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Estimating Important Elements In Science Teaching In Secondary Education : A Design Tool

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***Abstract* – Science teaching is the transformation of scientific knowledge into knowledge that can realize, understand, intake a group of students with appropriate modifications of the scientific content. The lesson of one teaching period is the core of the learning process in schools and the role of the teaching plan is decisive. The imprinting of traces left a teaching to the teacher who designed and implemented it, and to the students who experienced it, is a difficult case since several factors need to be taken into account, since the degree of success is deeply bound up with what is consciously participants experienced.**

In order to estimate important elements in Science teaching planning in Secondary Education, a bibliographic research was carried out with the research objects, that constituted the thematic areas, 1. framework & availabilities, 2. teaching methodologies, 3. the teaching plan, 4. the reflection & evaluation. The findings were summarized in a structural way and presented in the 'Design Tool of Important Elements for Science Teachings in Secondary Education' upon 4 axes and 18 important objects. The Tool can be exploited in the design phase of Natural Sciences' teachings, as pattern for newly appointed teachers or experienced teachers who want to specifically improve some points of their ordinary teachings, by revising the preparation process.

***Keywords* – Science Teaching, Secondary Education, Design Tool.**

I. INTRODUCTION

Education is a social experience through which children learn about themselves, develop interpersonal skills and acquire basic knowledge and skills. This experience should begin in early childhood, in different forms depending on the situation, but always with the involvement of families and local communities. Committee Delor (1996) 'Learning the treasure within' identified four structural axes of Education: learning to know, learning to do, learning to live and work together, and learning to exist. European cooperation in Education and Training for the period up to 2020 established the lifelong learning as a fundamental principle to cover learning in all contexts, whether formal, non-formal or informal, and at all levels from early childhood and schools through to higher Education, Vocational Education, Training and Adult Learning (EC, 2009).

At school dominate two main processes of education, teaching and learning. Their connection and interaction derive from the ascertainment that true school learning mainly based on teaching and the success of teaching is usually judged by the student's ability to retain and permanent use the knowledge learned. Since a teaching does not always mean learning and any learning is not the result of teaching, a teaching will be demonstrated useful and effective when the teacher takes into account the principles and laws of learning (Gagne & Briggs, 1979; Flouris, 1984).

The two broad categories of (theoretical) content included in teacher education programs are that of academic knowledge and that of professional knowledge. Professional knowledge was historically organized and presented in terms of the part-disciplines of Education, i.e. Philosophy of Education, History of Education, Educational Psychology, Sociology of Education and Comparative Education. With the shift in the roles that teachers are prepared, course content, especially the professional component and increasingly the academic component, moves from a thorough grounding into the sub-disciplines of Education, to training the student-teacher for a checklist of techniques, which he/she will need as a teacher (Wolhuter, 2011).

Science teaching is the transformation of scientific knowledge into knowledge that can realize, understand, intake a group of students with appropriate modifications of the scientific content. While good teaching perceives the essence of teaching as work in action (teaching as task) and focuses on the functionality, the effective teaching perceives the essence of a learning achievement (teaching as accomplishment) and focuses on the effectiveness (Matsagouras et al, 2014). The researches of positivist direction, in 1980 decade, focused in the effective schools and effective education ("teachers do make the difference"). Nowadays, schools find difficulties to make students interesting in the core subjects of Physics, Chemistry and Mathematics, which are crucial for Europe's competitiveness. Many discussions take place on whether the traditional teaching methods have role in the schools of 21st century, i.e. the transmission of knowledge and the education of students to reproduce it or whether teaching older students, who have developed sufficient skills and competences to be autonomous, should participate in more student-centered educational activities, in which students and teacher actively conquer the knowledge and cultivate skills (EC, 2007). The course of one teaching hour is the core of the learning process in schools and the role of the teaching plan is decisive (Arends, 1988). The imprinting of traces left to the teacher who designed and implemented it, and to the students who experienced it, is a difficult case since several factors need to be taken into account, as the degree of success is deeply bound up with what is consciously participants experienced. The results of learning objectives of the indirect teaching is not only facts, rules, sequences of actions, such as of direct, but concepts, processes, meanings, types, insights, subtractions (Borich, 1988).

All the course activities that takes place in the traditional, hourly, frontal teachings, i.e. narration, description, presentation, analysis, exercises solution etc.

are determined, initiated and implemented by the teacher, with the student not to participate so directly and actively, but constitutes passive receiver of those has chosen to offer the main transmitter, the teacher. Regulator, performer and controller of how teaching is conducting is only the teacher. However, in recent years, the frontal teaching loses its surrounding glamor of the past (Chatzidimou, 2011). According to YPEPTH-KEE (1999), the attempted educational processes should contribute in obtaining of variety of experience, in cultivation of the scientific character of student works, in development of collaborative relationships between students, teachers and local community, into respect for the neighbor and discipline to the requirements of the program and the group.

Evaluation and inspection systems of School Education can provide valuable feedback to schools, to build upon their achievements and meet the continuously changing needs. The European Parliament and the European Council recommended to Member States, since 2001, to establish transparent quality assurance systems and to create balanced framework of school self-evaluation and any external evaluations, to encourage participation in the process of all stakeholders and to disseminate good practices and lessons learned (EC, 2007qqqq). The teacher, in reflection on the used methodology and the involvement in the variety of school educational activities, needs to think what new can be implemented with the resources and options available, how to continuously utilize them and how best the results of evaluation to improve the way of teaching (KEE, 1998). Thus, through the continuous reflection, the teacher improves the pedagogy of self-knowledge and continuously upgrade the teaching, learning process.

II. Research Method

The research question was about the design of frontal, hourly, Science teachings in schools of Secondary Education of Greece, the most usual teachings, called traditional. The research objects, constituting the thematic areas of the teaching plan, were: A. framework & availabilities, B. teaching methodologies, C. teaching plan, D. reflection & evaluation of Teachings.

To answer the research question and the research objects of the thematic areas of this study, selected the qualitative strategy, as more suitable for non-measurable aspects of social reality. In the interpretation and interaction processes involved in learning, it is necessary to resort to qualitative research and not rely only on quantitative measurements whose validity is, sometimes, questionable (Bell, 1997; Iosifidis, 2003). The research method is a bibliographic review with general reference, briefing, in the literature of theories of learning, school teaching methodologies, teachers' education and training (Cohen & Manion, 1994).

In the developed literature review, the thematic areas had set from the beginning and then investigated in the relevant documents and articles, in extent and depth. The developed literature review was done in Greek and foreign literature, in websites, books, journals, scientific conferences, circulars of the Greek Ministry of Education. Emphasis was given to the European Union's documents concern educational strategies for schools and teachers that contribute to lifelong learning for a sustainable future and on the Greek Pedagogical guidance in school teaching (Delor, 1996; UNECE, 2006; EC, 2007; EC, 2009; PI, 2011). In modules' formation, significantly helped the high experience of the writer in school science teachings of Secondary Education. During the literature review provided the opportunity to analyze further and clarify many of the subject areas. With the resulted findings, observations and perceptions on the research objects, it was created a fuller picture of the identity of a school science teaching, able to be materialized in Gymnasiums and Lyceums.

The research findings, presented in a structural way in the 'Design Tool for Estimating Important Elements in Science Teaching in Secondary Education', can be exploited in the design phase of science teachings, as pattern for newly appointed teachers or experienced teachers who want to specifically improve some points of their ordinary teachings, by revising the preparation process.

III. Results and Discussion

Table 1 contains the Design Axes and objects which constitute the most important elements when planning a Science teaching (Biology, Chemistry, Geology-Geography and Physics) in Secondary Education.

TABLE 1. DESIGN TOOL FOR ESTIMATING IMPORTANT ELEMENTS IN SCIENCE TEACHING IN SECONDARY EDUCATION

AXES	OBJECTS
A. FRAMEWORK & AVAILABILITIES	Curricula, Syllabus, school books, teacher's guides, Ministerial documents
	Number of course's teaching hours per week
	Construction of the learning environments
	Production and exploitation of the available infrastructure
	The scientific content
B. TEACHING METHODOLOGIES	Targeting
	Multiple representations of the world
	Selection of the educational strategy
	Team work
	Selection of the educational activities and exercises
	Laboratory experiments
	Outdoor activities and homework
	Synthetic creative activities
C. THE TEACHING PLAN	Teaching flowchart
	Teaching phases
D. REFLECTION & EVALUATION OF TEACHINGS	Fields and criteria for the Teaching Evaluation
	Evaluation's Multiple Pedagogical Functions
	Barriers to a Science teaching

A. FRAMEWORK & AVAILABILITIES

According to Law No. 4186 for Restructuring Secondary Education, the purpose of the Lyceum is, among others, a. to provide high level of general knowledge, which will contribute to the balanced cognitive, emotional, intellectual and physical development of all students, b. to promote critical thinking, initiative, creativity and abilities of students, c. to develop knowledge, skills, d. to cultivate the ability of critical approach of new information technologies and communications skills. The Natural Science courses of Biology, Physics, Chemistry and Geology-Geography are taught in Greek Secondary Education for one or two hours per week, so during the whole school year are materialized approximately 25 teachings of the hourly and 50 hours of the two-hour courses. During the school year, students in Lyceums have one obligatory exam in each course and in Gymnasiums have two. At the end of school year all students have In-school Exams with issues given by the teacher in order to be evaluated for the next class. For the graduated students of Lyceums, designing teachings is most complicated and difficult because after 25 or 50 hours of total teaching, students of 18 years old give Pan-Hellenic Exams, in which the stress of the degree that they can receive is extremely high, because it plays a key role in their later life.

The new curricula, developed during the recent educational reform of the Greek Secondary Education, have those characteristics in order to make Natural Sciences attractive to students, not burden with additional schoolwork and homework. They are a. Aims-centered, with objectives relating not only to building knowledge, but also to develop skills and desirable attitudes, b. Innovative, focusing in the learning process on the students and their contribution to the initiation in research procedures and processes that promote scientific way of working and thinking ("young scientist" or "young investigator"), c. Sustainable, making students sensitive to environmental issues and stakeholders for sustainable development, d. Integration, adopting collaborative teaching and learning processes that foster responsibility, honesty, mutual aid, self-confidence and acceptance of the other, of the different. e. Digital, adequately integrating ICTs to achieve specific learning objectives.

Constructing the learning environments

The child has built from the very early the spontaneous concepts for life with the help, and always in relation with, the social environment, which later turned into a new, particularly cognitive child's relationship with the world (Vygotsky, 1997; Vosniadou, 2002). Thus, in this process, the cognitive concepts are transformed and change the cognitive structures (Posner et al., 1982). Each student builds representations, models of reality, and particular technical objects with which she/he interacts and develops action patterns which direct the behavior in all activities. The direction of thought development is directed from the social to the individual, having the construction of knowledge the same procedure, supported by favorable situations for learning, mediation of the adult and the appropriate social environment (Komis, 2004). All students participating in a teaching hear and see the same content, but focus their interest on different things, depending on their cognitive constitution, since the observation is guided by the written theory in everyone's mind.

The factors that shape and evolve the children's ideas are the media, interaction with other children, interaction with parents and adults, textbooks, teaching. Teachers should design the learning environments of today's schools, able to encourage students to learn actively, in collaboration with classmates, to use tasks that are meaningful for the school communities and materials that are authentic (Vosniadou, 2001). A teacher is judged adequate when utilizing available teaching aids and focusing on the lesson data, deems necessary and significant, motivates and tries to engage in the lesson willing and non-students (Greek President Decree 152/2013). Teacher has to organize the classroom before starting the teaching, such as students to seat in a defined way, the hardware to be functional and ready, the printed and digital material (students' worksheets, applets, software, apparatus, experimental devices, materials etc.) to be delivered to the students, in general to overcome organizational and functional difficulties and obstacles.

Production and Exploitation of the available infrastructure

To produce the educational material that will support the science teaching, teachers have to take into account the characteristics of students to whom they will address the teaching, the school equipment, the Natural Sciences laboratory, the computer hardware and software, the curricula etc. To enrich the course content, teachers, beyond the school books, utilize multiple instructional materials from the personal archive, from the school library and Internet, such as books, maps, notes, videos, CD-ROMs/DVDs, university books and notes, tutorial aids, articles from scientific journals and conferences, etc. The educational material produced in last twenty years in Greece and is posted in the depository of the Greek Ministry of Education and the Institute for Educational Policy (http://ts.sch.gr, www.e-yliko.gr, http://photodentro.edu.gr, etc.) significantly supports and guides the design and construction of teachings with a wide variety of educational tools and scientific content. In the design of a teaching is taken also into consideration the characteristics and needs of the course's examination, if for example it examined on national level and the gained score contributes significantly to exporting of promoting grade to access universities.

The Internet and Multimedia applications in Education can be used as means of access to a wealth of information, as a research tool and as space for the implementation of educational activities and actions with accessible maps, books, magazines, documents, immovable and animations. Internet enables the direct connections to the Science Institutions and Educational Policy Organizations, at local, national and global level, providing a learning environment that deepens, spreads, which enriches, constantly evolves and removes the teachers from the classrooms' isolationism, making them part of the global

educational community, of any society they live, work and activated (Kokkos, 2008). The teacher, taking advantage of the web 1.0 and web 2.0 technologies with the potential to expand the learning environment and give to the students some of the learning processes control (Mikropoulos, 2011).

The annual planning of hourly teachings and educational interventions (projects, study visits, synthetic creative activities, etc.) is useful to be made by each teacher in the beginning of the school year and include, among others, the following: a. teachers' names of any specialty to collaborate and support the students' activities, b. separation of students into working groups for Laboratories work or else activities etc. c. Ministry of Education directives on Curriculum and Syllabus, d. division-allocation of curriculum's paragraphs and school book's content into hourly modules, e. division-allocation of the questions and exercises of the school book in each module, f. special inclusion of hours for repetition, tests and final exams, g. special registration of hours for the presentation of the synthetic creative works in the common hours with the partner teachers, h. list of parallel texts, videos, websites to visit and recommended bibliography in each module, i. titles, explanations and shipping time for the synthetic creative team-works, j. programming of the outdoor visits.

The Scientific content

According to Anagnostopoulou & Lakka (2007), 'scientific literacy' is the individual's ability to use scientific knowledge, to identify questions and to draw conclusions based on scientific data in order to understand the natural world around and contribute in making the most suitable decisions for changes. Scientific literacy requires a comprehensive understanding of the important concepts of Science and their scientific interpretation, understanding of the limits and possibilities of Science, so that people can approach critically and reflectively the discoveries with a view for effective exploitation. Schools build upon the scientific knowledge of previous generations. Each discovery leads to the next as teachers and students seek solutions to problems and answers the questions. The knowledge we have about the universe is minimal and there are many questions still to be asked and answered. So, the more developed the tools we use, the more questions we have (VanCleave, 1994).

B. TEACHING METHODOLOGIES

In the choice of teaching methodology, the particular emphasis promotes students' self-motivation, collaboration with developing good interpersonal relationships among students and between students and their teacher, cultivation of critical thinking, creation of friendly climate and team culture etc. When teachers design their teachings they have to take into consideration the old Chinese adage 'I hear and I forget, I see and I understand, I do and I learn'. The environmental project «Investigating & Evaluating Environmental Issues & Actions» (1996) by Hungerford, Litherland, Peyton Ramsey and Volk revealed that, since the students have a strong natural interest in the environment, helping them to carry out independent research on environmental issues and to act then as responsible citizens, is an effective way to create widespread environmental knowledge. Researching and evaluating environmental issues and actions, improve learning of Science focusing on basic ecological concepts like energy flow, population dynamics, balance and communities and ecosystem interactions.

Targeting

Each course should contribute to the completion of the general education of students, the perception, understanding and awareness of current reality, to self-education, in developing critical and creative thinking, practice in research and familiarization with scientific methodologies, in evaluating and writing scientific texts, understanding scientific concepts and relationships, to improve observability and awareness of the value of natural ecosystems and the role of human disturbances of their balance (Ministry of Education-KEE 1999; Koulaidis, 2007).

According to the PI (2007), the objectives of school environmental projects, as educational projects, should be a. cognitive, concerning building concepts, understanding relationships/ interactions/ human consequences-environment, environmental problems and protection guidelines etc., b. scientific concerning the familiarization with scientific methodology/ research, critical and creative approaches to issues, development of scientific culture etc. c. participatory, concerning group work, development of cooperation, respect to different opinions, lifestyle and creative action, etc., d. social, regarding the connection of school with everyday life, culture of responsibility, decision-making ability and creative interventions etc. e. aesthetic, a strong connection with nature with the mediation of all senses, etc., f. self-educating by the use of library, Press, new technologies, internet, etc.

In order the cognitive objectives of the Science courses to be achieved, must previously be conquered the pedagogic, not so easy, specifically for newly appointed teachers who immediately realize that the teaching methodologies are taught in theory are not so easily applicable in practice (Duke, 1979; Gotovos & Mavrogiorgos, 1984; Pyrgiotakis, 1992). For them, priority objectives to be conquered is discipline inside the large classes and tackling of student indifference, learning difficulties and unforeseen events that may occur at any time in schools. The Science teachings in secondary schools ought to promote the development of the cognitive, psychomotor, emotional fields of students' personality, following the taxonomy of teaching goals of B. Bloom and his associates (Anderson et al, 2001). The formulation of teaching objectives is not an easy task, requires special skill and much practice, in order be done with the utmost precision and clarity. It is good when goals are setting, to include elements related to the proposed activities, taking into account the mental and social level of students, the personal learning pace, the existing problems, the available infrastructure, the pedagogical and teaching skills of the teacher itself (PI, 2011).

Modern teachings must not be aimed at memorizing information, which are offered to the students through the

various lessons but also to a wide range of skills, through a variety of educational activities (KEE, 1998). Such skills are the understanding of information and its application in solving problems, analysis-synthesis, the critical thinking, observability, imagination, creativity and originality.

Multiple representations of the world

Teaching as an art contains elements of personal conception and creation (Papanoutsos, 1976; Delor, 1996). Each teaching is developed on two levels, the level of empirical reality and the symbolic. For the progress in school teaching, and the displacement from the traditional to more modern and attractive forms of teaching, teachers ought to choose more impressive, modern materials, the most modern that they can exploit in Greek High schools' reality of nowadays. Multiple representations with the combined use of images, sounds-music charts and symbolic representations, experiments, models, etc., obtained by the use of ICT in the educational activities contribute significantly to the building of concepts, understanding of phenomena and the laws governing them. Complementing the oral and written speech, they grow the initiative and self-motivation of students as many senses take part in the learning process, enhancing students' desire for learning, simplifying teaching content also (Stavridou, 2011).

Teacher must be very flexible in designing and applying the teachings, to prepare them as pedagogically differentiated, taking into consideration the different pace of students' learning, the peculiarities in the classrooms, the different socio-cultural representations and all other elements that make teaching a unique, non-standard procedure (PI, 2011).Even though teaching is a solitary activity, in the sense that each teacher is faced with his or her own responsibilities and professional duties, teamwork is essential, particularly at the secondary level, in order to improve the quality of education and adapt it more closely to the special characteristics of classes and groups of students (Delor, 1996).

According to the UNECE Strategy (2005), the Education for the Sustainable Development must use a wide range of educational methods, participatory and oriented processes, finding solutions tailored to learners. Apart from the traditional methods, these should include, among others, discussions, conceptual mapping, philosophical search, values clarification, simulations, 'scenarios', modeling, role playing, educational games, surveys, case studies, visits, projects by the use of ICTs, study of best practices and exploiting experiences for problem solving.

Selection of the educational strategy

Key competences for lifelong learning, in the shape of knowledge, skills and attitudes are appropriate to each context are fundamental for each individual in a knowledge-based society. According to European Union strategies, these competencies of communication in any language, in mathematics, science and technology, in learning to learn, social and civic competences, sense of initiative and entrepreneurship, cultural awareness and expression ought to be cultivated in any educational project with emphasis on critical thinking, creativity, initiative, problem solving, risk assessment, decision taking and constructive management of feelings (EU, 2006). Teaching Science should be extended beyond the school, since children learn from their parents, siblings, other relatives, peers and adults (Rutherford and Ahlgren, 1991). They learn from the films, television, radio, records, trade books and magazines on computers, from visits to museums and zoos, sporting events, concerts, as well as textbooks and the school environment in general. Science teachers should take advantage of the wealth of the behavioral elements of the broader social context and exploit the parents and other interested adults in several ways.

The European Council recognizing innovation as crucial to Europe's ability to respond effectively to the challenges and opportunities of globalization named 2009 ας European Year of Innovation and Creativity. The specific objectives of the European Year of Creativity and Innovation was to highlight, many factors which can contribute to promoting creativity and a capacity for innovation, inter alia those linked to schools promoting education in math, scientific and technological skills conducive to technological innovation, and closer links between arts, business and schools and universities (EY, 2008). In particular, there is a need for skills and competences that enable people to embrace change as an opportunity and to be open to new ideas that promote innovation and active participation in a culturally diverse, knowledge-based society. Manifesto of European ambassadors for creativity and innovation targeted make schools and universities places where students and teachers engage in creative thinking and learning by doing and promote scientific research to understand the world, improve people's lives and stimulate innovation (EY, 2009).

Team work

Collaborative forms of teaching and learning make more successful the educational practices in classrooms, particularly when combined with ICTs use. They take into account the group's operating principles, ensure the group configuration and the emotional climate, connect the less connected, promote self-regulation, delimitation of the horizontal equal relationship, exploiting of personal experience related to the studied subject, emphasizing on positive experience, joint production of work through the synthesis of available resources and materials, in creation and joy climate (Polemi-Todoulou, 2010). The cultivation of the spirit of cooperation, teamwork and collective endeavor in group activities, the connection of school knowledge with technology, society, environment and quality of life, along with the development of better relations between teachers and learners, contribute to more comfortable production of new knowledge and its reframing to better consolidation, making, in this way, more effective the teaching.

Selection of the educational activities and exercises

For more comfortable, easier and more efficient introduction of new knowledge, and check of its intake, a variety of methods, techniques and materials can be used in the planned activities. The schematic representations,

diagrams, graphs, statistical analysis of prepared data or of measurements were taken by the students themselves, pivot tables cultivate critical thinking in the recruitment of scientific knowledge. The paintings, compositions-collage-posters, modeling with simple materials, scriptwriting, tale, narrative or even a short theater play with presentation to schoolmates, CD/DVD production, creation of a website with specific material which was collected and produced in the context of the studied subject, creation of a lending video or printed and digital specialized scientific content, etc. exploit the preferences, talents and skills of the students.

The scientifically informed students know and understand the scientific terms and processes that are essential for participation in society, now and in the future, they can set queries and find answers to questions that emerge from their everyday experiences and raise their interest (KEE, 2007). In the open-ended questions of free answer and essay type, which are usually used in traditional test system, the examinees freely express their aspects on an issue or solve a problem. In particular, the questions of short open response demand increased critical ability of the students to distinguish the important from the unimportant. Closed type questions are those that are accompanied by a series of proposed answers, one is selected as correct. In the category of closed type questions are those of right-wrong or disjunctive answer, the multiple-choice, the coupling, the agenda and the gap filling questions. The selection of the proper type of questions depends on the type of course, the pedagogical training, teaching experience and ingenuity of the teacher (KEE, 1999). In the first activity of the worksheet, which starts the teaching, usually are shown pictures and the students are forced to imagine, to think, to express opinions and views that highlight the existing knowledge and possible misunderstandings, their alternative ideas. This activity is crucial in teaching because it gives rise to debate, attracting the interest of students at the beginning of the teaching hour and draws on the existing knowledge.

In the recapitulative discussions in the classroom or at home, especially in Lyceums, it is proposed to solve exercises that have been given to the Pan-Hellenic Exams. These exercises allow the review of the theory in the form of questions and answers and the understanding degree of syllabus issues with problems solving, similar to those students will face in the upcoming examinations offering self-evaluation and self-estimating (Rothstein, 1990).

Laboratory Experiments

In laboratory experiments are taught notions, terminology and laboratory methods, are offered opportunities to students to feel, actually, young scientists. The manual of experiments must be clear and extremely detailed, where appropriate be given also images, in order experiments be run safely and successfully. The worksheet is the work protocol with reflection questions which usually includes the objective, the required materials, the process steps, the expected results, the 'Why?' and space for the configuration of possible explanations of the results. The teacher must have before carried out the experiment and have checked all the deviation possibilities from the indicated path, but basically that the experiment gives results. Ideally, are presented and expected results for the better guidance of the students. In sections of 'why?' can be given scientific explanations of the results in understandable terms (VanCleave, 1994).

Outdoor activities and Homework

Outdoor activities and homework support significantly the cognitive objects of Natural Sciences, since the lessons of Mother Nature are of particular value for children during their development. Nature can inspire, offer joyous and creative experiences, can touch each one with unique and different way. The games in Nature familiarize the body and feelings with the natural environment, provide a peaceful mood of reflection, showing the most complex functions and principles of natural ecosystems (Cornell, 1979).

Students get homework the reading of the taught paragraphs, exercises of schoolbooks exercises to solve and to study parallel texts, issues of national exams, choice questions from the Evaluation Guide for Lyceum's students and others, suggested in the curriculum and the teacher's book (KEE, 1999).

Synthetic Creative Activities

Synthetic creative activities assigned to groups to investigate web sites and libraries, commonly referred to broader modules and have a long term horizon. The scientific material, collected and organized jointly, can be used at the resumed chapter, at the end of the school year, and to stay in the school archive for use in the coming years. The home-work exercises are a simple extension of the school daily work while synthetic creative activities, because of their interdisciplinary character, cover broad cognitive areas and exploit the enthusiasm, talent and creativity of the students.

Parallel texts, excerpts from school books, newspapers, scientific articles, books, etc. are designed to enhance the theoretical background of students, to broaden their horizons of knowledge and cultivate their critical thinking. Books, titles of relative educational videos/DVDs etc. from school libraries are proposed for lending, so that students can read and attend whenever they have free time.

C. THE TEACHING PLAN

Most researchers (Trilianos, 1991; Cohen & Manion, 1989; Arends, 1988) agree on the key elements of every successful teaching plan, which are summarized in objectives, course content, teaching methods, materials, instruments/devices, exercises, the organization and the process of evaluation. School teaching is an organized set of deliberate and methodical, direct and indirect, intellectual, emotional, psychomotor and participatory actions, in consequence, to promote the student learning (Charalampopoulos, 1987; PI, 2011). Teaching, usually, implemented in the following phases of the Scientific-Inductive method: disclose the subject and objectives as well as the teaching flow diagram, check of existing knowledge and alternative ideas, then, the new knowledge is introduced with laboratory and other activities, test it in new environments, evaluate the achievement of objectives and given the homework. A teacher is judged adequate when teaching be completed with summary and

appropriate embedment exercises, within the planned time limits, with a positive atmosphere and without any particular problems (President Decree 152/2013).

Teaching flowchart

The teachings are designed in the context 'goal-teaching intervention-evaluation' and consequently, the entire course of teaching should be characterized by relevance target-teaching-assessment of the interventions. The teaching flowchart drawn up based on the content and structure of the scientific thematic module. The worksheet contains a few questions of closed and open type of short answers related to cognitive teaching goals. Students are required to choose one correct answer or give short answers following the flow chart of the course. Apart from the questions, it contains instructions for real or virtual experiments, suggested sites to visit and other activities. The questions' answers are sought in specially created material given to students or in the school book, to work individually or in teams, discuss, express aspects and find out the correct answers. For implementing the laboratory exercises, the teacher asks students to carry out the laboratory procedures of the workbook, working in teams. The teacher advises, guides, suggests by intervening only where necessary to move the process comfortable. In more detail, teaching phases have:

Teaching phases

I. DEFINITION of TEACHING FRAMEWORK-ORIENTATION

a. Notified the subject and the purpose of teaching. At the beginning of teaching is given to students detailed information / schedule on the course objectives, the activities to implement at school and at home, educational methods that will be followed by a summary of a flowchart, able to attract attention and interest.

b. Written, notified and reasoned the goals. Teaching's cognitive objectives usually are 2-3 in order to in time be covered during the 40 minutes of teaching hour.

c. Determined the teaching's process and informed about the students. The flowchart contains, for the classroom and at home, the lesson title, themes, objectives, worksheets (experiment and evaluation sheet), exercises, protocols of laboratory exercises, navigation instructions for the Internet sites, titles of parallel texts for home study, titles of book and videos related to the subject for lending from the school library, subjects were given in previous national exams, questions and exercises of Curricula, etc.

d. Attempted connection with the prior knowledge and teachings. It is important for teachers to identify which of those students learn informally are incorrect, incomplete, poorly understood, or misunderstood, and that basic education can help students to reconstruct their knowledge and acquire new.

e. Provoked curiosity and interesting of students with one specially selected activity

f. Identified hypotheses by the students on the new subject. Students are invited to express aspects and set questions concerning the negotiating scientific subject, so revealed their orientation to the new subject which is going to be taught.

II. INTRODUCING THE NEW KNOWLEDGE

a. described concepts

b. described and explained phenomena and natural laws

III. IMPLEMENTATION OF NEW KNOWLEDGE-GENERALIZATION

a. Checked the function of new notions. With the application of new knowledge is checked if the introduced notions function in new environments, making connections with daily and social life, sustainability, the quality of life and sustainable welfare of societies.

b. reconstructed and realized the new knowledge.

c. identified, formulated, explained, looking for extensions.

IV. EVALUATION OF THE OBJECTIVES-HOME WORK

a. Evaluation of the achievement of cognitive objects. To evaluate if achieved the cognitive goals, usually correlate one or two questions or one exercise for each objective, which is, usually, referred to one activity. Can be chosen activities that assess overall goals or a portion of goals.

b. Reflections. The final evaluation of the teaching's purpose and objectives becomes with homework and in the reflection discussion that can be done at the beginning of the next teaching period. This can be made with structural way, with prepared questionnaire.

D. REFLECTION & EVALUATION OF TEACHINGS

The educational evaluation contributes multiply in improving the quality of the produced educational work since it aims to determination of achievement of the learning objectives, resources and outcomes of the educational activities. It can be very useful in planning of the next stages of teaching and learning in the course, in the exploration and mapping of individual and collective progress of students regarding skills, interests and peculiarities in all phases of the learning procedure, etc. (Papaioannou, 2013). The qualitative upgrading of the educational process, which aims to support and encourage students and to creation of learning motivations, helps to identify learning difficulties and deficiencies, to design appropriate teaching interventions to improve the teaching process.

Fields and criteria for the Teaching Evaluation

Feedback from any educational activity, as teaching is, develops higher mental functions, cultivates metacognitive skills so it is good to seek as much as possible into teaching. Therefore, the 'Assessment Worksheet' is good to be named 'Feedback Sheet' and to evaluate all types of targets, not only cognitive (PI, 2011). The fields and the criteria of observation, evaluation, feedback of teachings, that Greek Ministry of Education defined for introducing teachers' evaluation in Pilot-Experimental Schools (Circular of the Greek Ministry of Education D1/F.361.22/116672/01-10-2012, FEK2788/SB'/15-10-2012) concluded, among the others, criteria of design and preparation of teaching for teaching plan, selection of the type of teaching, clarity of objectives, activities within a coherent structure, compatibility with curriculum, syllabus and the cognitive level of the students).

In all assessment tasks that are set in contexts and

dealing with subjects that are meaningful to students, performance will be affected by students' familiarity with the context and subject matter. All competences are used in a context and in relation to some content. Although the context also has an influence on application of science concepts, it presents particular problems when the focus of the question is to elicit data about use of inquiry skills (Harlen, 2013). While the elements of good teaching, methodological, psychological and ethical principles with the consequent learning process is the valuation criteria of teaching work, the comparative data of students' performance in regional or national examination should not be exclusive and individually criteria because charge or credit results to the teacher that may were not possible to affect, since the socio-cultural indicators have high variation in regions (Matsagouras et al, 2014).

Evaluation's Multiple Pedagogical Functions

Teachers must have constantly in mind the multiple pedagogical functions of evaluation and continually puts themselves questions about the evaluation methodology and tools they use in every case (KEE, 1999). Most especially, if they integrated into the overall design of teaching, if provide students regular feedback on their efforts to learn, if they motivate the students, if they take into account the individual characteristics and the specific needs of students, whether assessing a wide range of knowledge and skills or limited to only recall information, if developing critical and synthetic capacity and promote creative thinking and learning.

The evaluation of students has important educational and social functions, which are necessary both for the same the Education also the wider community (KEE, 1999). The continuous feedback from the teachings, in order to improve the quality and increase the effectiveness, allows to teacher to intervene in the learning process, to identify the teaching action and offer additional support and guidance to students in need. For the evaluation of teaching and self-assessment of students can be completed a questionnaire like that of Sheet for Student Periodic Self-evaluation (KEE, 1999). Questions are closed type, with more than one choice, adapted and related on how the student experienced the lesson. The students asked how they felt during the course, if easily understood the lesson, if actively participated in the course, how satisfied think that the teacher is of them.

Barriers to a Science teaching

Barriers to a Science teaching can be the inadequate visual teaching materials, the often ugly building situation, the time limit of the total presentations and laboratory exercises and many other factors that affect the success of a teaching event. The students' stress must not be ignored, especially Lyceum where the degree of stress is extremely high since it plays a crucial role in the future course of the lives of students. Stress also not missing from teachers who pressured enough to catch up to cover the curriculum and syllabus and to invent ways to maintain steady the students' interest in the course. They have, also, to deal with the emotional changes of students, since they are going through the most turbulent period in their lives, the adolescence.

IV. CONCLUSIONS

The lesson of one teaching period is the core of the learning process in schools and the role of the teaching plan is decisive. The imprinting of traces left a teaching to the teacher who designed and implemented it, and to the students who experienced it, is a difficult case since several factors need to be taken into account, since the degree of success is deeply bound up with what is consciously participants experienced.

In order to estimating important elements in Science teaching plan in Secondary Education, a bibliographic research was carried out with the research objects, that constituted the thematic areas of framework & availabilities (curricula, syllabus, school books, teacher's guides, ministerial documents, number of course's teaching hours per week, construction of the learning environments, production and exploitation of the available infrastructure, scientific content), teaching methodologies (targeting, multiple representations of the world, selection of the educational strategy, team work, selection of the educational activities and exercises, laboratory experiments, outdoor activities and homework, synthetic creative activities), teaching plan (teaching flowchart, teaching phases), the reflection & evaluation (fields and criteria for the teaching evaluation, evaluation's multiple pedagogical functions, barriers to a science teaching). The Tool can be exploited in the design phase of Natural Sciences' teachings, as pattern for newly appointed teachers or experienced teachers who want to specifically improve some points of their ordinary teachings, by revising the preparation process.

Reflecting on the question of good and effective teaching, student-centered and teacher-centered, which follows modern methodological, psychological and ethical processed plan, and utilizes appropriate ways to stimulate student interest by exploiting knowledge, ideas and skills, raise questions about whether contributes to personal sense of the new knowledge, how teacher is evolved personally and professionally, if achieved the national standard set (Matsagouras et al, 2014). There is an urgent need to re-examine the nature and structure of schooling in a more critical way to address Education for the Sustainable Development in a broadest context i.e. school organizational principles, operational practices, school grounds management, and curriculum content. We are faced with a paradox: is Education the problem or the solution in working toward a sustainable future? At current levels of unsustainable practice and over consumption it could be concluded that Education is part of the problem. If Education is the solution, then it requires a deeper critique and a broader vision for the future. Thus, whole systems redesign needs to be considered to challenge existing frameworks and shift our thinking beyond current practice and toward a sustainable future (UNESCO, 2005).

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