Advanced science concepts can be approached in to an interdisciplinary context [26] or during non-formal activities [27].

With a view to ascertain the opportunity of studying of advanced science concepts using constructivist strategies in middle and high school we deployed a study using an enquiry questionnaire. Projecting our investigation we considered all the sequences described in literature [28, 29, 30] defining the problem, establishing the aim of the research, identifying the objectives, framing the hypotheses, analyzing and interpretation of results.

1.1. IDENTIFYING THE PROBLEM

Starting with an over 25 years of experience in middle and high school, from the experience in educational projects and programmers', we ascertain a high level of interest of low grades students towards advanced science concepts, particularly connected with explaining some physical processes and phenomena in using devices in commodity market, but also related to watching some science documentaries in media.

The new law in education offers a lot of opportunities for science activities according to students' interests and the possibility to adapt advanced science concepts to students' peculiarities of age and understanding, during optional classes from curriculum at school's decision, educational non-formal educational projects or during the 25% from the amount of classes at teacher's disposal [31]. For this end, teacher can use cognitive-constructivist instruments and/or informatics tools to offer examples in the field of interested domains identified to student's target teaching group.

2. THE AIM, OBJECTIVES AND HYPOTHESIS OF THE INVESTIGATION

The aim was established staring with the problem identified and consists of determining students' level of interest for studying advances science concepts and for the favorite strategies to be used to approach these concepts [32].

The Objectives of the investigation consists of establishing the opportunity to introduce advances science concepts in middle and high school. We was interested to find out to what degree students in middle and high school desire their teachers to adapt advanced science concepts to their peculiarities of age and understanding in constructivist approach, using cognitive constructivist informatics tools. We considered their grade level: middle or high school and high school profiles.

Hypothesis:

1. There is interest for studying advances science concepts adapted to their peculiarities of students; age and understanding, because in school these concepts are not approached.
2. Advances science concepts must be studied at physics
3. For a better understanding of advances science concepts, teachers should use constructivist strategies and cognitive constructivist informatics tools.

The lot of subjects. There were questioned students from grades VI–XII from two middle schools and two high schools in Bucharest, during school year 2011–2012, first semester. The sampling is a logical one. The selection of the sample's components was based on the rule that the members of the sample must be students in grades VI–XII studying physics. We chosen students from high

school real profile: mathematics-informatics and natural science because is supposed to these students have an availability for studying sciences.

Table 1

Introducing the lot of subjects and the number of participants to the investigation

Middle School *Grades VI-VIII*	School A	89 students
	School B	132 students
Amount of students in Middle School	221 students	
High School *Grades IX-XII*	Mathematics-Informatics	112 students
	Natural Sciences	109 students
Amount of students in High School	221 students	
Amount of students in sample	442 students	

Investigation technique. We choose to use indirect inquiry based on questionnaire. The instrument of research used was fills out by the subjects. The questionnaire has 7 items.

Analyzing statistic data. The first question refers to the areas of interest from advanced science concepts students from grades VI–XII may be interested in.

As Fig. 1 shows, more of 50% from students prefer the study of magnetic data recording and nanotechnologies, over 40% want to study about advances materials and only 7% are not interested.

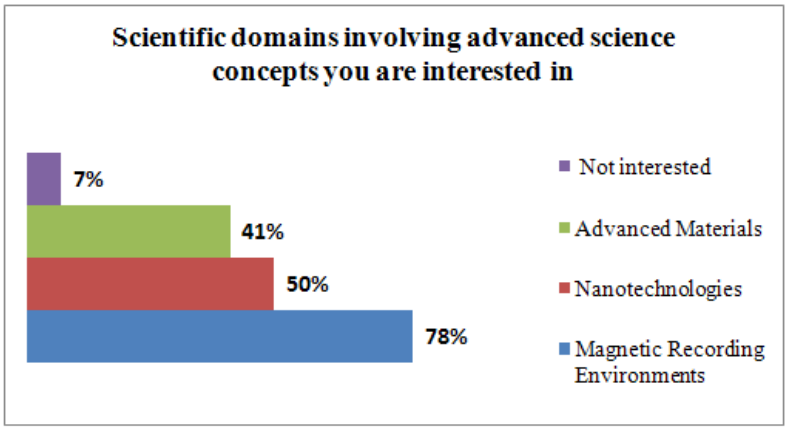

Fig. 1 – The areas of interest from advanced science concepts.
The colored versions could be accessed at http://www.infim.ro/rrp/.

The percent of the students asserting that they learn at school advanced science concepts is under 20% as it is pointed out in Fig. 2, whereas about 50% of them consider that in school receive insufficient information's about this subject. In middle and high school there are sporadic preoccupations on this problem, discussion with students being presented only during extracurricular activities like educational projects as Nanoyou [33].

Having an eye to the evolution of education in the field of nanotechnologies in advanced countries it is necessary to change the scientific education for the students.

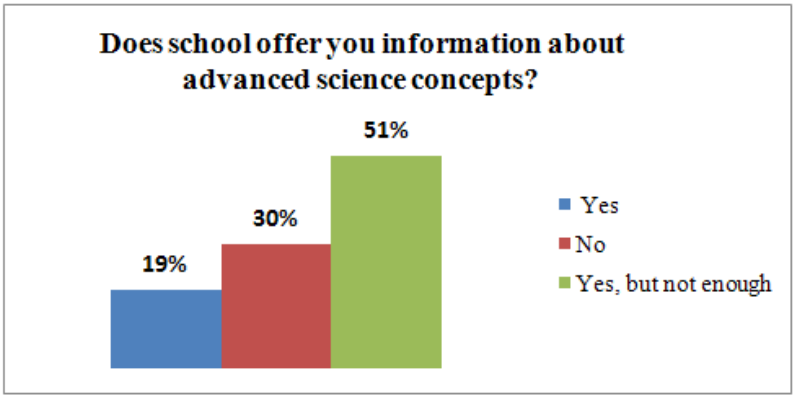

Fig. 2 – The percentage of students having information from school about advanced science concepts. The colored versions could be accessed at http://www.infim.ro/rrp/.

To the question: Do you want your teacher to adapt advances science concepts your peculiarities of age and understanding? More than 90% of students declare they want to study in school advanced science concepts as it is shown in Fig. 3. This is explicable due to students' access to information sources outside the classroom such as Discovery School a Ministry of Education Program for students [34], virtual educational programs [35, 36, 37] offering students the opportunity to find out news from science before these concepts are approached in school.

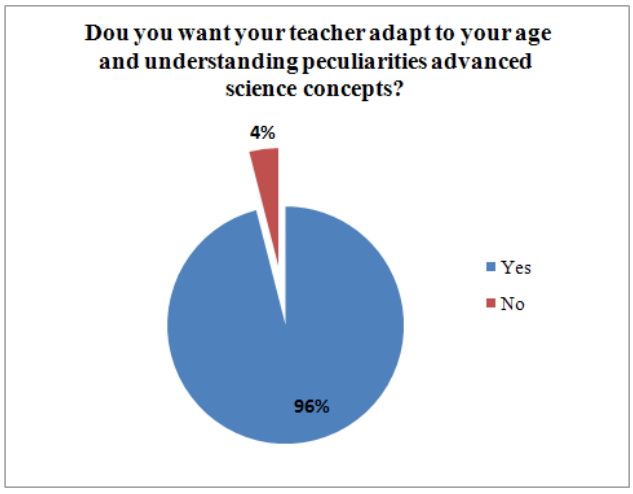

Fig. 3 – Students' grade of availability for the study of advanced science concepts. The colored versions could be accessed at http://www.infim.ro/rrp/.

Figure 4 obviously reflect that over 90% from middle and high school students want their teachers to adapt advanced science concepts to their age and understanding peculiarities. This can be explained because in middle and high school science is historically approached. Advanced science concepts having a large using in technique are partial approached only in real high school profile, according to national curriculum. Middle school students reach these concepts insomuch as their teacher offers them examples connected to reality during science lessons.

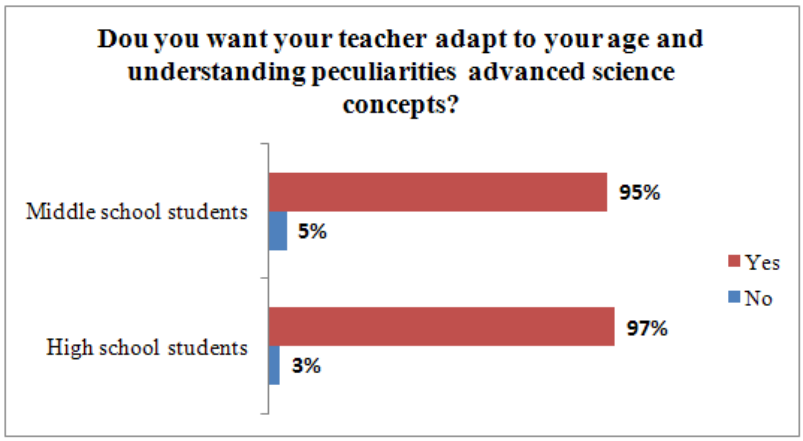

Fig. 4 – Comparing middle and high school options that teachers have to adapt advances science concepts to their peculiarities of age and understanding. The colored versions could be accessed at http://www.infim.ro/rrp/.

Students want to study advanced science concepts in proportion of over 50%; only 25% of them consider opportune do acquire these knowledge in high school, as it is illustrated in Fig. 5. This fact is explained by the interest of students between 11 and 15 years attending middle school are more curious and more interested of science, particularly in physics. But then, it has to be mentioned the great number of informational sources in virtual environment addressed exactly to this target and also formal and non-formal educational projects in schools.

The fact that 7% from students prefer to study in primary classes advance science concepts is explained by their participating to European programs, allowing low aged students to familiarize with science basic concepts [38, 39, 40].

The percent of 25% from those who estimate as being opportune to study advanced science concepts in high school is justified by the fact that students aged to15 to 19 years old attending high school are more mature and have a solid base knowledge allowing them to approach science interdisciplinary.

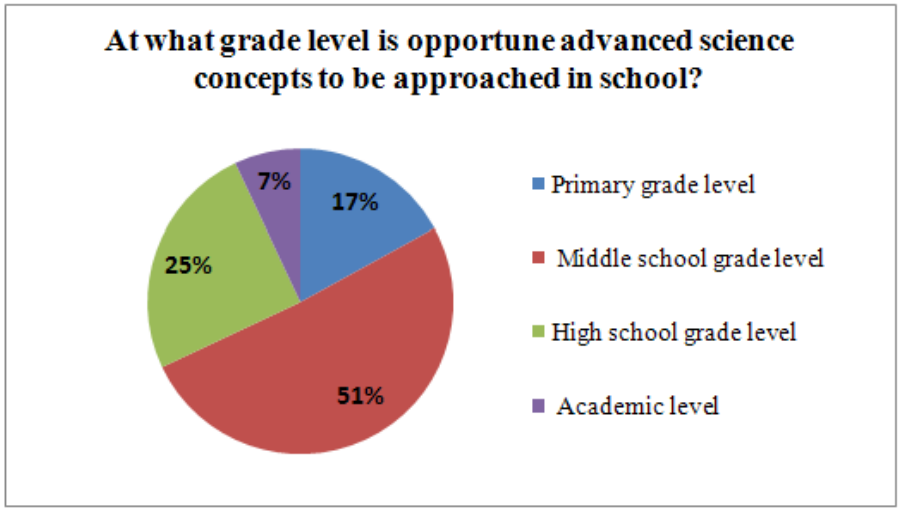

Fig. 5 – The grade level students' estimate there is opportune to approach advanced science concepts. The colored versions could be accessed at http://www.infim.ro/rrp/.

Over 15% of those who answered indicate that University is the best place to study advanced science concepts, what is happening nowadays. Romanian academic scientific and technical education is internationally recognized as being benchmarked (Fig. 6).

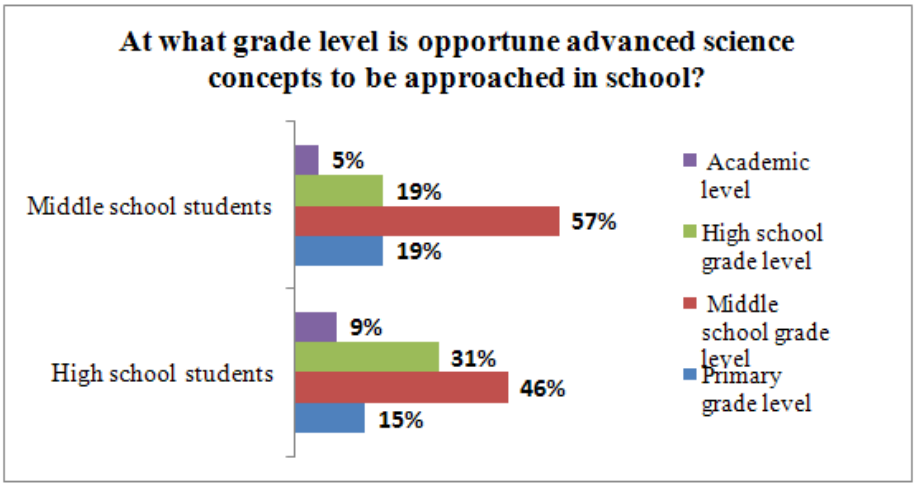

Fig. 6 – The grade level student's advanced science concepts should be approached viewed by middle and high school students. The colored versions could be accessed at http://www.infim.ro/rrp/.

Students attending mathematics-informatics profile high school, asserts in proportion of about 60%, that in middle school is desirable to approach advanced science concepts, regard their mates from natural science high school profile, considering in proportion of 50% , high school is opportunely to approach them as it is shown in Fig. 7.

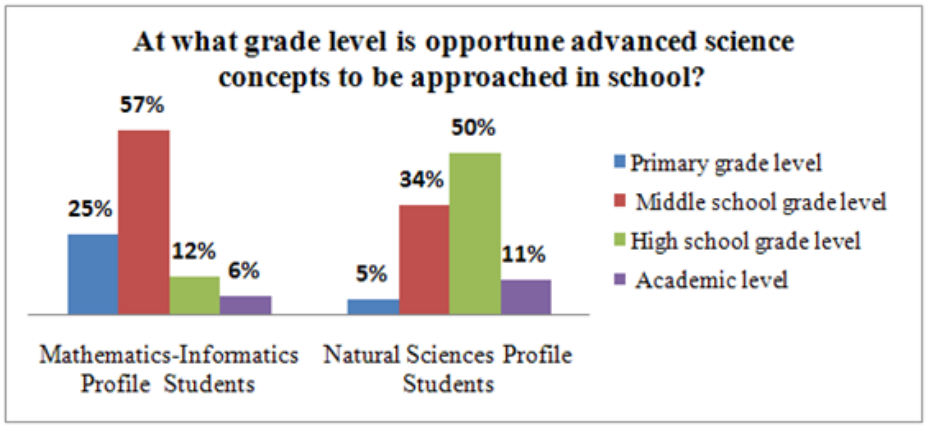

Fig. 7 – Comparison between Mathematical-Informatics and Natural Sciences High School students' opinions regarding grade level should be approached advances science concepts. The colored versions could be accessed at http://www.infim.ro/rrp/.

Students from Mathematical-Informatics high school profile are interested in the study of mathematics and natural sciences since they attended primary classes, as 25% from them assessed.

The study of physics is tidily connected with mathematics, having a large practicability in techniques, using informatics as students used to logically thinking, hands on activities, calculation skills, since primary classes, prefer to find out answers to questions regarding advanced science concepts from low grade levels.

Students from Natural Science high school profile usually obtained in middle school low results than their mates from Mathematics-Informatics high school profile, being nevertheless interested in the study of science. More than 30% of them say that middle school is desired to study advanced science, and about 20% of them declare that academic educational level is more recommended.

More than 50% from students asses that physics is the most indicated discipline in condition to explain advanced science concepts practicable in techniques, whereas about 44% of them prefer interdisciplinary approach, as it is illustrated in Fig. 8.

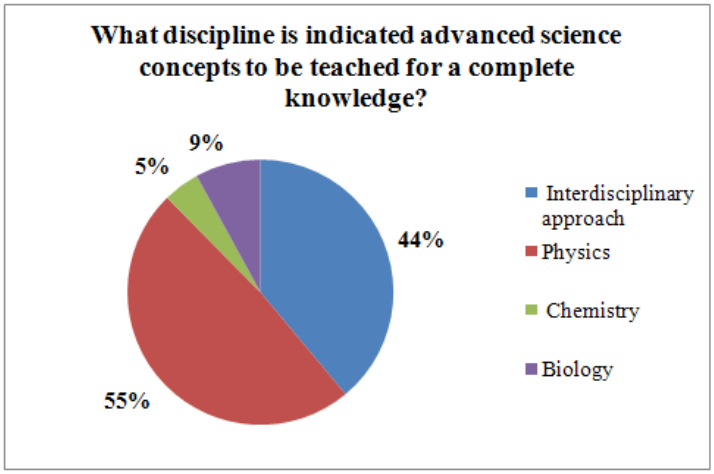

Fig. 8 – The discipline advanced science concepts should be approached. The colored versions could be accessed at http://www.infim.ro/rrp/.

Students from middle school as their mates from high school asses in proportion of more than 50% that physics is the discipline able to answer questions regarding advanced science concepts, about 30% prefer interdisciplinary approach and biology is named by over 10% from middle school students, because they begin studying this discipline starting to V-grade, biology being more familiar than chemistry as it is shown in Fig. 9.

For all of that there are not significant differences between middle school and high school students' answers, in both instances physics is named being the discipline bounded to explain advances science concepts used more and more in hi- tech.

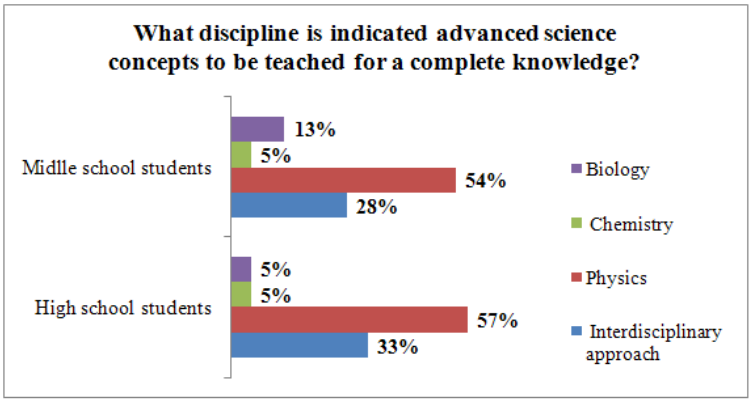

Fig. 9 – Comparing middle and high school students' opinions regarding the discipline should be bounded to approach advanced science concepts. The colored versions could be accessed at http://www.infim.ro/rrp/.

Students from mathematics-informatics high school profile are of opinion that advanced science concept teaching should be or at physics or interdisciplinary in the proportion or about 45%, while their mates from natural sciences high school profile indicate physics in the proportion of 65% as it is illustrated in Fig. 10.

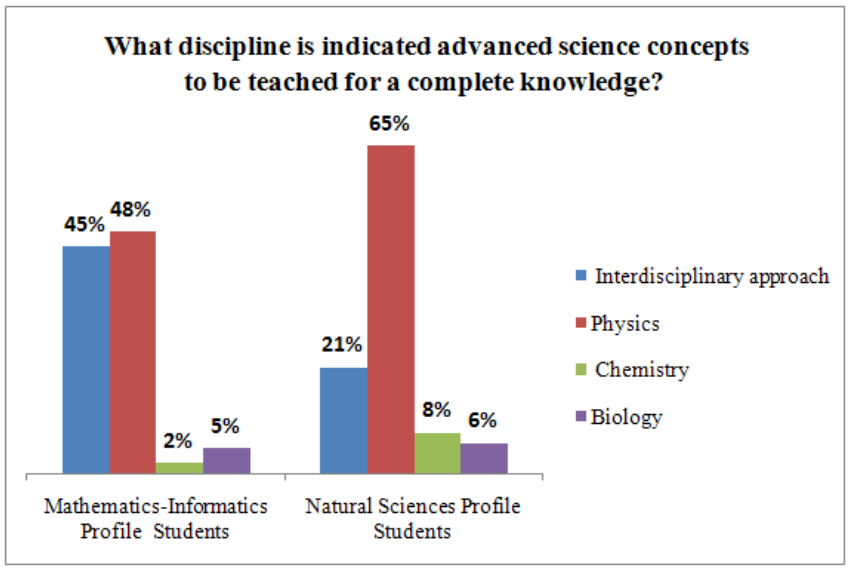

Fig. 10 – The preferences for the disciplines advanced science concepts should be learned. The colored versions could be accessed at http://www.infim.ro/rrp/.

Students from mathematics-informatics high school profile have a different vision from those from natural science by associating advanced science concepts with physics equally with interdisciplinary approach, about 45%.

As the study of informatics involve advanced mathematical concepts and the applications designed for real life simulations include information from all scientific fields that offers to this high school profile students a large, interdisciplinary science approach perspective.

For a better understanding of advanced science concepts, teachers should lead students in discovering new concepts involving them in group activities, say 83% from students answering the investigation. Only 12% from students prefer traditional strategies, that are chalk and blackboard, and 5% from them selected individually self studying as it is reflected in Fig. 11.

Group activities involve using constructivist strategies by the teacher, as most of the middle and high school students agree. Students from mathematical-informatics high school profile as those from natural science profile do not agree individual self studying, so they choose for that kind of activity less than 5%.

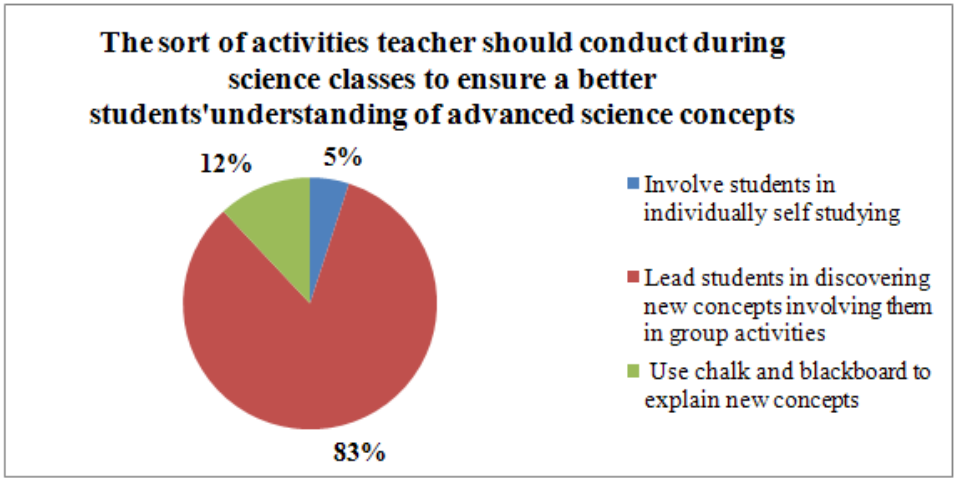

Fig. 11 – Students' preferences for the sort of activities to be used by the teacher for receiving more complete information. The colored versions could be accessed at http://www.infim.ro/rrp/.

Traditional strategies are preferred by natural science high school profile students in the proportion of 18% compared to 6% from mathematical-informatics students More than 75% from students selected constructivist strategies approaches as teachers use group strategies during science classes, as it is shown in Fig. 12.

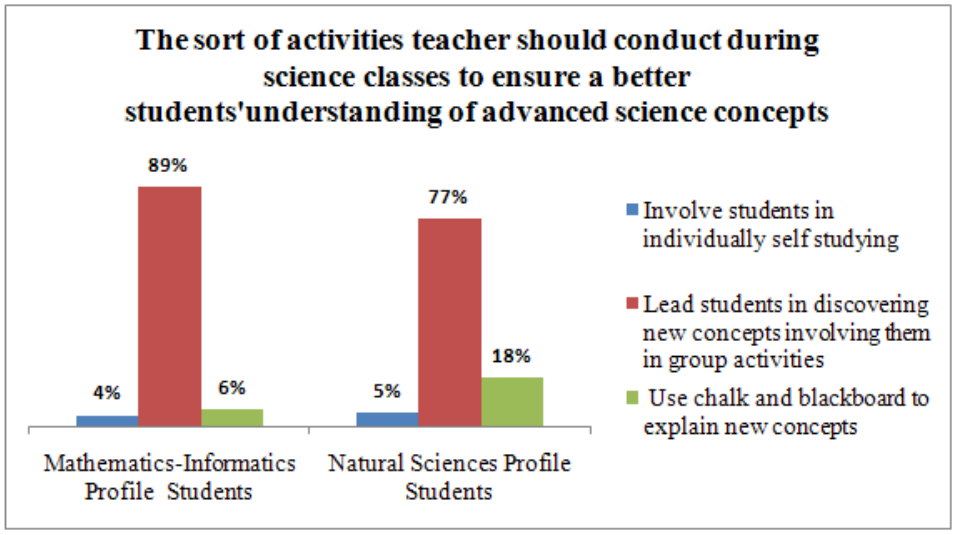

Fig. 12 – Comparing mathematics-informatics and natural sciences high profile students' preferences regarding sort of activities to be used by the teacher in science classes. The colored versions could be accessed at http://www.infim.ro/rrp/.

Teachers and students making together informatics tools is the most accepted activity by most of the students participating to this investigation, while documentation on internet followed by a discussion with the teacher is preferred by less than 10% of students, as it is shown in Fig. 13.

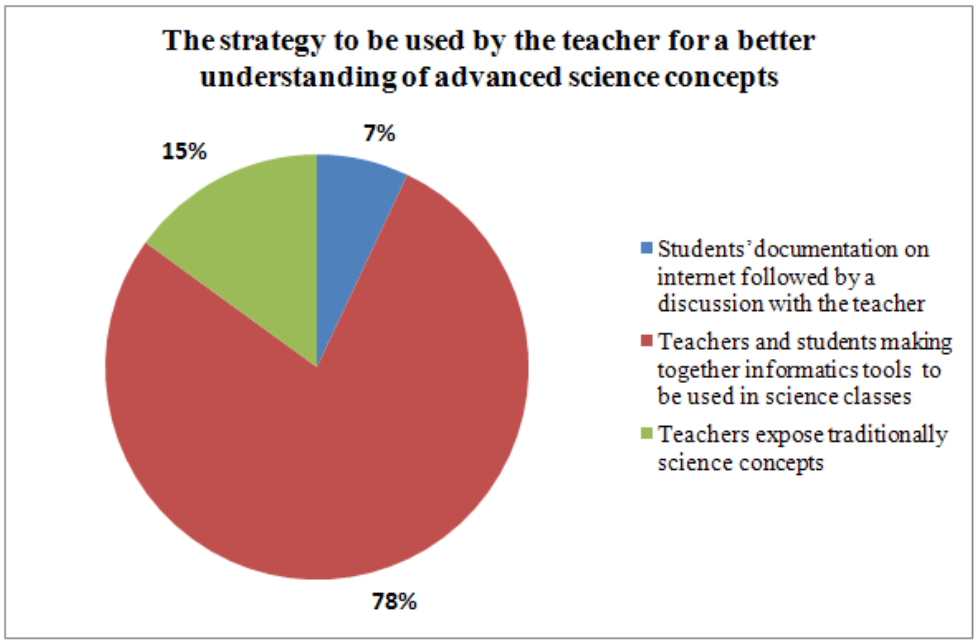

Fig. 13 – Students 'and teachers' activities during science classes. The colored versions could be accessed at http://www.infim.ro/rrp/.

Mathematical informatics high school profile students prefer with more than 20% than their mates from natural science profile using informatics tools during science classes, though more than 70% from students want making and using informatics tools together with science teachers, as it is shown in Fig. 14.

Only 3% from students attending mathematical-informatics high school profile selected traditional approach that is justified by the great number of informatics classes offering a different modern perspective on studying approach.

More than 20% from middle school students accept using traditional strategies in instruction, while only 10% of high school students selected this option, as it is shown in Fig. 15. Students want teachers make informatics tools together with students in proportion of more than 70%.

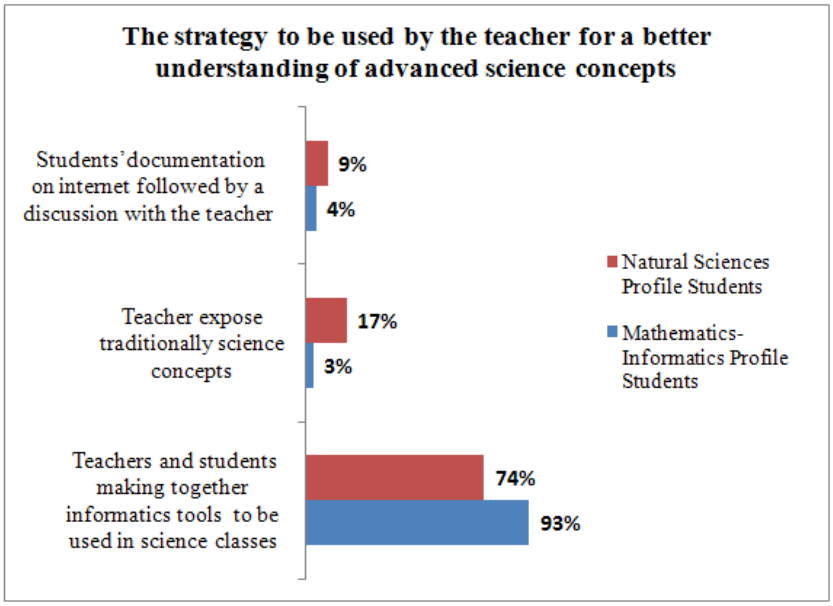

Fig. 14 – Comparing mathematics-informatics and natural sciences high school profile students' preferences. The colored versions could be accessed at http://www.infim.ro/rrp/.

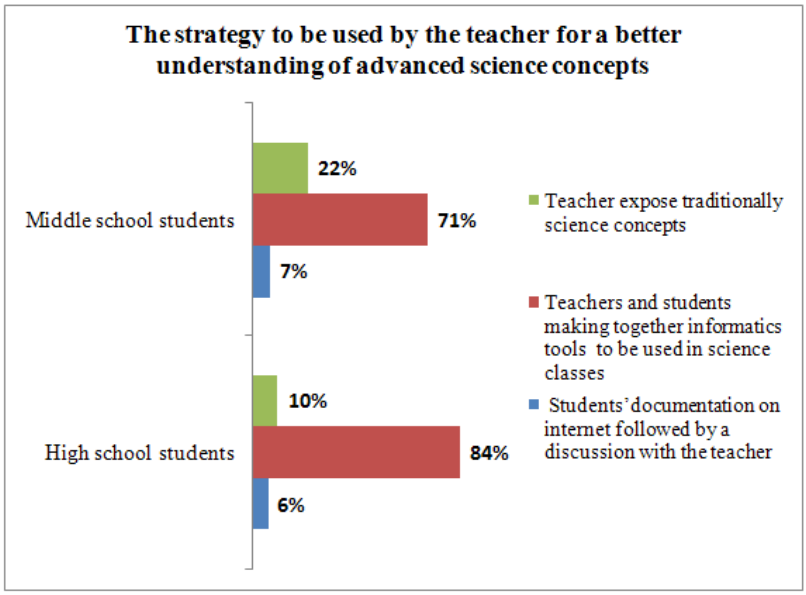

Fig. 15 – Comparing middle and high school students' preferences. The colored versions could be accessed at http://www.infim.ro/rrp/.

3. CONCLUSIONS

Based on this investigation results and their interpretation it can be concluded that hypothesis are verified. At this rate it can be assessed that is desirable that in middle and high school, to be adapted advanced science concepts peculiarly to students' age and understanding. In the mean time it is opportune to be used constructivist strategies during science instruction together with informatics tools made for a better approach of advanced science concepts.

National curriculum and syllabus for middle and high school permit introducing optional disciplines developed by the teacher. Curriculum at school's disposal facilitate modernizing didactical going through, as there can be approached themes, modules or interdisciplinary projects whose contents can be build by the teacher based on students' needs.

Hereby, we identified a field of students' interest in science approach based on the results of the questionnaire applied, namely the study of magnetorezistive materials, as it is shown in Fig. 16.

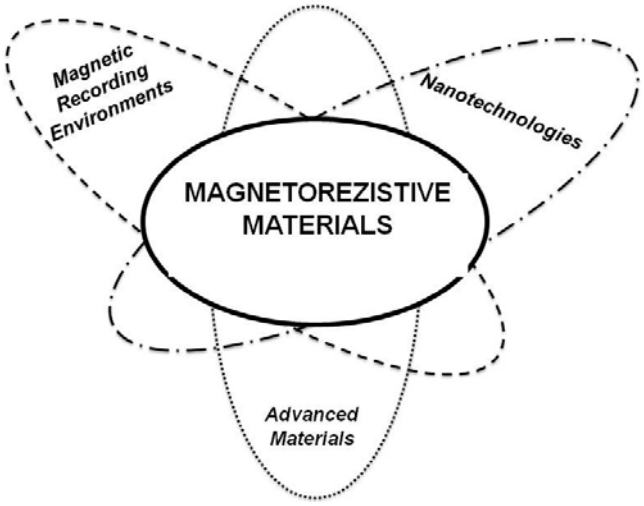

Fig. 16 – The study of magnetorezistive materials.

The generous fields of magnetorezistive materials include notions and concepts from nanoscinces and advanced materials with practicability in magnetic recording environments, so used by our students.

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