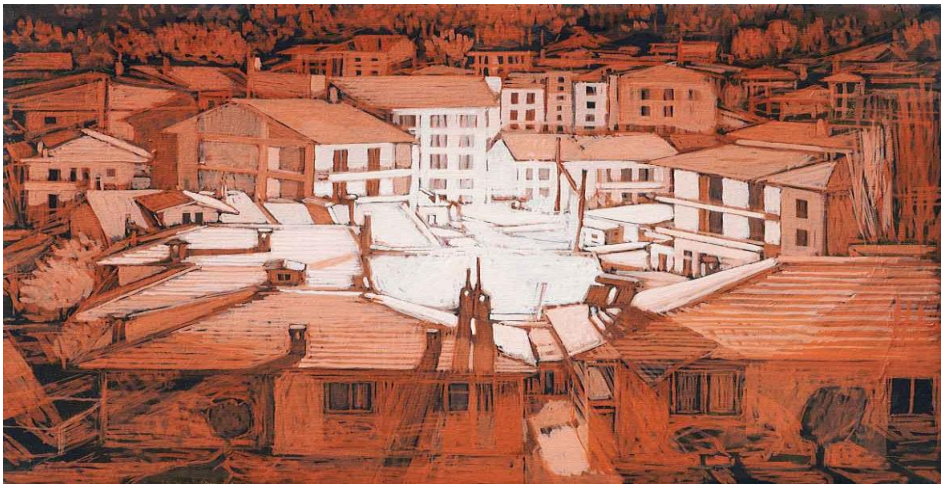

11th Pan-Hellenic Conference

TEACHING OF SCIENCE AND NEW TECHNOLOGIES IN EDUCATION

"Redefining Science and Technology Education in the 21st century"

19-21 APRIL 2019

Friday April 19	Saturday 20 April	Sunday 21 April
9:00 Registration Opening	**9:30-11:30** Parallel Sessions C Round Table	**9:30-11:30** Parallel Sessions Symposium 2
11:00-12:30 Workshops Educational Implementations	**11:30-12:00** Break	**11:30-12:00** Break
12:30-14:30 Parallel Sessions A	**12:00-13:00** Keynote Speaker 2 Carvalho S. Graça	**12:00-12:30** Closing Ceremony
14:30-16:00 Break	**13:00-15:30** Lunch Break ENEFET Buisness Meeting	
16:00-18:00 Educational Implementations & Parallel Sessions B	**15:30-17:30** Symposium 1 Parallel Sessions D Poster Session Workshops Educational Implementations	
18:00-18:30 **Break**	18:00-20:30 **City tour**	
18:30-19:30 Opening Ceremony		
19:30-20:30 Keynote Speaker 1 Lavonen Jari		
20:30 Welcome Reception		

Book of Abstracts

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ΕΝΕΦΕΤ
Ένωση για την Εκπαίδευση στις Φυσικές Επιστήμες & την Τεχνολογία

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ΔΥΤΙΚΗΣ ΜΑΚΕΔΟΝΙΑΣ

Municipality of Florina

Conference Topics

Science Teaching and Learning

Technology Teaching and Learning

Science and Technology Teacher Education

Scientific and Technological Literacy

Development of Critical Thinking in Science and Technology Education

Students and Teachers Views and Reasoning in Science and Technology Education

Curricula and Books in Science and Technology Education

ICT in Science and Technology Education

History and Philosophy of Science and Technology in Science and Technology Education

Teaching practices

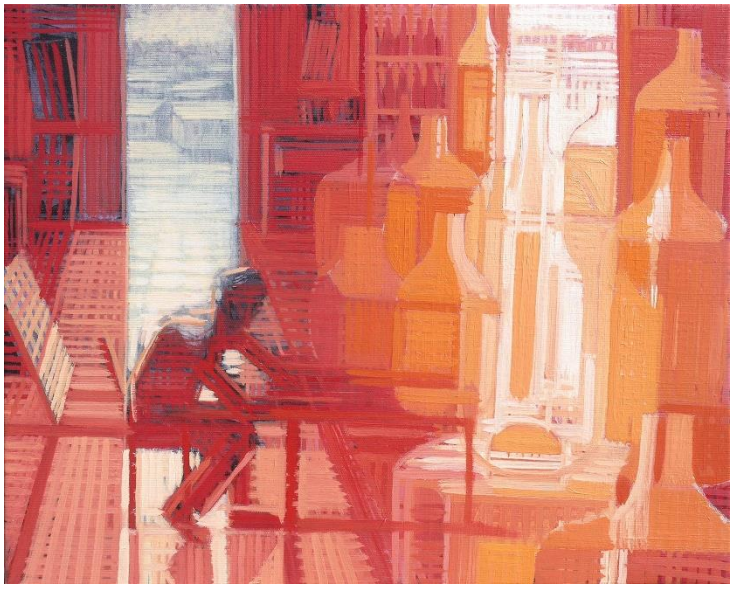
Experimental teaching

Analogies, models and modeling

Science and Technology Non-formal and Informal Education

Interdisciplinary approaches to Science and Technology Education

Teaching and Learning in Environmental Education / Education for Sustainabilit



ABSTRACTS

Collaborative Design and Implementation of a National Teacher Education Development Program

Jari Lavonen, Faculty of Educational Sciences, University of Helsinki, Finland
(Keynote Speaker 1)

A development programme or a reform in teacher education are common tools for improving school education. However, engaging of relevant partners in collaboration and implementing the new ideas broadly to practice are challenging. In the presentation, I will analyse the nature of the collaborative design of the Finnish Teacher Education Development Program 2017 and the implementation of this program in a decentralised education system where teachers, schools, municipalities and universities have high autonomy. The development program was designed by 70 experts from the universities, Ministry of Education and Culture, and representatives from the Association of Finnish Local and Regional Authorities, Teacher Union, Student Union, and the Principal Association. While designing the program, research outcomes related to teacher education were analysed, teacher education strategies in various countries benchmarked and a national brainstorming related to the renewal of teacher education organised. Moreover, several local and nationwide meetings were organised. Altogether, 31 pilot projects were financed by the Ministry in order to implement the development program. Based on the survey, the pilot projects have been focusing to the strategic aims of the development program and are supporting the six concrete strategic action guidelines. Both directors and partners feel strongly that the activities in the pilot project have been supportive to teacher educators' professional learning and to the implementation of the strategic aims.

Redefining empirical research with/for children in health education

Graça S. Carvalho
CIEC, Institute of Education, University of Minho, Braga, Portugal
(Keynote Speaker 2)

Nowadays children are the focus of intense research. Some researchers perceive research with and about children as being just the same as the research with and about adults, other researchers see it as being entirely different, and other researchers are in between these two extremes. The way researchers perceive children and childhood has implications for the research process and affect the ways of listing them. In this conference, differences between research with adults and children will be discussed, giving particular emphasis to issues of ethics and imposing researcher's perceptions (critical reflection of the use of 'child centered' methods), validity/reliability (children may exaggerate or lie to please the researcher), language clarity (language appropriate to children's age), research context (setting where children are at easy), building rapport (empathy making to create a trusting zone of rapport), data analysis (care to interpret children's perspectives), appropriate research methods (using children's preferred methods and familiar sources). Research task-based methods make research fun for children and tap into their interests. Some task-based methods will be presented and discussed: drawings, photographs, spider diagrams, diaries, interviews and questionnaires. In short, even considering that children are socially competent actors, researchers must be critically aware of the reasons why research with children may be, in some aspects, different from that with adults.

Comprehension of genetic information flow by Secondary Education students

Alexopoulos Panagiotis, Kouka Anna, Mavrikaki Evangelia, Galanopoulou Dia

Graduate Programme "Chemical Education and New Educational Technologies", University of Athens, Greece

The comprehension of concepts concerning the flow of genetic information by 760 third class students of Middle School was studied by distribution of a questionnaire consisting mainly of close-ended questions. Processing of students' answers, both per question and by combination of answers to complementary questions showed that: a. students' understanding of fundamental biological as well as chemical terms and concepts (e.g. chemical bond) is limited, b. they confuse macroscopic and molecular level concerning cellular organization, while c. the resemblance of various terms adds further confusion. All these must be taken into consideration during teachin preparation.

What is the Gender of Science? Gender and Science Textbooks

Ampatzidis Georgios[1], Armeni Anastasia[2]

[1]School of Pedagogical and Technological Education (ASPETE),
[2]University of Patras

Despite efforts to strengthen women's participation in science, it seems that they are still under-represented in fields such as physics and technology. It has been suggested that textbooks are one of the factors which contribute in the formation of the 'gender gap'. This article focuses on the frequency of appearance of men/women and male scientists/female scientists in the illustrations of science textbooks of the Greek lyceum. The analysis of 11 science textbooks shows that men and male scientists appear more frequently than women and female scientists respectively in the images of physics, biology and chemistry textbooks.

Plants as living organisms and as factor of human well being: Primary school students' perceptions and knowledge

Amprazis Alexandros, Papadopoulou Penelope
University of Western Macedonia

Plants contribute essentially to human well-being and to life phenomenon on planet Earth. In this study we examine primary school students' perceptions of plants as living things and as source for the production of basic nutritional and non-food products. A questionnaire survey was conducted on one forty-eight children aged between 10 and 12 years. According to the results, plants are not considered as living things by the majority of children, while the recognition of plant products raises issues of misconceptions. The findings bring to light the need for a deeper understanding of the structure and role of the flora.

Nanotechnology: searching for the students' conceptions about size and scale

Andreakou Eirini – Zacharoula, Papadopoulou Penelope
Department of Early Childhood Education University of Western Macedonia

The purpose of this paper is to investigate the secondary students' perceptions regarding size and scale, one of the nine big ideas for teaching nanotechnology. A questionnaire of two tasks was given at students of Junior High School and of the First grade of a High School in the Prefecture of Magnesia. In the first task, nineteen objects were given to students in order to choose the appropriate size. In the second task the students had to group ten objects and justify their choice. The results showed that students have difficulties in understanding nanoscale size differences and distinguishing nano- from microscale.

From Olympus to our Solar System" A didactic scenario for the teaching of Astronomy through Mythology

Andrikou Asimina, Tsompanopoulos Ioannis
University of Western Macedonia, Department of Primary Education

The modern discussion for the teaching of Science promotes interdisciplinarity with other cognitive subjects (disciplines), such as History. Our teaching scenario is a three-phase project and it concerns the interdisciplinary approach of Astronomy to Mythology. Students will learn the origin of planets' names, their movement and their features through varied and alternative educational practices, such as New Technologies, Historical Educomic, Modeling and Role - Playing. This teaching proposal is an innovative idea that it can be applied by future or active teachers.

Characterization of 10th-grade Students' Argument Structure Regarding the Recycling of Materials

Antonoglou Lemonia[1], Salta Katerina[1], Koulougliotis Dionysios[3]
[1]Department of Environment, Ionian University; [3] Science Laboratory Center of Ilioupolis, Athens

In this paper, we examine the structural quality of students' argumentation regarding methods for recycling of materials within a web-based learning environment which gives emphasis on inquiry. The analysis of students' written arguments via the use of the Toulmin model and the scheme proposed by Sandoval and Millwood, showed that students' claims are usually accompanied by data. Furthermore, in several but not in most cases, the students make use of a warrant in order to explain how the data lead to the claim. These warrants are either causal or empirical and less often factual.

Online learning environments and teacher professional development: examining teacher readiness

Bakogianni Eleni, Tsitouridou Melpomeni, Kyridis Argyris
SECEd Aristotle University of Thessaloniki

The purpose of this study is to investigate the level of readiness of primary and secondary school teachers to participate in online learning activities. In particular, teachers' attitudes towards: i) computer and internet self-efficacy, ii) self-directed learning, iii) learner control in an online context, iv) motivation for learning and v) online communication self-efficacy were examined. 216 in-service teachers participated in the quantitative study. The results of the study revealed that the teachers, in general as well as the science teachers in particular, show quite high level of online learning readiness to use online learning in the context of their professional development.

Space Science applications in Secondary Education: Space equipment-based seismograph made by students

Bampasidis Georgios
Department of Primary Education, National & Kapodistrian University of Athens, Secondary Education, Greece

Space Science and Astronomy educational applications offer a modern teaching tool in Science Education. Students built a digital seismograph by using materials and software based on space equipment that is installed in the International Space Station. The team exploited the experience gained by the participation in the european space science school competition «Astro Pi Challenge». The construction was submitted in the national school competition «Build your own seismograph», where it was awarded. The method and the learning results of the procedure are presented.

Critical thinking evolution in primary school: a case study in a Science Festival context

Bara Yvoni, Zaxou Panagiota, Spyrtou Anna, Dimitriadou Aikaterini
University of Western Macedonia

Students' critical thinking development is a current curriculum target in advanced world countries. Science Festival (SF) constitutes an open inquiry learning environment which is considered to contribute to the development of critical thinking. The present research reflects the critical thinking evolution of a student during her participation in a SF. Specifically it is studied whether the student's critical thinking skills and dispositions were influenced by the educational processes developed within the Festival. The results are encouraging as they showed growth in one skill (Interpretation) and in two dispositions (Self-Confidence and Inquisitiveness).

A proposal for the introduction of the big idea "Forces and Interactions in nanoscale" in secondary education.

BARTZA RAFAILIA, SAMARA-CHRYSSOSTOMIDOU ANASTASIA, HATZIKRANIOTIS EVRIPIDIS
Aristotle University of Thessaloniki, Department of Physics

This paper deals aims to the introduction of Nanotechnology in secondary education, specifically the introduction of "Forces and Interractions in nanoscale" and deals with a proposal, in order to achieve this purpose. In particular, the model of continuum of electrical forces is introduced, as the most effective for explaining and understanding the nanoscale's phenomena. Interactions of entities are described through the electron mediation mechanisms and the energy changes that follow, while prominence is given to their dependence of the properties and structure of matter, as well. Furthermore, a proposal for educational reconstruction of this idea by using instructional tools is presented, while students' alternative ideas and difficulties are considered, too.

A proposal for the introduction of NSE – related concepts in School through the incorporation of the building block "Size and Scale"

Batsiolas George, Prospathopoulos Alexandros, Hatzikraniotis Euripides
Aristotle University of Thessaloniki, Department of Physics

Nanoscience-Nanotechnology (N-ST) is a scientific area that is intensely preoccupied the scientific community, with rapid development and with its social impact. A modern challenge for education is the integration of N-ST concepts across all levels. This is presented as a critical and urgent need due to the shortage of NST-educated educators and the need for future literate citizens in N-ST. According to literature review, the integration of N-ST content rely on core concepts, called "Big Ideas" (BI). This paper focuses on the presentation and analysis of the one of the Big ideas: "Size and Scale", as a way of integrating N-ST content into education.

Using the mythology to study various forms of energy in natural sciences: An interdisciplinary teaching proposal

Baytelman Andreani
Cyprus Pedagogical Institute

The present interdisciplinary teaching proposal presents the way of modeling the myth of the windbag of Aeolus and the journey of Odysseus to Ithaca from the Greek mythology, as it was used for the teaching and learning of various forms and transformations of energy, to students of the 6th grade elementary school. This teaching proposal aimed at promoting students' conceptual understanding of various forms of energy, as well as the development of modeling skills. This teaching proposal was evaluated using self-assessment and hetero-assessment of students, as well as summative assessment. The results of the assessments were very positive and are discussed at the end of the work.

Mismatches in preschool's children thinking about mechanical equilibrium

Chachlioutaki Maria-Eleni, Pantidos Panagiotis
SECEd, Aristotle University of Thessaloniki

Many researchers refer to mismatches that appear in learners' ideas. These have to do with meanings expressed by the speech and the accompanied gestures, the so-called gesture-speech mismatches. This paper explores the mismatches in pre-school children's thought about mechanical equilibrium within a multimodal learning environment. Data was collected from a test that was repeated at three different times, among which two teaching interventions were inserted. The research was applied in five pre-school children. Five types of mismatches have been identified through the synergy of all semiotic systems used

The combined use of tablet, interactive whiteboard & virtual reality by preservice primary teachers for science teaching.

Chairetis Manolis, Stavrou Dimitris
Department of Primary Education, University of Crete

Designing and implementing an inquiry based teaching is a particularly demanding process for teachers, and it is therefore necessary to educate them. One of the methods proposed to tackle the challenges and difficulties that arise is to integrate technology tools such as tablets, interactive boards and virtual reality glasses into science teaching. However, the benefits of combining these teaching tools for inquiry based teaching have not yet been sufficiently explored. In such an effort the purpose of this study is to train students of the Department of Primary Education in combining the use of the above mentioned tools within inquiry based learning.

Teaching Newton's laws using the flipped classroom: a case study

Chalkiadakis Konstantinos, Kalogiannakis Michail
University of Crete, Department of Preschool Education

Flipped classroom is an instruction model that combines elements from both direct instruction and online learning. In this approach teacher's lecture is transferred out of the classroom, by getting students to watch online videos. Thus, there is more free teaching time, so as to allow differentiated instructional approach to be used inside the classroom. The current study is trying to investigate the efficacy of this model for teaching Newtons laws to 16 year-old students of Lyceum, by applying a quasi-experimental design with a pre and post test using IBCM (Inventory of Basic Conceptions - Mechanics) questionnaire.

Investigation of the connection between the conceptual understanding of Natural Sciences and the understanding of Nature of science

Charalambous Maria, Constantinou Constantinos
University of Cyprus

This study investigates whether the cultivation of epistemological proficiency for the nature of science strengthens conceptual understanding, based on an alternative definition of conceptual understanding. Two separate studies were conducted. The first study explored whether the understanding of nature of science enhances the application of the concept of magnetism in system analysis. The analysis of the data led to the rejection of this assumption. The second study investigated whether the understanding of nature of science automatically leads to an understanding of the epistemological dimensions of magnetism. And in this case, the data suggested that this claim was wrong.

The compilation of gene models in biology textbooks of Greek education

Christidou Akrivi, Papadopoulou Pinelopi
University of Western Macedonia

The purpose of this study is to investigate the formation of the historical gene models (Mendelian, Classical, Biochemical, Neoclassical, Modern), deepening their individual epistemological features, as they are represented in the Greek biology textbooks. The results show that the most common feature of the dominant Biochemical model in Greek textbooks concerns the absence of environmental elements in gene function and describes also the Mendelian and Classical models. This feature may enhance genetic determinism by creating alternative concepts to students.

Computational Pedagogy and S.T.E.M

Christoforaki Maria
Bachelor student of Primary Education Departement of University Of Crete

The research is about the relationship between the development or improvement of computational thinking of students using STEM experiments such as an earthquake shaking table of 3 degrees of freedom along with a Barton pendulum. Research concern issue is the enhancement of teaching computational thinking through experimental tools that promote learning by experimental activities done by them. The participants were 100 students aged 6-16 years during the national competition Science On Stage 2017 and the competition held by the Union Of Physics Teachers :" Physics spreads magic" . The students worked individually during the experiment . They understood the meaning of computational thinking and responded sufficiently to the demands of the experiment at the rate of 87,4% , while only the 12,6% did not adapt to the needs of the computational experiment .In our study was found that the use of the earthquake shaking table as a vehicle to develop the computational thinking was effective . The students after the intervention can face an earthquake with composure and try to protect themselves as long as they understood that from a scientific standpoint the earthquake is a "friend" of human. The visualization of the phenomenon helped them to adapt easier to the experiment process. The students conquered theoretical knowledge, the meaning of problem , the methodology of solution , experiment properties, learning and exploitation of the earthquake shaking table.

Primary school students' understanding about the energy footprint concept

Dalarou Vasiliki[1], Malandrakis Georgios [2]
[1]University of Western Macedonia, [2]Aristotle University of Thessaloniki

This study explores the degree of understanding of the energy footprint concept and its importance, giving particular emphasis on product life cycle. Participants were 102 5th grade students from four elementary schools in Preveza, and data collected through a questionnaire comprised of four open-ended questions and 12 images. The analysis revealed that the majority of students may find that some kind of energy is required in the manufacture of a product, a lower percentage realized that energy was required during the operation of the products and no reference to energy was made regarding the end of life stage.

Learning concepts in nanotechology through scientific and refutational texts

Deliali Areti, Pnevmatikos Dimitrios
University of Western Macedonia

The purpose of the study was to investigate the effects of refutation and expository text in learning concepts of nanotechnology. Within an leaning intervention framework, 34 sixth-grade students read either a refutation or an expository text about Gecko lizard and completed a questionnaire of six questions just before and after reading. The one-way analysis of variance (ANOVA) showed that students responded significantly better after reading the texts. The t-test showed that the two groups did not differ significantly before reading, but differed on some questions after reading the text. Compared to the expository text, the refutation text readers had significantly better learning outcomes in conceptual understanding and learning.

Innovative club of natural disasters in secondary education

Demenagas Petros[1], Sotiropoulos J. Dimitrios[2], Katsafados Petros[3], Mayromatidis Ilias[3]

[1]Nea Genia Ziridis School, [2]Computer Science Department, University of Thessaly, [3]Geography Department Harokopio University

The recent devastating natural disaster in the neighbouring areas of Mati and in Mandra became the incentive for the creation and implementation of the "Natural Disasters Club" for senior high school students of Nea Genia Ziridis School. Students will get to know the different kinds of natural disasters, the basic variables/parameters of such disasters and the instruments/apparatus related to them. They will become aware of what these disasters entail and will learn how to prepare in the event of one, as well as cultivate and acquire skills that will ensure their security and survival as well as that of the people around them.

Presentation and qualification of an educational interactive software focused on the microscopic structure of matter

Drolapas Anargyros, Gikopoulou Ourania, Kalkanis George

National and Kapodistrian University of Athens

This study presents an interactive software that depicts the structure of matter in a microscopic level using animated representations. By using this software it is possible to teach basic concepts about the structure of atomic models and matter. Helping pupils to spot the differences in structure between solid, liquid and gas state. By visualising expansion and contraction, as well as the correlation between temperature and the speed of particle movement in matter. The presentation of the software is accompanied by the results its use in the classroom, where it is reflected that it has helped to cope with cognitive difficulties that are widely reported in the bibliography.

Development of an assessment tool for Metamodeling teaching practices: Implementation in a Case Study in Primary School

Drongiti Eleftheria
University of Western Macedonia

In this paper are analyzed the teaching practices of a primary education teacher, which promoted metaknowledge regarding the Modeling Competence. The direction of analysis includes the levels and categories of metacognitive teaching practices that promote metamodeling knowledge of models and modeling. From the results emerged that the metacognitive teaching practices promoted the highest level of metamodeling knowledge, emphasizing the nature of the models.

Physics in my City

Drougas Ag.Vasileios
Department of Informatics and Telecommunications University of Ioannina Greece

A physics discovery game and its applications in the city we live in. Students discover physical application points in an embossed model. They lift a construction application into data points, discover words and concepts related to the application. Based on these words, they look for group-by-team information by creating a task for the subject that they present to other students. Each team with names, engineers, physicists, environmentalists, manufacturers, to showcase a physics application in the city, proposing changes and arrangements that will help human life. They discover solutions to collaborate with other sciences and create new applications.

Real 3D model for observation of the weight force

Drougas Ag. Vasileios [1], Kotsis Konstantinos[2]
[1]Department of Informatics and Telecommunications University of Ioannina
[2]PTDE University of Ioannina

This paper presents a real three-dimensional model for observing the force of weight in vertical direction as a body moves on a ramp of different gradients. Students can measure the angle of force's deflection force relative to the vertical direction on the contact surface with a numbered fit. Also substantiate views of direction of the vertical reaction from the ground to each location. Its usefulness is focused on real depiction, experimentation, exploratory learning, elevating skills and building skills of students. It highlights the force as three dimensionally complementary to the theoretical approach of the school book as an experiential observation.

Real 3D model for the buoyancy force

Drougas Ag. Vasileios[1], Kotsis Konstantinos[2]
[1]Department of Informatics and Telecommunications University of Ioannina
[2]PTDE University of Ioannina

This work is a presentation of the real three-dimensional model of the buoyancy force in a body immersed in a container. It helps students to understand the existence of the force and its change in a body that inside a liquid. It was created to highlight the force of buoyancy in a real presentation and students to understand the appearance and direction. Its usefulness is focused on real depiction, experimentation, exploratory learning, and elevating skills and constructive ability of students. It highlights the existence the force in three-dimensional of theoretical approach in the Gymnasium schoolbook as an experiential observation.

Incorporation of modern electronic components and technologies into the educational process of Physics

Eleftheriou Georgia, Gikopoulou Ourania, Kapotis Efstratios, Kalkanis George

National and Kapodistrian University of Athens

The educational process of Physics in late primary and early secondary education is deficient in the inclusion of modern electronic components (LEDs, printable circuits, etc.). This study attempts to ascertain whether it is possible to incorporate them into experiments for students in teaching. For this purpose, novel experiments were developed and evaluated, which were appropriately integrated into worksheets, following the model of the inquiry based learning.

Evaluation of students' learning outcomes of 6th grade of Primary School using the SOLO taxonomy: Teaching the reflection of light using the simulation M.A.T.H.M.A.

Evangeloua Filippos and Kotsis Konstantinos

Department of Primary School Education, University of Ioannina, Ioannina, Greecea

This study explores the conceptual understanding of 56 Elementary School students that performs virtual experiments - using the simulation software "MATHMA" - for the phenomenon of reflection of light. The SOLO taxonomy is used to evaluate the learning outcomes. The results which presented in this research support the argument for the learning value and the contribution of simulation to the teaching and learning of Science.

Contribution of the ILS platform (Inquiry Learning Space) in teaching photosynthesis through inquiry

Fermani Maria[1], Mavrikaki Evangelia[2]
[1]Department of Biology at the National and Kapodistrian University of Athens, [2]Department of Primary Education at the National and Kapodistrian University of Athens

The Go-Lab program, a European collaborative project, is dedicated to promoting and supporting STEM education, which in turn is based on inquiry-based educational approaches. The present study evaluated the contribution of Go-LAB in teaching photosynthesis. The study sample consists of 92 second-grade high-school students, and the educational intervention was comprised of three teaching hours. The success of the intervention was evaluated through a multiple-choice questionnaire. The analysis showed that after the intervention, students (regardless of their gender) displayed a statistically significant improved understanding of the subject ($p<0.01$).

Implementation of an innovative educational learning scenario for elementary school pupils. Developing actions to understand the hydrologic cycle

Zygouris Fotios[1], Kapoulitsas Athanasios[2], Antoniadou Sofia[2,] Makatsori Angeliki[3], Vlachou Vasiliki[2]
[1]University of Western Macedonia, [2]Primary Education Teacher, [3]Secondary Education Teacher

Understanding the hydrological cycle is an important element in the learning of natural sciences by primary school children. However, the perceptions that have them raise questions in understanding natural phenomena. The implementation of the educational application with the help of the scratch program enabled the interaction and learning of children. More specifically, the analysis of the questionnaires found that children understood the specific natural phenomenon and their knowledge increased significantly. One of the most important elements was the great cooperation and interaction between them, but also the prevailing of a constructive learning climate.

A cross-age study of students' predictions in novel situations

Fotou Nikolaos, Abrahams Ian
[1]University of Lincoln, College of Social Sciences, School of Education, Science and Technology Education Group

This paper reports on a study that examined the reasoning students across a wide range of age followed in order to make predictions in situations they had not considered before being asked about. Here, a cross-age comparison of the reasoning followed and whether the predictions made were compatible with the scientific account is presented. The data reported were drawn from focus groups and a questionnaire that Greek students from primary and secondary education were asked to fill in. The findings indicated the importance of analogies in students' prediction-making which, however, in most of the cases led them to prediction incompatible with the scientific account.

Evaluation of Usability and Effectiveness of a Cognitive Tool for Drawing and Handling Structural Formulas of Organic Compounds

Ganiti Despoina[1], Passias Lazaros[1,] Vlacholia Maria-Panagiota[2], Koutalas Vasileios[1], Charistos Nickolas[1], Sigalas Michael[1]
[1]Department of Chemistry, Aristotle University of Thessaloniki [2] Department of Chemistry, National and Kapodistrian University of Athens

In this study we present the evaluation of usability and effectiveness of the cognitive tool 2DrawChemQuiz, which enables free drawing and handling of structural formulas of acyclic organic compounds, via directed tasks for solving chemistry problems. Students of 2nd grade of General Lyceum and experts gave positive evaluations of the tool's usability. Specific interaction patterns of experts during the problem-solving tasks were identified. The engagement of students with the tool improved their performance in questionnaires involving the understanding of structural formulas.

Energy and related scientific concepts, as these are perceived by upper secondary school leavers

Garyfallidou M. Despina[1], Ioannidis S. George [2]
[1]Marasleio Experimental school of Athens [2] School of Education, University of Patras

The concept of energy, fundamental as it is to understanding our world, is essential in defining other scientific concepts. Upper secondary school-leaver's ideas (mainly, though not exclusively studying arts-oriented subjects) have been studied herein, using a specially designed questionnaire. In it, some fictitious discussions are presented, in a form of internally consistent arguments amongst imaginary students. Participants were asked to select whose train of thought they agreed with, and to justify their choice, using their own words. Their replies to these open-answer questions have been suitably analysed and presented herein, while some interesting results are drawn.

Investigating high-school students' difficulties regarding concepts of Chemical Kinetics

Gegios Theodoros, Salta Katerina, Koinis Spyros
Department of Chemistry, National and Kapodistrian University of Athens

In this study we investigated the learning difficulties that high school students encounter with chemical kinetics. A questionnaire consisting of multiple choice questions and short answer objective type questions was developed, following its evaluation, it was administered to 619 students, in 27 General high schools across the country. Research results show that students face difficulties in recognizing the conventions of symbolic representations, performing the mathematical operations required, distinguishing between kinetic and thermodynamic concepts and recognizing and/or understanding the plethora of information conveyed in diagrams as well as their abstractions.

Investigating the efficacy of socioscientific issues (SSIs) as a teaching framework for developing argumentation skills in the absence of relevant prior knowledge

Georgiou Martha[1], Mavrikaki Evangelia[2], Constantinou Constantinos[3]
[1]Head of N.Smirni's Science Laboratory Center, PhD in Science Education, [2]Associate Professor, Faculty of Primary Education, NKUA, [3]Professor, Department of Education, University of Cyprus

In this study we investigated whether high school students can effectively argue on SSIs of Biotechnology when they lack the relevant knowledge but they have been taught Biology over at least two years in a context that is considered to enhance argumentation skills. Twenty Cypriot students participated in this study. They responded to open-ended questions in writing. The results show that arguments tended to be perfunctory but students were aware of the process of developing an argument and its fundamental elements, despite the absence of relevant prior knowledge.

A proposal to introduce "Structure of Matter" in secondary Education

Gialavouzidou Peristera[1], Renti Anna[1], Hatzikraniotis Euripides[2]
[1]Postgraduate Course on Physics Education & Educational Technology, Department of Physics - Aristotle University of Thessaloniki, [2]Department of Physics - Aristotle University of Thessaloniki

Nanoscale science and engineering (NSE) is an emerging field, therefore it's appropriate teaching the fundamental notions of which it is composed. These notions are the central concepts of Nanoscale, are called Big ideas and they are nine. This project is proposal regarding an introduction to the concept "Structure of Matter" in secondary education. Especially, a new teaching method is suggested which sets three goals taking under account the pre-existing knowledge of students in atomic and kinetic theory, the students' misconceptions and the difficulties they may encounter.

Pre-service elementary teachers develop teaching material based on a visit in a research center

Giannakoudaki Kalliopi, Kokolaki Athanasia, Stavrou Dimitris
Department of Primary Education, University of Crete

The teaching of cutting-edge research subjects is thought to increase students' interest about science and at the same time enable them to experience the way scientific knowledge is developed. In this direction, the contribution of students' visits in out-of-school contexts, such as research centers, seem to be significant. The present study attempts to study the way in which pre-service elementary teachers develop educational material for the teaching of a contemporary scientific subject based on their visit to a research center.

Study of school visits in a research center for Science teaching on cutting-edge research topics

Giannakoudaki Kalliopi, Stavrou Dimitris
Department of Primary Education, University of Crete

This study aims to point out the extent to which Secondary Education teachers take advantage of a visit to a research center, in Science teaching and more specifically on cutting-edge research topics. During the first phase of the research, the existing educational programs of the Foundation of Research and Technology in Hellas (FORTH) were studied, while at the second phase of the study, two Communities of Learners (CoL), composed of teachers, researchers of FORTH and Science Education researchers, were formed. The aim of each CoL is to design the school visits at FORTH in such a way that cognitive benefits for the students will be optimized. The findings of the first phase are presented, while the findings of the second phase, which is in progress, will be presented at the conference.

The scientific / educational method with inquiry and the scientific way of thinking – An investigation

Gikopoulou Ourania
National and Kapodistrian University of Athens

In order to investigate whether the scientific/educational method by inquiry develops the scientific way of thinking a research was conducted on 5.654 students (years 1998-2016) at the University of Athens. 3.417 of these were exercised in laboratory experiments not incorporated into a teaching method, while 2.237 performed the same experiments incorporated into the steps of the method. The comparison of the recorded answers of the two groups showed the superiority of the students of the second group in terms of accuracy and completeness of their conclusions, interconnection of their conclusions with the theory and their applications.

The pre-existing ideas and the representations of undergraduate Primary-Education teachers on the wave-particle duality, the wave interference and the wave diffraction.

Gkiolmas Aristotelis, Stoumpa Artemisia, Skordoulis Constantine, Lazos Panagiotis & Chalkidis Anthimos
Department of Primary Education, University of Athens, Greece

In the current paper, an investigation is presented, concerning the pre-instructional ideas, the views and the representations of prospective Primary School educators, on the wave-particle duality, on the wave interference and on the wave diffraction. This research is an initial stage o a broader research, aiming at the construction of a teaching model for the instruction about the wave-particle nature of matter, to educators not possessing a very rigid Mathematics' and Physics' background. The undergraduate students answered to questionnaires concerning the aforementioned phenomena and concepts. Rom the processing of questionnaires, conclusions were drawn, as regards the way that the students conceptualise and what they do believe about these phenomena and concepts, without, enough among them, ever being taught about the former until now.

Forming young researchers: Exploring and understanding of geosciences at museums' laboratories as a form of informal education

Goula Panagiota, Starakis Ioannis, Galani Lia
Faculty of Primary Education, National and Kapodistrian University of Athens.

Subject of study of this research is the development of an informal education project with the purpose of the acquaintance of primary school pupils with the concepts of geosciences, such as geological time, fossils and rocks. The research was conducted on 44 pupils of the 6-grade of three primary schools of Attica. With the aim to evaluate this intervention questionnaires of cognitive and psycho-emotional content were developed before and after the intervention. The implementation of the project shows that students can perceive these concepts, while in some cases they face difficulties to find the relative place of events of the Earth's history.

Future teachers' environmental behavior: Study for e-waste management and recycle

Goulgouti Anastasia, Plakitsi Aikaterini, Stylos Georgios, Aslanidou Euaggelia, Ntantou Glykeria
University of Ioannina

The purpose of this study is to investigate the environmental behavior of 124 future teachers at Pre- School Education department at University of Ioannina concerning electronic waste and solid waste. Statistical analysis reveals moderate participation in recycling despite future teachers' awareness of the problem of electrical and electronic devices. At the same time, the reasons that prospective teachers recycle or reuse objects highlight the crucial role of family. Finally, future teachers refer the ways in order to promote recycle and highlight the importance of information.

A Professional development program for primary teachers: explicit introduction of the Pedagogical Content Knowledge inquiry aspects

Haitidou Maria, Spyrtou Anna, Kariotoglou Petros
University of Western Macedonia

This research focuses on 13 primary teachers' views of Pedagogical Content Knowledge (PCK) inquiry aspects, during a professional development program. The program consisted of two phases. Specifically, the first phase includes: (i) the explicit introduction of inquiry aspects of PCK based on Otto & Everett's PCK model and (ii) teachers' engagement in an inquiry teaching approach concerning Nanotechnology. In the practice phase teachers design and implement two teaching approaches concerning Nanotechnology and Density in their own classrooms. Results indicated that teachers extended their PCK inquiry teaching-learning views.

High school students' ideas for chemical bonding through the construction of static models

Haritos Costas[1], Salta Katerina[2], Antonoglou Lemonia3, Koulougliotis Dionysios[3]
[1] Model Lyceum of Anavryta; [2]Science Laboratory Center of Ilioupolis, Athens; [3]Department of Environment, Ionian University

In this work, we present the ideas of high school students regarding chemical bonding, as they were brought out from the analysis of the drawings of static models provided by 68 students. It was shown that their ideas may be classified into 7 and 6 models for the covalent and the ionic bond, respectively. A portion of students, which does not represent the majority, provided models which are in accordance to what is taught in the class. However, the study shows that in general the students who participated in this study tend not to perceive the notion of the chemical bond as a representation which aims at providing explanations for the observed properties of the substances that constitute the materials.

The historical routes of herbs and their use in cosmetology

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[1]M.Sc. Environmental Education Officer Athens A Directorate of Secondary Education; [2]Greek Language Teacher 22nd High School of Athens; [3]Greek Language Teacher 22nd High School of Athens; [4]Greek Language Teacher 22nd High School of Athens

Initially there will be a presentation of the two parallel environmental projects that took place in the 22nd High School of Athens. There will be a presentation of the creation of our herb school garden and the workshops concerning the use of herbs in our school. In the seminar organised by KPE Makrinitsas an experiential workshop was held by our team which included recognition of herbs and aromatic plants through the sense of smell (aromatic poaches) and taste (herbal brews), creation of aromatic poaches with herbsand the manufacture of a cosmetic cream based on the herb "aloe vera". Finally there was a presentation of herbs and their basic properties.

Master's Students' SYMPOSIUM Introducing Science, Engineering & Technology of the NanoScale in Education

Hatzikraniotis Euripides[1], Spyrtou Anna[2]
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This symposium attempts an introduction of the Nanoscale Science, Engineering & Technology (NSET) in education. The purpose of the symposium is to give postgraduate students the opportunity to present their work on one of the most modern subjects of Science, such as NSET, and thus to show their developed content transformation skills. The symposium consists of two parts: the first includes proposals for introducing basic concepts of NSET in education, while the second is related to the design, development, implementation and evaluation of educational material and teaching interventions.

Design Based Learning in the subject of physics: Measuring the change of interest and cognitive development of lower secondary education school students

Hionis Georgios[1], Halkia Krystallia[2]
[1] Secondary Education, [2] Faculty of Primary Education, School of Education, National and Kapodistrian University of Athens

This study refers to a teaching intervention based on Design Based Learning, implemented to ninth grade students of a public school, in the subject of physics. The main objective was to study the change in students' interest in physics and their cognitive development, as opposed to a guided inquiry approach. The results showed that the intervention increased the students' interest in the teaching process, maintained a greater interest in physics, while on a cognitive level, although it had equivalent direct results as compared to guided inquiry, it showed better long-term results, especially for the female students.

Review of Science Teaching Interventions using Technology to Students with Intellectual Disability

Iatraki Georgia, Soulis Spyridon-Georgios,
Department of Primary Education, University of Ioannina

The present study attempts to record and evaluate Science teaching interventions, using modern Technology, to students with intellectual disability, in order for them to gain access to academic content. To identify and review these interventions, we conducted a systematic review of the primary research literature, published between 2013 and 2018. Four case research studies were identified through determined inclusion criteria. The study concludes with a discussion, where the contribution of the review and the restrictions for practice are noticed. The necessity for continuous research in natural science teaching to students with intellectual disability is also emphasized.

STEM integration in Primary school: Perceptions of teachers with experiences in innovative projects

Iatrou Paraskevi, Spiliotopoulou Vasiliki
Department of Education, ASPETE

This paper investigates primary teachers' perceptions in terms of the STEM practices in elementary classrooms and the meaning of integrating Science and Mathematics with everyday situations and the world of work. Structured interviews have been conducted with 6 teachers, who had been involved in innovative projects, with the goal to identify their positions and difficulties. This STEM integration seems to be conceptualized as cross-thematic approach, as connection of different subjects, as enrichment of teaching with everyday situations, and as contextualization of knowledge in teaching. In addition, conceptions of unified vision of knowledge, as well as science and mathematics as an integrated body of knowledge have appeared.

Study of practices and perceptions of in-service teachers through the process of designing and implementing an educational field trip in a science education laboratory

Iliaki Georgia, Stavrou Dimitris
Department of Primary Education, University of Crete

The purpose of this study is to explore the attitudes and perceptions of in-service teachers as they go through the process of designing and implementing an educational field trip with their class in a science education laboratory. The sample was nine in-service primary teachers, who visited the Science teaching laboratory with their students. The results highlight the need for teacher education in through the process of designing and implementing an educational visit in order to make full use of the learning outcomes of such a visit.

Detecting misconceptions of High School students on the concept of force: Achieving cognitive conflicts using simulations

Ioannidis N.Christos [1], Zacharis K. Georgios [2]
[1]3rd Lyceum of Xanthi, [2]Hellenic Open University

This work aims at detecting the perceptions of students of Lyceum students' of the first grade in Greece through a questionnaire, on the concept of force and on bodies' interaction. In addition, it aims at achieving cognitive conflict with the use of didactic intervention according to the exploratory model and the use of ICT. The results of the initial questionnaire indicate that students' perceptions are consistent with those of the literature. At the same time, some of their initial perceptions after didactic intervention using simulations seem to shift to the scientifically acceptable according to the results of the final questionnaire.

Remaining non-bias systematic errors and their role in education research

Ioannidis S.George
School of Education, University of Patras, Greece

The various types of systematic measurement errors are analysed herein, with an emphasis on education research where, as explained, their value is larger than is commonly assumed. The existence of bias-type systematics is explained and examples are given, as well as methods of their numerical evaluation. The difference between bias-type and remaining (non-bias) systematic errors is explained. A novel consideration of remaining systematics according to their contributing sources follows, and examples are given for each category. Increased awareness about various systematic error contributions and their numerical handling of is expected to increase precision, dependability, and reproducibility in education research.

An analysis of practical activities in middle school Physics textbook of the first grade

Ioannidou Olga [1], Skoumios Michael [2]
[1]Secondary Education, [2]Department of Primary Education, University of the Aegean

The purpose of this study is the analysis of practical activities that are included in the first grade of middle school Physics textbook. In total, 12 worksheets of practical activities were identified and analysed. Millar's framework (2009) for practical activities was used for the analysis. Through the analysis it was possible to distinguish the main and secondary educational goals and some aspects regarding the design and presentation of activities.

Conceptual approach of Engineering Design Process for STEAM activities in Kindergarten

Ioannou Michalis, Bratitsis Tharrenos
University of Western Macedonia

In recent years STEAM education has become an important field of research. Engineering is a field that lately attracts more attention in Early Childhood Education and Kindergarten. It seems that it can be realized, mainly, through the Engineering Design Process. The introduction of Engineering in the young ages offers children the opportunity to develop knowledge and skills also in other fields as well, like Science and Mathematics. In this paper the various Engineering Design Processes for education settings are presented and a new suitable EDP for Kindergarten is proposed.

Employing Literature in the teaching of Geo-Environmental courses

Iordanidis Andreas
Western Macedonia University of Applied Sciences, Department of Environmental Engineering

This study refers to an innovative approach in the didactics of Geo-Environmental subjects in universities with the help of literature extracts. This is applied by the writing author, who is teaching relevant courses in a Greek university during the last twenty years. Literal works, dated back to the 19th and 20th century, from the following Greek and foreign scholars are utilized: Papadiamantis, Vizyinos, Roidis, Kondylakis, Tsitselikis, Papantoniou, Venezis, Tatsopoulos, Jerom, Pamuk, Klima. The academic courses include Mineralogy/Petrology/Economic Geology, Environmental Pollution/Engineering, Ecology/Protection of the Natural Environment, Natural Hazards and Geological Heritage.

Teaching the "Natural and Cultural Heritage" course at universities

Iordanidis Andreas
Western Macedonia University of Applied Sciences, Department of Environmental Engineering

The course "Natural and Cultural Heritage" is being taught at the Western Macedonia university of Applied Sciences for five successive academic years. In the frame of the later course, students are asked to produce a presentation regarding tangible and intangible monuments from their home places. Thus, a remarkable database is being created, encompassing monuments from all over Greece (and abroad). All these data will be uploaded in a new, relevant website, wherein all potential scholars, interested in cultural/natural heritage issues might have access.

A stereoscope viewing of the micro-cosmos

Iordanidis Andreas
Western Macedonia University of Applied Sciences, Department of Environmental Engineering

The introduction of stereo-microscope viewing to primary school pupils is addressed in this work. A trinocular stereoscope from Euromex company, which is capable for observation under both incident and transmitted light was employed. The stereoscope was connected to a laptop via a CMEX-1 digital colour camera, all images were retrieved with the ImageFocus software and the observation could be video-projected in live time. Several kinds of fine particles were chosen for viewing, including spores (e.g. tomato, beetroot), fossils (e.g. shark tooth, animal bone), minerals (e.g. obsidian, potash) etc.

Embodied developments in preschool children's ideas about day/night cycle

Irakleioti Evangelia[1], Pantidos Panagiotis [2]
[1]Preschool teacher, [2]Assistant professor, SECEd, Aristotle University of Thessaloniki

The current study examines whether preschool aged children's bodily explanations are responsible for any developments in their thinking. The study was conducted in three phases (pretest, teaching intervention based on the human body, posttest). The pretest and posttest were similar and consisted of three tasks. The first task was based on children's verbal discourse, the second one on their drawings and the third on their human bodies. It was shown that the children achieved to develop their ideas on some aspects of the day/night cycle phenomenon using exclusively their bodies.

Interpretation and utilization of written feedback by elementary students

Irakleous Evangelia, Constantinou Costas
University of Cyprus

The purpose of the present study lies in investigating the use of written feedback comments by students. The participants were 11 elementary students. The data were the students' decoding of written feedback, video recordings of students' discussions while decoding and interpreting teacher's feedback and individual semi-structured interviews with students. The data were analysed qualitatively and quantitatively. The analysis of the data revealed that students had difficulties in decoding and interpreting teacher's feedback comments. Many of teacher's comments were decoded in a wrong way.

Investigation of preservice teachers' Pedagogical Design Capacity and Pedagogical Content Knowledge for Inquiry based Learning within their participation in a professional development program

Irakleous Maria, Papaevripidou Marios, Zacharias Zacharia
University of Cyprus

The study aims at examining preservice elementary teachers' curriculum materials that they designed during their participation in a Professional Development Program (PDP), in an attempt to unravel their Pedagogical Design Capacity (PDC) and Pedagogical Content Knowledge (PCK). The data sources involved mainly teachers' curriculum materials. The data were analyzed using the grounded theory method. The data analysis revealed that the curriculum materials were developed along five PCK dimensions. A number of curriculum materials' characteristics were identified for each one of these dimensions, which in turn were clustered along three levels and revealed teachers' PDC and PCK per dimension.

In-service primary teachers develop and apply teaching modules based on microcomputer-based-laboratory activities

Kalatzantonakis Michalis, Stavrou Dimitris
Department of Primary Education, University of Crete

The rapid development of technology, has led to the integration of technological achievements, such as Microcomputer-based-laboratory (MBL), providing a wide range of teaching possibilities to the teacher. Teachers, seem to face problems trough the implementation of MBL in the classroom, and mostly towards the use of Inquiry Based Learning (IBL). This study, explored the way in which MBL are used by five in-service primary school teachers, who were trained to design and implemented teaching in their classrooms, using MBL.

Deficits in Physics Education "from Lyceum to University" – A Research and Suggestions

Kalkanis George, Tombras George
National and Kapodistrian University of Athens

Greek Physics-curricula for upper-secondary education are designed taking into consideration neither the needs of the university nor of those who are to become university students, thus leading to knowledge deficits and depriving university students from unobtrusive progress in their studies. We conducted a study on 728 students. Our research questions were the clarification of such deficits (if they are indeed any) in the material theoretically and experimentally taught in Greek lyceum and the formulation of proposals to remedy the situation. Our findings not only affirm as the main deficit the lack of experimentation, but also highlight its extremely high percentage (96%).

Cognitive Style and Motivation in Science: The Case of Structured Inquiry in Early-Years Education

Maria Kallery[1], Angelos Sofianidis[1], Popi Pationioti[2], Kaliopi Tsialma[3], Xristina Katsiana[2]

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Differences in children's motivation in science can be explained by the theory of "systemizers" and "empathizers". Researchers claim that people with "systemizing" cognitive style have a higher motivation for science. They propose a suitable formulation of didactic approaches to motivate children with an "empathizing" brain. The aim of this work is to investigate how pre-school and early-primary children respond to structured inquiry activities with specific characteristics according to their cognitive style. The results showed high percentages of the highest level of engagement/involvement and high success rates in assessment for all types of children's brain. The findings suggest that such activities may be appropriate for triggering the motivation of young children with all types of brain.

Introducing computational thinking and fundamental object-orientated programming concepts in early childhood education within the context of physical and natural science courses

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In the contemporary digital era, introducing computational thinking concepts is considered essential at all stages of schooling, since it is linked to skills applicable and beneficial in everyday life. In this study, we present a novel educational framework that aims to foster the growth of computational thinking at the first and second grade of primary school, within the context of physical and natural science courses. We also report two pilot studies of the framework, aiming to examine the achievement of

goals set, as well as its feasibility. Findings are very promising and form the basis of a relevant extensive research.

From historical hygrometers to educational self-constructions and experiments - A research

Kapotis C.Efstratios
National and Kapodistrian University of Athens

Using as a trigger of interest historical hygrometers of the last century, which are only available in Science and Technology Museums, we constructed three different hygrometers with simple materials. These hygrometers can be constructed by teachers and students and can be used for educational experimental devices. They were already tested for their potential to be constructed in schools and were implemented in the context of relevant work by groups of students of all school grades, supported by specially designed worksheets that followed the scientific/educational method by inquiry. The evaluation showed the feasibility of their educational value and utility.

Evaluation of Educational Material of Environmental Education Centers of Western Macedonia: Learning Objectives in the Context of Sustainable Development

Kapoulitsas Athanasios, Amprazis Alexandros, Papadopoulou Penelope
University of Western Macedonia

The present study examines the objectives of the programs of the four Environmental Education Centers (EEC) of Western Macedonia, based on the 17 goals for sustainable development as defined by the UN. Content analysis was carried out and, according to the results, a significant number of the sustainable development aims are not recorded in the EEC programs. In addition, an emphasis on cognitive goals compared to socio-emotional and behavioral is presented. The results demonstrate a potential need to redefine the content of EEC programs with a view to updating them and adapting them to the modern directions of efficient, sustainable development.

An educational proposal for the introduction of the Least Action Principle with lines of equal height–potential

Kapoyannis Athanasios, Kapotis Efstratios, Kalkanis George
National and Kapodistrian University of Athens

In this paper we present an attempt to introduce educationally the Least Action Principle to students of departments with a main subject of Physics studies. The main part of the proposal is the association of the Least Action Principle with the use of lines of equal height used to depict the geographical relief in two-dimensional maps, stretching, however, the existed differences. In particular, the proposal is applied to the motion of constant velocity and the vertical motion from the ground with initial speed. For this effort, educational worksheets that followed the scientific/educational method with investigation were also created.

Assessing the effectiveness of storytelling in teaching NOS related issues from the teachers' scope

Kapsala Nausica, Mavrikaki Evangelia
National and Kapodistrian University of Athens

Nature of science (NOS) is an important part of science education; nonetheless, teachers tend to neglect it mainly due to lack of time and lack of resources. We propose that telling stories derived from the history of science, combined with discussion is a suitable way of teaching NOS. Twenty-two teachers who initially attended an experiential storytelling workshop, evaluated four stories about their NOS content, and storytelling as a method after adopting it as a teaching method in their classes. Our results show that they recognized storytelling as a useful educational tool for teaching NOS and they were willing to apply it.

The exploitation of Art and Technology in the teaching of light and shadow

Christos Karageorgos[1], Terzi Vasiliki[2]
[1] 2o Primary School of Kalambaka [2]Experimental Primary School of Athens

The paper attempts to present an interdisciplinary approach to teaching light and shadow, as it appears in the classroom textbook, "Natural Urban. Explore and Discover. " It interconnects the concepts of light, shadow with art forms and the use of cameras. Photo creations and tables are presented by the students themselves aiming at understanding the sources of light and creating shadow. Students discovering the possibilities of modern technologies in the production of panoramic and threedimensional photographs have explained the way of encapsulation of light in digital imaging devices and made their own works of art by better understanding the concepts.

Explicit teaching about questioning skills

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Questioning skills is an integral part of learning and scientific inquiry. The aim of the research was to find out whether the explicit teaching of questioning skill can enhancing students questioning skill.The intervention was implemented in a class of 30 fifth grade students in the context of teaching about the linear propagation of light and the size of the shadow. Questioning skills assessing framework was based on 4 dimensions: Recognition of Questioning techniques, Prior Knowledge, Transfer and Disposition. Post-test showed that the explicit teaching of questioning skills allowed us to create an auxiliary framework for formulating scientific questions by increasing the degree of students' autonomy.

INVESTIGATION OF THE KNOWLEDGE OF THE STUDENTS OF THE DEPARTMENT OF INFORMATION AND TELECOMMUNICATIONS FOR ELECTROMAGNETIC WAVES

Karali I. Eleni, Drougas Ag.Vasileios
University of Ioannina Department of Informatics and Telecommunications

This work is based on research - action results that took place in students of the 1st year of the Informatics and Telecommunications School of Arta based on their knowledge of electricity and magnetism as part of my dissertation work. For the purpose of the survey, a properly formulated questionnaire with 10 key questions was created. Which students were asked to complete anonymously. From the analysis and the statistical study of the students' answers came out significant results for their knowledge of Electro-, Magnetism, Electromagnetic Waves and their relationship with corresponding experiments from high school.

Teaching Science and "Environmental Studies": the types of instructional material used by teachers

Karampelas Konstantinos [1], Skoumios Michael [2]
[1]Department of Primary Education, University of the Aegean, [2]Department of Primary Education, University of the Aegean

This study investigates the types of instructional materials that elementary teachers use in science in the 5th and 6th grade and in "environmental studies" in the 3rd and 4th grade. A total of 320 teaching sessions have been observed and the types of instructional materials used in every five-minute interval. It was concluded that in both science and "environmental studies" conventional types such as the textbook are used more frequently, whereas technological such as software are used less. Moreover, differentiations were noticed in the instructional material used between science and "environmental studies".

Design, development, implementation and evaluation of activities for biodiversity teaching in adult groups: A pilot study

Karapatsiou Evgenia, Papadopoulou Penelope
University of Western Macedonia

In recent years, planet's biodiversity undergoes a significant loss due to anthropogenic changes in ecosystem functions that affect every form of life, making it difficult to maintain and enforce its protection. This paper presents the design, development and evaluation of activities that have been implemented in adult education concerning biodiversity knowledge. The results of implementation showed that activities improved the trainees' knowledge of the concept of biodiversity, in particular the majority could, at the end of intervention, identify the loss of biodiversity, its causes and the high importance of its preservation.

Perceptions of lower secondary school students concerning glacier changes after teaching approaches with satellite images

Karatza Athina [1], Galani Lia [1], Parcharidis Issaak [2]
[1]National and Kapodistrian University of Athens, [2]Harokopio University

According to literature, satellite imagery and its use in teaching enhance the development of geographic thinking and the more holistic understanding of the problems the conscious citizen of the future will encounter. The purpose of this study was to investigate students' perceptions concerning glacier changes and their causes after implementing a teaching approach with satellite images created by ESA on the one hand, and, on the other, an approach with proposed improvements. According to the results, most students perceived glacier retreat over the last few decades, while the majority interpreted the phenomenon referring to one factor at a time.

Implementation and evaluation of a TLS for the instruction of concepts of the Stars continuous spectrum

Kardaras Ioannis Kallery Maria
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In the present study, a brief description of a Teaching Learning Sequence (TLS) is given for teaching the concepts of physics in the 2nd Lyceum describing the continuous spectrum of the Star as well as its application. Stars are considered blackbodies and therefore they can be described with the same laws and concepts. Also, the results of the students' perceptions of the experimental activities carried out as well as their cognitive results are presented. The two above were evaluated by questionnaires. The results showed that the intervention had a significant impact both on the positive attitude of the students towards the experiments and on their cognitive progress.

Teachers and museum educators' views about inquiry practices: the aftermath of a joined professional development course

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STEM education has gained special attention both in formal and non formal education. Therefore, both teachers and museum facilitators' role is viewed with a common lens and is in the heart of a number of EU funded programs. In a small scale research, we studied two teachers and two museum facilitators who shared a joined professional development course on the Tinkering approach in the context of a EU program. We looked for their views about their teaching practices and the joined course. The outcomes of the research will determine the following steps.

Inquiry-based laboratory activities for material identification

Katana Eleni [1], Salta Katerina [2]
[1]Science Laboratory Center of Omonoia, Athens, [2]Science Laboratory Center of Ilioupolis, Athens

The present study presents a set of inquiry-based laboratory activities which concern the identification of materials based on their macroscopic physicochemical properties. The activities aim at involving students in scientific practices, and increasing their motivation for learning on an everyday life context.

Investigating Difficulties When Using Sensors of Mobile Devices in Teaching Physics

Kateris Alexandros[1], Lazos Panagiotis[2], Tsoukos Serafeim[3], Tzamalis Pavlos[4], Velentzas Athanasios[5]
[1]2nd Experimental Lyceum of Athens, [2]National and Kapodistrian University of Athens, [3]2nd Experimental Junior High School of Athens, [4]Agricultural University of Athens, [5]National Technical University of Athens

The present work is part of a wider study on the difficulties encountered during experimenting in the school science lab by using sensors of "smart" mobile devices (MDs). Specifically, we investigate experimental data differences and other possible "technical" difficulties during measuring sound and light using MD sensors, caused by the fact that students have a great variety of MDs (different models and software). Ways to overcome these obstacles are discussed and proposed.

Augmented reality of pupils' assignments in biology of lower and upper secondary education

Katsakoulas Ioannis [1], Galanis Mihalis [2]
[1]Gymnasium Emponas Rhodes, [2]3rd Gymnasium Petroupolis

A technique added in the armamentarium of teaching is the augmented reality. It lies in the incorporation of digital content in the display of the real environment either by image recognition or by geographical positioning. Most of the 66 pupils in A, B and C classes of both lower and upper secondary education showed renewed interest and desired the assistance of learning that pertains to the selected biology curriculum by this technique˙ however, only among other teaching techniques and occasionally.

Alternative ideas about science concepts in fiction books for children on air pollution

Kazantzidou Dimitra, Kotsis Konstantinos
Department of Primary Education, University of Ioannina

This study examines the scientific accuracy of science concepts and phenomena in the text of children's fiction books on air pollution. The texts were processed via qualitative content analysis method in order to record the errors and inaccuracies in science. The misrepresentations were organized in categories and related to examples of the potential children's alternative ideas. The results and the conclusions provide the educators with the common characteristics of the recorded inaccuracies about science concepts and phenomena together with recommendations on how to use these books in education.

The evolution of students' misconceptions from a Department of Primary Education during their studies in the concepts of Mechanics and of Scientific Literacy

Kitsiou S. Eleni [1], Kotsis Th. Konstantinos [2]
University of Ioannina, Department of Primary Education

This paper examines the effect of the year of study for students attending in a Department of Primary Education regarding the approach of issues which refer to matters of concepts of mechanics as well as of scientific literacy in Sciences. In addition, teachers' misconceptions are a subset of students' alternative ideas. So, in order to achieve our research goals a survey was conducted and a written questionnaire was distributed. According to the results, it seems that the number of correct answers and the year of study are dependent variables. Furthermore, the additional time of studies contributes positively to students' answers to engineering questions and neutrally to their answers to scientific literacy questions.

The effect of educational seminars on Natural Sciences in students' misconceptions from a Department of Primary Education for basic terms of Mechanics and of Scientific Literacy

Kitsiou S. Eleni [1], Kotsis T. Konstantinos [2]
University of Ioannina, Department of Primary Education

In this current part of the presentation examines the effect of attending educational seminars on Natural Sciences in the participants' misconceptions on both the notions of Physics and of Scientific Literacy in Sciences. The participants were 534 in total, male and female students in a Department of Primary Education and they were asked to fill in a written questionnaire of 50 questions. But, the individuals, who had attended an educational seminar on Natural Sciences, were just a few. Nevertheless, for those individuals, a statistically, important difference can be observed, both on the questions of scientific literacy and on the total amount of the questions, concerning the average compatible answers with the scientific attitude answers, in comparison with those of the rest of the participants.

The development of environmental ethics through nanotechnology products

Kizos Pantelis [1], Malandrakis Georgios [2], Spyrtou Anna [1]
[1]University of Western Macedonia, [2]Aristotle University of Thessaloniki

The aim of this study is to connect environmental ethics with Nanoscience – Nanotechnology (NST). Moreover, we present the fundamentals of an ongoing research aiming to develop environmental values, towards the enhancement of sustainability, through the selection of nanotechnology products. During the study we will develop a Teaching Learning Sequence (TLS) based on the teaching approach of Values and Knowledge Education (VaKE). Participants will be undergraduate students from Departments of Education. Our research questions aim to explore the values that are considered as important by students in selecting nanotechnological products, and the development of these environmental values through the TLS.

Differences between dyslexic and non-dyslexic students in their performance in a spatial and geospatial test: A pilot research

Klonari Aikaterini, Passadelli Anthoula Styliani
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This paper presents the results of a pilot study, that took place in Lesvos and Helias lower secondary schools. The aim was to identify any differences in spatial and geospatial abilities between dyslexic and non-dyslexic students, 12-14 years of age. The survey involved 50 students (25 dyslexic and 25 non-dyslexic) and was conducted using a questionnaire. The results showed that all students have problems with the development of their spatial and geospatial abilities, with dyslexics lagging far more in both, although they have achieved better results in 3D visualizations. No statistically significant differences were observed between boys and girls.

Socioscientific Issues: The development of an educational program for pre and in service elementary teachers

Kokolaki Athanasia, Stavrou Dimitris
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An educational approach of science education that is thought to contribute to the "coordination" of the cognitive, epistemic and social aspect of science is the socioscientific approach. Through this approach students get familiar with scientific concepts as well as the nature of science and the relationship among science, technology and society. However, the negotiation of socioscientific issues in science courses is a quite demanding process for teachers. Thus, the aim of this paper is to present a framework for pre service elementary teacher education to effectively manage these issues in practice.

Conceptual change in pre-school education: Case studies of collaborative model-based reasoning about astronomy

Kollas Spyros, Sakellaridi Eleni
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The notion of conceptual change as a dynamic process, that includes important aspects of intentional learning, is often questioned among preschool students, due to developmental constraints. The current study investigated whether a learning environment of collaborative model-based problem-solving could facilitate preschool children's conceptual change regarding the phenomenon of day and night cycle. The results show that collaborative reasoning - not only in the form of verbal explanations and argumentation but also as expressed directly through the coconstruction and manipulation of models- promoted the revision of their alternative conceptions, the examination and integration of new knowledge and the change of their pre-existing representations.

Modification of the Physics Department's laboratory classes for the accessibility by persons with visual impairment

Koniari Angeliki
University of Ioannina-Physics Department

People with visual impairment face obstacles in several learning and educational sectors, thereby restricting their scientific training. Their limited options include physics, which is made unfeasible at the university level, in both theoretical and experimental capacities. The aim of this task is to investigate and propose methods in making Physics laboratories accessible to young people with visual impairment. In this paper, we studied the laboratory infrastructure of the Department of Physics in Ioannina and of the new assistive technologies pertaining to these individuals, with the aim of producing a result concerning their functionality

Investigation of the development of spatial abilities in students through the use of digital spatial visualization applications

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This paper explores the contribution of the use of two-dimensional and three-dimensional digital representations in the development of spatial abilities concerning the size (dimensions, area) and the functionality of the space, to students of the Department of Civil Engineering Educators of ASPAITE intended to teach the lesson of Technology in the Secondary Education. The research was conducted through the design and the implementation of a 13-week teaching titled "Investigating and designing a kindergarten". The results of the research prove the positive contribution of 3D compared to the 2D digital representations (an improvement of 39.4% and 19.2% respectively) to the development of spatial visualization and spatial perception.

Using Geographic Information Systems and Satellite Images for the development of argumentation on socioscientific issues in secondary Geography and Environmental education

Konstantakatos Gerasimos [1], Georgiou Martha[2], Galani Lia [3], Skordoulis Constantine[4], Koutromanos George [5]

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This experiential workshop aimed to approach and negotiate a Socioscientific issue (case study) by developing appropriate argumentation through the capabilities provided by satellite images in conjunction with Geographic Information Systems (i.e. extraction of spatial information, classification, etc.). It is mainly aimed at teachers of secondary education, who would like to exploit and integrate satellite images into Geography classes. During the workshop, the potential use of satellite images and data as educational tools to solve socioscientific issues will be discussed.

Development, implementation and evaluation of a teaching-learning sequence (TLS) about energy footprint in primary school

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This study presents the development, implementation and evaluation of a Teaching-Learning Sequence (TLS) about teaching Energy Footprint as it was carried out in 16 5th grade students. Its goal was students' energy literacy through the understanding of the concept of Energy Footprint and the adoption of reduction practices from students. The TLS was implemented through 13 teaching hours. A questionnaire was administered aiming to assess students' knowledge and perception about energy issues before and after the intervention. The analysis of the questionnaire has shown that the students can comprehend environmental problems, however there was minor change of their behavior.

Educational proposal for teaching the rock cycle in geology

Kontokostas E. Georgios

Secondary Education

The limited exploitation and low understanding of geological notions and formation of rock, in modern education in physical sciences, motivated the design of research procedures about the understanding of rock cycle, using techniques entailed in the scientific / educational methodology by inquiry, suggesting/using prototype briefly representations of simple geological procedures. The most interesting point of the research was when the students realized that the complexity of the natural world arises from the combinations of few simple procedures.

Experiences of Exploiting the Flipped Classroom for Teaching 'Management of Natural Resources', Case study in Secondary Education

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This study is a case of applying the educational model of "flipped classroom", implemented in "Management of Natural Resources" (lesson in A΄class of Lyceum). The study aims to offering the necessary knowledge for the ways teachers can embody this model in their teaching. Furthermore, the difficulties of applying the method are registered, as they were pictured in queries answered by students. In conclusion, teaching in flipped classroom leads to increased interest of students in class and of course, their improved interaction in it.

Thunderbolt Hunt. Educational Program on Science Education under the prism of the Activity Theory at the Archaeological Museum of Ioannina.

Kornelaki Athina Christina, Plakitsi Katerina
University of Ioannina

The present paper proposes an alternative context in the Didactics of Science Education in non-formal settings of general interest such as the Archaeological Museum of Ioannina. The context is examined in the light of the Activity Theory while the scientific method processes as well as the interactions which take place during the educational program "Thunderbolt Hunt" are studied. The videotaped implementation of the educational program as well as the students' drawings and the research's field notes constituted the research data which were analyzed qualitatively.

Laboratory experiments in the course of Chemistry:Difficulties and Success Criteria used by Secondary Education Teachers

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Graduate Programme "Chemical Education and New Educational Technologies", University of Athens, Greece

We investigated the difficulties that faced 250 Secondary Education teachers when conducting laboratory experiments Chemistry, as well as the criteria that they set for evaluating laboratory teaching successful, using 74 closed questions in 9 groups. Analysis of the results showed that the majority of teachers used primarily expository and verification experiments, the main difficulties they faced are the large number of students per class and the limited hours available for the laboratory exercises and the teaching hours of the course, the main success criteria were the increase of interest for the subject of Chemistry and the pleasure of the whole process they gain.

Window in Astronomy: an interdisciplinary approach through 6th grade's Geography curriculum.

Koukioglou Stavros [1], Papaioannou Sofia [2], Molohidis Anastasios [3], Pantelidis Antonios [4]

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The removal Astronomy's course from the Secondary Education Curriculum combined with the sporadic reference of primary and secondary schools' textbook to astronomical information have resulted in the creation of a significant knowledge gap regarding students' understanding of Physical Science. This workshop aims to promote Astronomy as a tool for achieving the didactic objectives of Geography's course as well as a means of motivating and engaging students with Physical Sciences. For this purpose, the curriculum of Geography is capitalized in combination with ICT, through the use of freeware astronomical software

Enhancing junior highschool students' epistemological beliefs about models in science

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The adoption of science models and modeling practices in science education is a widely accepted method. However, students' beliefs about models deviate from the scientifically acceptable ones. This research aims to enhance students' epistemological beliefs regarding science models by the use of a model based, inquiry Teaching Learning Sequence as an intervention method, which contains modeling processes. The results suggest an increase in students' performance in their epistemological beliefs regarding the nature, purpose and change of scientific models. In addition, it is this study's intention to unveil the criteria by which students distinguish and categorize images representing obvious models from non-obvious ones, as well as from non-science representations.

An Evaluation study of the extent to which Nature of Science is included in science classes of Greek Secondary Schools

Koumara Anna, Plakitsi Katerina
Department of Early Childhood Education, University of Ioannina

The present work aims to record the degree that Nature of Science (NOS) aspects are embedded in science classes in the secondary schools of Greece. For the validity of results, various components (curriculum, school textbooks, knowledge/teaching of teachers, views of school inspectors and final knowledge of students) are analyzed. The curriculum and the textbooks' content is encoded, an international evaluated questionnaire was used and interviews were analyzed. As a result, it appears that NOS aspects are included in science classes of the Greek Secondary School to a limited degree.

Nanotechnology and its exploitation in the protection of our cultural heritage: A Teaching Learning Sequence for Preschool Children

Olga Kremmyda[1], Penelope Papadopoulou[1], Ioannis Karatasios[2], Anna Spyrtou[1]
[1]University of Western Macedonia, [2]NCSR Demokritos

The aim of this study was the design, implementation and pilot assessment of a Teaching Learning Sequence (TLS) for preschoolers, concerning Nanotechnology as a way of preserving our cultural heritage. The theoretical framework on which the design was based is presented as well the first implementation of the TLS to preschool students to a non-formal educational environment (scientific center). Our intention was to test, primarily, the possible improvement on the understanding simple scientific concepts and applications of Nanotechnology and how an environment of non-formal education can contribute to the learning of children.

Interdisciplinary approach of (co)teaching of Mathematics and Physics: The case of the capacitance of a capacitor

Kritikos Georgios, Moutsios-Rentzos Andreas, Pinnika Vasileia, and Kalavasis Fragkiskos

Department of pre-school education sciences and educational design, University of the Aegean

In this paper, we focus on the importance of interdisciplinary communication in the curricula and textbooks between school Mathematics and Physics. Giving as an example the capacitance of a capacitor, we try to identify learning obstacles created by the lack of this communication. We designed a pilot research on a sample of 28 postgraduate students who are teachers of different disciplines. At the same time, we searched for links of the research findings with the presentation of the relevant concepts in the school textbooks of Physics and Mathematics. Finally, we elaborated an interdisciplinary teaching framework, transforming the current one-discipline didactical model.

A TWO-DIMENSIONAL ANALYSIS OF THE RESULTS OF PISA 2015 SCIENCE LITERACY

KYPRAIOS NIKOLAOS

Tutor - Private Education

In this descriptive study, a comparison was made between the five most successful OECD countries with the less successful five, in PISA Science literacy in 2015. The analysis was two-dimensional: firstly through the financial and human resources invested in education, and secondly, through the learning environment and organization of schools. Data were obtained through OECD and PISA review documents. The results demonstrated that, in terms of the curriculum, school autonomy in decision-making, affect students' performance positively. Moreover, a non-linear relationship between class size and student performance was found. Implications on Greek students' low performance are discussed.

The Role of Significant Life Experiences in shaping environmentally literate citizens

Kyriazi Panagiota, Mavrikaki Evangelia
National and Kapodistrian University of Athens, Faculty of Primary Education

Research in the field of SLE (Significant Life Experiences) has been shown to contribute to the development of the goals of Environmental Education / Education for Sustainable Development. For this reason, it was considered necessary to include in the research instrument GELI, which measures the level of Environmental Literacy of post-secondary Greek students, questions exploring the SLE of the participants (N = 1010). The purpose of this paper is to highlight the importance of SLE in the formation of environmentally literate citizens.

Polymers in our everyday life and environmental challenges: Chemistry laboratory activities

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The present study presents innovative chemistry laboratory activities which concern the properties of polymers in everyday products. The laboratory activities aim at involving students in scientific practices, increasing their motivation for learning, and promoting sustainable development.

Gradient definitions of scientific concepts: the pedagogical approach of E.LE.FY.S.

Lefkos Ioannis[1], Mitsiaki Maria [2]
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In this paper, we propose a pedagogical approach of scientific term definitions as an essential component of scientific literacy in Physics. Such an approach makes use of the Illustrated Science Dictionary for School, which includes gradient definitions in terms of conceptual and linguistic difficulty. In the theoretical part of this article, we reflect on the necessity for the pedagogical approach of conceptual complexity in Science, whereas in the applied part we present the philosophy behind gradient definitions of ELEFYS, a freely accessible digital dictionary (elefys.gr).

Development of an innovative audiovisual material for the introduction of Nanotechnology in primary school: A review of the literature

Makariou Ourania [1], Spirtou Anna [2], Bouzas Vasileios [3]
University of Western Macedonia

Nanotechnology specializes in the study of structures with nanoscale dimensions. These dimensions are far from our sensory perception and therefore their approach and understanding meet difficulties. Audiovisual materials are projected as means that can contribute to face this challenge. In this context, the present work describes a methodology for the development of a specific audiovisual type that of animation, concerning a particular aspect of the Nanotechnology content, the Size. Specifically, we present the first step, the literature review. The results will be used to create a didactically transformed script addressing to elementary school students.

The Society we envision and Education for Sustainable Development: Investigation of students' views through experiential workshops.

Makris Athanasios[1], Malandrakis Georgios[1]
[1]Aristotle University of Thessaloniki

The participatory research, with experiential workshops, explores the views of undergraduate and postgraduate student teachers of the Aristotle University on the Society they Envision and Education for Sustainable Development (ESD). The research also explores how they shape and change in collective processes in an experiential workshop. Nature, the most popular concept, finally almost disappears. Contrariwise, Solidarity, Peace and Democracy are reinforced. The workshop seems to help in the understanding of ESD and it's social, economic, environmental and political dimensions. It shows the risk of the marginalization of the environmental dimension by the anthropocentric nature of ESD, although it is a main pillar.

Approaching periodic table with a creative way

Malamou Konstantina, Malamou Sevasti
Secondary Education

This work summarizes the way in which the teaching of the Periodic Table has been approached in the Chemistry course in assigning individual and group assignments. The assignment of the works has been made at the school years 2015-2018 at Model High School Zosimaia by 9th grade students. The assignment of the works were related with the unity "Classification of the chemical elements" and more specifically with Periodic Table.

Science in Europe. A glance from Parga

Malamou Sevasti, Malamou Konstantina
Secondary Education

The present paper was carried out in the Educational Program "Teachers4europe" in the school year 2017-18 to 11th Grade Students Science Oriented. The objectives of the program were the students to get acquainted with the European Research Centers, the interconnection of Natural Sciences being taught in school with the contemporary research that is carried out in these Centers and the perspectives of professional orientation and rehabilitation in Europe. Moreover, objectives were the approach of scientists working to some of these Research Centers and communication via internet with them. The duration of the program was at about 8 months.

Primary teachers' professional development in the context of peer coaching: the development of their nanoliteracy

Nikos Mantratzis, Anna Spyrtou, Leonidas Manou
University of Western Macedonia

Peer coaching highlights the interaction of inexperienced teachers with more experienced colleagues, with the goal of professional development. In this context, two in-service primary teachers were trained by a colleague concerning the concepts and phenomena of Nanotechnology-Nanoscience. It is investigated whether peer coaching has the potential to contribute to the nano-literacy of the educated teachers. The latter completed a written questionnaire before and after their training. The learning outcomes are encouraging for drawing positive conclusions about the impact of the peer coaching to the nanoliteracy of the two trained teachers.

Primary teachers' ideas about the lotus and the gecko effects

Manou Leonidas [1], Spyrtou Anna [1], Hatzikraniotis Euripides [2], Kariotoglou Petros[1]

[1]University of Western Macedonia [2]Aristotle University of Thessaloniki

The natural lotus and gecko effects have multiple applications in everyday life, e.g. in clothing and in medicine. Their approach to all levels of education is considered as indispensable, as they are recognized essential thematic areas to the core content of Nanoscience and Nanotechnology. The first attempts towards this direction have already been published, however, the field of recording teachers' ideas is still in its infancy. This paper seeks to illustrate this aspect by recording 141 teachers' ideas. The results show that their interpretations are plausible and based strongly on their sensory perceptions, abstaining from the scientific point of view.

Teaching the Newton's second law through science practices: the structure and the content of students' arguments

Mastrogiorgaki Melpomeni [1], Skoumios Michael

[1]Secondary Education, [2]Department of Primary Education, University of the Aegean

The study focuses on investigating the effect of a teaching-learning sequence on Newton's 2nd Law to the structure and content of high school students' written arguments. Instructional material on Newton's 2nd Law was developed and was implemented to 39 high school students (15 years old). The research data included students' answers (arguments) to questionnaires both before and after the teaching-learning sequence. Students' arguments were analyzed with the use of rubrics for evaluating the structure and the content of the arguments. It was found that the teaching-learning sequence significantly contributed to improving the structure and the content of students' arguments.

Informal education and chemistry: the Athens Science Festival as a case study

Mavridi Maria, Paschalidou Katerina, Salta Katerina
Department of Chemistry, National and Kapodistrian University of Athens

The Informal Education in Science is referred to a multitude of designed settings and experiences outside of the formal classroom. Concerning Chemistry, despite the increase of informal educational activities in Greece, studies and evaluations of their results are missing. This study examines the ideas of 20 volunteers performed Chemistry Experiments in the Athens Science Festival. An anonymous open-ended survey of 20 questions has been used and the analysis of the answers indicated vagueness in concerning the purposes of the actions and the evaluation of the festival's success.

Student artifacts on nanotechnology in the context of a formal-informal education synergy

Michailidi Emily, Stavrou Dimitris
Department of Primary Education, University of Crete

The negotiation of contemporary scientific topics is an appropriate field for the harmonious intertwining between formal and informal education. The aim of this paper is to study students' understanding of core nanotechnology concepts as it is depicted on student artifacts constructed after the implementation of a nanotechnology module designed to bring formal and informal learning environments into balance. The results show that such a partnership can help students to develop some basic knowledge of nanotechnology concepts, depending on their level and cognitive background, and to communicate it effectively using multiple forms of interaction.

Teacher mentoring for the implementation of teaching modules on cutting-edge research topics

Michailidi Emily, Stavrou Dimitris
Department of Primary Education, University of Crete

The negotiation of cutting-edge research topics in science courses may contribute to the scientific literacy of students. However, incorporating such an approach into teaching practice requires appropriate preparation and support for teachers to meet the challenges of such a venture. In this context, this work examines the support provided by mentor-teachers to other in-service teachers who are called to implement to their classrooms modules on cutting-edge scientific subjects with social implications. Data indicate that mentors focused their support on science-specific instructional knowledge and tended to do so using mostly directive skills, but also trying to adapt their role according to mentees' needs.

Original STEM educational experimentations for hydrostatic pressure, buoyancy and float. Self-constructions - Research - Evaluation

Michalopoulos Vasileios, Kapotis Efstratios, Kalkanis George
National and Kapodistrian University of Athens

This paper is an evaluated educational proposal for teaching hydrostatic pressure, buoyancy and float in middle school students. It consists of three inquiry-based worksheets, targeted to the deeper analysis of the aforementioned notions and the embellishment of their understanding, through experimentation with the original experimental devices and the application of new knowledge in the construction of a submarine, using common materials. The proposal was implemented on middle school students and the results, of the educational evaluation followed, show a statistically significant difference between the experimental and control groups, providing a finding that demonstrates the fulfillment of the proposal's principal goal.

Climate change and the role of Education. The case of Elementary school textbooks *Geography* and *Physics*

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The present study investigates the existence of Climate change issues in Elementary school textbooks of *Geography* and *Physics*. The phenomenon of Climate change is clarified and the need for a Climate Change Education within Sustainability is described. Content analysis with a priori established categories is used as a research method. Results reveal that Climate change, appearing mainly in the latent content of both textual and pictorial materials, occupies inefficient place in the textbooks under study, since relative information is presented in a superficial and fragmented manner.

Detecting alternative conceptions of Lyceum students during homework

Molohidis Anastasios [1], Hatzikraniotis Euripides [1] and Petridou Eleni [2]
[1]Department of Physics - Aristotle University of Thessaloniki, [2]Experimental school of Aristotle University of Thessaloniki

This paper negotiates a way to detect pupils' alternative conceptions through their introduction to inquiry activities, during homework. Implementing the didactic strategies of just in time teaching and the model of the inquiry continuum, 9 worksheets (WS) were designed to cover up the chapter of Electricity in the 2nd class of Lyceum. Students were actively involved with small and flexible WS, in homework, using common simulations. Their responses to the WSs were for them a preparation for the upcoming teaching, and, for their teacher, a way to detect their alternative conceptions, which could be crucial points of teaching intervention.

Development of an integrated digital educational environment for teaching electricity to 5th grade students

Mplioumi Florina
SED, University of Thessaly

The easy and unlimited access to a prodigious range of information and the constant improvement of technological tools and information provide unprecedented opportunities for 21st century citizens. The current study uses these possibilities and presents an integrated educational tool that combines experimentation in real and virtual environments with storytelling in order to create a digital environment in which 5th grade students learn about electricity in a playful way.

Planet 2030 in education for sustainable development

Nanni Eftychia, Kolokouri Eleni, Kornelaki Athina-Christina, Plakitsi Katerina
Department of Early Childhood Education, School of Education, University of Ioannina, Greece

This workshop concerns education for sustainable development and more specifically, the 17 goals of sustainable development as they are defined in the Agenda 2030 of the United Nations. The methodological frame of the workshop is based on the socio-cultural studies in which learning is a process of collaborative work and comes as a result of communication and interaction. Furthermore, learning is based on the socio-cultural background and experience of the participants. The workshop aims to the reinforcement of the public understanding of Science as well as the use of tools and methods to achieve education for sustainable development through experiential learning.

Developing Teaching material in a Microcomputer-Based Laboratory by Primary School Preservice Teachers

Nipyrakis Argyris, Stavrou Dimitris
Department of Primary Education, University of Crete

Using Microcomputers in Physics Laboratory has become a commonplace, while contemporary tools with innovative features tend to be more and more popular in education. In the present research, the teaching material that preservice primary school teachers developed integrating MBL is been studied, considering the use of technology that was made and the implementation of innovative technology features as well. Discussion that took place in the supporting model of Learning Community revealed the potentialities, but also the barriers in integrating New Technologies from the preservice teachers due to the lack in Technological & Pedagogical Content Knowledge.

The explanation of the water's role in the dissolution by sixth grade primary student

Ntalaouti Paraskevi, Tsaparlis Georgios
Primary Education of Ioannina, University of Ioannina

Sixth-grade primary school students explain the water's function in dissolution discussing in small groups, after they had been taught a basic particle model. They start the discussion using alternative points of view for the water's role. However, the use of particle ideas for the explanation of a series of phenomena related to dissolution, helped the students to consider the warer's role drastic in dissolution. The water's molecules split the dossolved substance because they are small and agile or because they give energy by beating or pushing it. We suggest detailed teaching of the interaction between dissolvent and dissolved substance molecules.

Design, implementation and evaluation of a Teaching Learning Sequence for the teaching of the Evolution Theory to junior high school students

Ntinolazou Christina, Papadopoulou Penelope,
University of Western Macedonia

The object of the present study was the design, implementation and evaluation of a Teaching Learning Sequence (TLS) for the Evolution Theory (ET). The theoretical framework on which the design was based is presented, the first implementation of the TLS to junior high school students as well as the procedure and the results of the following evaluation with a questioner as a basic instrument. Effort has been made to test the possible improvement on the understanding of the ET. It was found that teaching contributed to the reinforcement of certain scientific concepts that the students use correctly in their justifications and the retreat of most of their alternative ideas.

Macrocosm, microcosm and nanoscale through tangible interfaces and embodied metaphors

Palaigeorgiou George, Spyrtou Anna, Gkitsas Stergios, Triantafillidou Regia
University of Western Macedonia

This paper presents the design, development and evaluation of learning material about the lotus effect. The educational material incorporates tangible interfaces and embodied metaphors and aims to help students describe phenomena observed in the macrocosm with microcosm and nanoscale properties. The proposed activity follows the principles of learning through small research studies and was designed for non-formal learning environments. 26 elementary school students participated in the proposed activity and their responses indicated that their understanding about the relation between macrocosm, microcosm and nanoscale was significantly improved. Additionally, their attitude towards the intervention was very

positive.

The impact of a teaching intervention for sound on the quality of students' arguments

Palli Ioanna [1], Skoumios Michael [2]

[1]Secondary Education, [2]Department of Primary Education, University of the Aegean

The study aims at investigating the effect of a teaching intervention for the sound on the quality of middle school students' arguments. Teaching material was developed for the sound and it was tested on 44 middle school students. A questionnaire that was provided to students before and after the teaching intervention was used to collect the data. The analysis of written answers (arguments) was performed with frameworks for assessing the structure and the content of arguments. The data analysis showed that the students significantly improved the quality of their arguments.

Beat acoustic interference

Panagiotidis Theodoros

Third Lyceum Ptolemaida - Greece

An interference pattern of audio sounds (oscillations)of frequencies close to each other can be used to produce an acoustic beat .The beat will be heard (oscillation amplitude) and the frequency and amplitude of the acoustic beat are going to be measured. The lab experiment can either take place with the aid of three smartphones or alternatively using analogue devices i. e two generators of auditory frequencies ,a speaker, and an oscilloscope.

The exploitation of mobile learning- ipad- in the teaching of the electrical circuit

Panousis Konstantinos, Konstantopoulos Alkiviadis- Michail, Biboudi Maria
Experimental elementary school at the University of Athens

Mobile learning, as an evolution of e-learning, changes pedagogical practices and creates new collaborative learning environments in all cognitive subjects. This paper presents the concept of the electrical circuit through a flexible learning environment with no space-time commitments and original activities offered by the exploitation of the capabilities of mobile devices, ipad. There is an action research conducted in fifth grade students before and after using the I pad. The results of the research have shown that pupils after Iped's teaching intervene better understand the concept of a "closed"electrical circuit.

Chemical equations with symbols and pictorial models: Is there an evolution of pupils' knowledge from 8th to 9th grade? The case of a (Greek) model school

Pantazi Giannoula [1], Malamou Constantina [2], Tsaparlis Georgios [3]
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In this proposal, we investigate how the knowledge of pupils about the representation of chemical reactions with symbols and pictorial models evolved from the 8th to the 9th grade. The study was conducted with 64 lower-secondary school pupils from a public model school during two consecutive school years (2015-16 and 2016-17). It was found that there is a statistically significant difference in student performance in the 9th grade. This behavior was found to occur only with the students of lower average performance. Students with high or intermediate performance did not show a statistically significant change.

Educational Material for the Big Ideas of the Disciplines: An application in Soil Mechanics

Pantazidou Marina

National Technical University of Athens

This article ultimately aims to support the practice of selecting instruction topics with guidance from the question "what is worth being taught to everyone from the disciplines"? To this end, it presents methodological corroboration from the field of formal education (as opposed to non formal or informal learning) and gives an example pilot application in Soil Mechanics, which includes the basics of Geotechnical Engineering, one of the main branches of Civil Engineering.

Primary students' perceptions regarding the importance of food consumption from the bottom of the nutritional pyramid

Papadopoulou S. Athanasia, Georgopoulos Alexandros, Malandrakis Georgios

Aristotle University of Thessaloniki

Present study explores primary students' perceptions towards the importance of consumption of food groups from the base of the food pyramid, namely cereals, and vegetables and fruits. Participants were 216 third grade students from the greater metropolitan area of Thessaloniki and data collected through the use of a closed-form questionnaire. Analysis was performed using a quantitative approach. Results indicate that the perceived importance of cereals was medium *(Mean=1.32, theoretical maximum=2)*, whereas that of vegetables and fruits was high *(Mean=2.40, theoretical maximum=3)*. In addition, the attributed importance to these two food groups was differ in a statistically significant degree.

Freshman Physics students understanding of graphs depicting kinematics

Papadopoulou Mary, Stylos George, Kotsis Th. Konstantinos
University of Ioannina

This article presents the results of a qualitative research that took place during 2016-2017 at the University of Ioannina, Department of Physics, studying first year students during the 2nd semester. The purpose was to investigate students' difficulties in understanding and using the graphics dealing with kinematics. This was achieved by using a questionnaire based on the Beichner (1994) survey, with multiple-choice questions. The results of the survey have shown that students face difficulties in understanding the graphics of kinematics, from what they already know at the time.

Perceptions about the protected areas: a study with preservice teachers

Papadopoulou Penelope [1], António José Correia de Almeida[2], Beatriz García Fernández[3]
[1]University of Western Macedonia, [2]Instituto Politécnico de Lisboa, [3]Faculdad de Educación de Ciudad Real, Universidad de Castilla-La Mancha

The study, part of an international comparative survey, was carried out with the participation of 196 students of a Faculty of Education and aimed at recording their perceptions of protected areas. A questionnaire common to all three countries was used, validated for all three countries, while its reliability for the Greek study was very satisfactory. There were no strong agreements or disagreements, a sign of relative uncertainty, and some misunderstandings about the nature and role of protected areas were recorded. The findings highlight the necessity of teaching relevant thematic subjects in the environmental orientation courses.

Postgraduate studies in Science Education

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In this roundtable, a number of questions relevant to postgraduate programs in science education are seeking for answers. These are related to:

• the content of such programs, which can emphasize either the physical sciences themselves or issues concerning education, pedagogy, new technologies, etc

• their attractiveness and value for postgraduate students

• their management, e.g., whether it is organized as an independent program or it is a direction of a more general structure administrated by an Educational or a Physical Sciences Department, whether it is organized by one or more Departments, Schools or Universities, whether e-learning technologies are also used, etc.

Interpretation of physical phenomena by primary school students in the context of a Teaching Learning Sequence (TLS) using particle theory

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This paper presents the results of the implementation of a specific Teaching Learning Sequence (TLS) regarding the use of particle theory by primary students in order to interpret physical phenomena. The results that are presented focus on the improvement of students' ability to interpret the phenomenon of melting using the particle theory after the implementation of the TLS as well as the students' ability to interpret the phenomenon of expansion, which had not been taught to them.

Teaching and learning of chemical bond: tenth-grade students' misconceptions and the influence of enriched instructional material

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Chemical bonding is a fundamental but instructionally complex topic. In this proposal we summarize previous studies on students' misconceptions and conceptual difficulties, including a study with Greek tenth-grade students. We also refer to the outcomes of a quasi-experimental research design using students from a prestigious private school. The control group was taught using the school chemistry textbook, while the treatment group used enriched teaching material. Finally, we present the findings of an additional piece of research that deals with the treatment groups' responses to two metacognitive questions that required students to state the difficulties they had experienced in their study.

Periodic Table-Implementation, Design and Application of an Open Yard Game at the Chemistry Teaching in High School

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Over the last years, in the international literature there has been a growing trend in using games regarding the teaching of chemistry both in the secondary and tertiary education. These games are primarily digital, but there are also card and board games. In this research the implementation, the design and the application of an open yard game at the Chemistry Teaching in both third class of Junior High School and first class of Senior High School, is presented. This type of game concerns the teaching of the subject Periodic Table, it is played at the school yard, remains the same in both classes but it is applied in a different way.

Determination of the Identity of an Unknown Produced Gas in the School Laboratory by the Determination of its Relative Molecular Mass

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The laboratory work is strongly connected to the chemistry teaching both in secondary and tertiary education. In the school laboratory it's a challenge the design of a simple, short and easy to conduct by students, experiment. Considering that the stoichiometry is no longer taught at the fourth grade of the high school, a lab work concerning the identification of an unknown gas was invented and is presented in this work. The determination of the identity of the gas is achieved by the determination of the gas's relative molecular mass, without the need of the stoichiometry or the awareness of the reactions taking place.

Implementation STEM Educational Practice of Elementary Education.

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In this paper is presented the experiences of STEM practices in elementary education and it is sought to raise awareness of the potential for STEM activities to be introduced in Greek schools, given their context. Indicatively, one of the activities carried out for a period of nine teaching hours in the 5th grade of Public Primary School is presented. Implementation revealed that educational scenarios are required to be carefully designed, with clear delineation and open to the solutions to be proposed. While their positive effect extends to multiple levels (cognitive, psychomotor, emotional).

Developing educational tools and materials for the interdisciplinary and inquiry-based approach in the context of the PLATON project

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The PLATON project suggests an alternative methodology for analyzing and promoting the content of Natural Sciences (Interdisciplinary approach) and an instructional approach that can be adopted by teachers in their everyday practice (inquiry-based approach). For the development of educational tools and teaching resources concerning the interdisciplinary approach, six European curriculums were studied, and three levels of Science Ideas were developed. For developing educational tools and curriculum materials concerning the inquiry-based approach, inquiry cycles and practices extracted from the literature were taken into account, the analysis of which yielded nine inquiry components, which are presented as gradual educational adaptations to teachers.

How primary school students conceptualize nanotechnology and the lotus effect?

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The aim of this paper is to identify how primary school students conceptualize nanotechnology and the lotus effect. The participants were 204 primary school students (5th and 6th grade). A written questionnaire with open ended questions was used as a research tool. The data analysis was inductive. Six categories were formed concerning the meaning of nanotechnology and five categories were formed regarding the explanation of the lotus effect. Primary students seem to correlate nanotechnology with small sized objects as well as with anthropomorphic features. They also attribute lotus hydrophobicity to perceptual based leaf's characteristics, such as its hard surface.

Environmental Values and Environmental Moral Reasoning of Pre-service Teachers, During their Interaction with a Digital Narrative Story

Petrou Stella, Korfiatis Konstantinos, Lapathioti Nikoletta
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This paper studies the moral reasoning and the environmental values of thirteen pre-service teachers (21-23 years). An essay containing environmental multiple-choice moral dilemmas, as well as open-ended questions, was used to depict changes in participants' values after their involvement in the digital interactive activity. It turned out that the specific sample was characterized by altruistic-biocentric values. Biocentric values was enforced after the end of the learning activity. Results of the present research support the idea that a non-dogmatic education which gives to students' opportunities for reasoning on realistic situations and collaboration enhance their moral maturity.

Design, Development and Implementation of an educational material under the Erasmus+ Program: culture in nanoscale through the renaissance stained glass

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Nanoscience-Nanotechnology (NST) is a modern field that studies and manipulates nanoscale materials. Within the achievements of older time civilizations certain nanomaterials can be detected, to which their exceptional properties are attributed. Linking NST content to culture promotes interdisciplinarity and can increase students' interest in science. In this respect, the present work describes the design and implementation of an educational material regarding the Renaissance stained glass to 14 primary school teachers, coming from seven European countries under the ERASMUS+ program. Teachers expressed their intention to implement the activities to their students.

Reconstructing students' ideas on the formation of seasons taking into account their causal reasoning

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An example of primary students' alternative ideas reconstruction is presented in this paper, which takes into account students' causal reasoning. Through inquiry based activities the students come to the conclusion that the Earth's orbit around the Sun is very close to a circle making weak the idea that the formation of seasons depends on the distance between the Earth and the Sun. A new causal model is proposed in order to replace their primary one, a strategy that seems to promise a more effective physics concepts' instruction.

The use of sensorimotor activities in the teaching of concepts of mechanics to high school students

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The study focuses on both the learning outcomes of students' participation in sensorimotor activities and the extend of its approval by them. The collection of primary data was carried out: (a) with assessment tests before and after the intervention and (b) using a self-referential questionnaire. The results of the study show positive effect on learning and students' positive attitude towards the usefulness of bodily activities within the educational process. In conclusion, the results demonstrate the need to provide opportunities and support structures for a more systematic participation of students in such activities.

Physical and Biological Sciences in Early Childhood Education: current aspects and perspectives

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For the past 30 years, cognitive movements such as Science Education, Learning Psychology and Early Childhood Pedagogy have created a rich literary tradition, in which a multidisciplinary approach addresses the issue of the importance of the timing of initiation of children aged 4-7 in the world of Physical and Biological Sciences, the development of activities for young children, the creation of special programs, the training of teachers, etc. This round table highlights the current aspects and perspectives in thematic areas such as biological and physical dimensions of knowledge, socio-cultural issues, the perspective of digital learning, informal and formal education and teachers' training.

Interactive Digital Map of the Byzantine Empire

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This paper deals with the design of a digital map of the Byzantine Empire for both teacher and student use. Upon closer inspection of the fifth grade's History textbook, it has been noticed that there are not enough maps that show the overall growth of the Byzantine Empire, from the moment it was manifested to the day of its demise.Thus, a digital map was created for the History course. The software that has been used for the construction of this map is ArcMap, v. 10.4, while, upon its completion, it was uploaded onto the website of ArcGIS Online. The final product is a digital map of the Byzantine Empire for teaching purposes.

Examining differences in science achievement between fifteen-year-old immigrant and native-born students

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The present study examines differences in fifteen-year-old immigrant and native-born students' science achievement in Greece. Multilevel modelling analysis was conducted based on a national representative sample of 5,532 students from 211 schools in Greece. Immigrant students had statistically significant lower science achievement than native-born students, even after controlling for individual and school-average socio-economic status and main language spoken at home. However, after controlling for the main language spoken at home, the difference in science achievement between native-born and immigrant students decreased significantly, which suggests an inadequate mastery of the language of instruction from a number of immigrant students as a barrier to acquisition of scientific knowledge and skills.

Improving the quality of science teachers' lesson plans

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The study focuses on investigating the effect of a science teachers' professional development program to the quality of science teachers' lesson plans regarding science practices that they involved. A teachers' professional development program was developed and was implemented to 25 science teachers. The research data included science teachers' lesson plans both before and after the program. Teachers' lesson plans were analyzed with the use of rubrics for evaluating the level of science practices that they involved. It was found that the science teachers' professional development program significantly contributed to improving the quality of teachers' lesson plans.

Inquiry-based laboratory activities for approaching the content of Nanotechnology in primary school

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Nanotechnology is an interdisciplinary field that aims to the production of innovative applications in multiple sectors of daily life (pharmaceutical industry, self-cleaning surfaces, fabrics etc). This paper presents inquiry-based laboratory activities addressing to primary school students and more specifically to 5th and 6th grades ones. The main purpose of the activities is students to be familiar with the nanoscale, to understand some natural phenomena associated with Nanotechnology (lotus effect, gecko effect) and finally to stimulate student's interest concerning the affection of the nanoworld to the macroworld

Chemistry teachers' views on integrating online tools supporting inquiry activities into science teaching

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In this work, we present the views of middle and high school teachers regarding the integration of online tools supporting inquiry activities into chemistry teaching, as they were brought out from the content analysis of interviews provided by six teachers who used such a tool in their classrooms. It was shown that their views may be organized into four main groups which concern advantages, barriers and methods of integration as well as the evaluation of the students' work. Each group contains views which are related to either the teaching approach, the scientific content, the teachers, the students, or/and the infrastructure.

Integration of virtual experiments and simulations following B' level professional development

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This survey aimed to inquire the practices of Greek science teachers who have participated in the ICT professional development program (B' level) concerning virtual labs and simulations. As research tools, we used class observations and personal interviews. The survey design was based on Technological Pedagogical Content Knowledge model (TPACK). The analysis showed that science teachers have gained knowledge concerning the use of virtual labs and simulations in teaching, thus they make great effort to integrate them in their teaching while they recognize their benefits.

Investigation of 3rd Lyceum students' ideas regarding the concepts of work and energy: using ICT to generate cognitive conflicts

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The aim of this study is to investigate the ideas of the 3rd grade Lyceum students about the concepts of work and energy, before and after the implementation of a teaching intervention developed using ICT. In order to explore students' perceptions and assess the effects of the teaching intervention on their conceptual understanding and change, students were asked to complete an online questionnaire before, during and after the intervention. The findings indicated that the survey results were in consistency with the bibliography. Students show difficulties in conceptual understanding of the Mechanical Energy Conservation Authority, they consider that the concept of Kinetic Energy is more comprehensible than the Dynamic Energy, while they were positive in experimenting with virtual laboratory environments.

A proposal on how to introduce at high school the concept of size-dependent properties at nanoscale

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In this paper we are examining the Big Idea of Nanoscience and Nanotechnology (N-ST), i.e. "Size-dependent properties" as well as their didactical transformation into school knowledge. In the first part of the paper we are proceeding with the scientific approach to the properties that are changing at the nanoscale. In the second part we propose their educational transformation and their integration into school, focusing on the difficulties and alternative ideas of the students.

Physics secondary education teachers' conceptions of the nature of school physics and biology

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The present study investigates how Greek in-service physics teachers understand the nature of school (Newtonian) physics and biology. Our empirical findings indicate that physics teachers share homogeneous conceptions about the Nature of The Sciences, which result from how they understand the nature of Newtonian physics and how they have assimilated positivism. Their viewpoint induces troublesome situations, such as the erroneous projection of features of Physics onto Biology and the appearance of misunderstandings about several NOS (Nature of Science) items.

Elaborating on Teachers' Professional Change in the Context of a Community of Learners

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This study focuses on teachers' professional learning in NanoScience and nanoTechnology throughout the process of developing a teaching module in the context of a Community of Learners. Utilizing the Interconnected Model of Professional Growth for the analysis of teachers' collegial interactions, this study delves deeper on the mediating processes that support their professional learning in order to introduce cutting edge science topics in school. Our findings indicate that as teachers confront with the challenges of developing a module with educationally innovative features they are engaged in mediating processes that progressively forge different change sequences.

A study of primary, middle and high school students' abilities to critique the evidence of science arguments

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This study examines primary, middle and high school students' abilities to critique the evidence in written science arguments that they read. As a data collection instrument, a questionnaire is used, which was dispensed to 261 students of primary school (11 years old), 257 students of middle school (14 years old) and 259 students of high school (15 years old). Data analysis revealed that most of the students have not developed their abilities to critique the evidence in written science arguments. Furthermore, it was found that there is no significant differentiation between students' answers and their age.

Evaluation of science teachers in Greece: Strengths and Weaknesses of their teaching practice

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Teacher's evaluation is considered critical for teachers' professional development. Evaluation systems with different characteristics are used worldwide. In the present study, an evaluation system designed by the researchers was implemented. Data are collected from classroom observation using a rubric and from students using a questionnaire. Aim of the study is to highlight the strong and the weak aspects of science teachers' practice. The results showed that the weak aspects are mainly related to pedagogy. Findings indicate the strengths of teachers' practice and the aspects of teaching in which science teachers need support.

Learning about molecules through my senses

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With this innovative teaching proposal, an attempt is made to approach the concept of molecules by pupils through their senses. Through innovative inquiry activities, the direct correlation of the concept of molecules with the four senses, is attempted in a pleasant and creative way, raising the interest of the students. This correlation can help the students not only to conceptually link the microcosm (molecules) with the macrocosm (food, everyday materials) but also eventually can lead them to the comprehension of the concept of our unified natural world.

Scientists in action: educating primary students in science through an innovative STEAM program

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This paper (an example of good practice) aims to present an ongoing innovative STEAM program for primary students. In particular, educational activities are implemented in an open as well as guided inquiry learning environment. The main goal is the creation of interactive exhibits that will be presented to the audience by the primary students. During the program, they are expected to develop their interest in science as well as their scientific, linguistic and social skills.

Building the concept of solubility through interaction with game-based simulation software for preschool age

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The contemporary students' increasing need to interact with appropriate digital educational software, combined with the complexity of the academic discipline of Science, has led us to develop a game based simulative software for the discipline, addressed to kindergarten students. One of the fundamental modules of this software is that of solvent and non-solvent materials. In this paper we will present the experimental survey conducted in order to evaluate the result of this educational intervention.

The use of bodily modelling as an investigative tool in teaching Moon's apparent movement

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In the present paper, the results of a teaching intervention on K-5 students are presented. Its main purpose was to use bodily modelling as an investigative tool in teaching Moon's apparent movement. Bodily modelling gave students the opportunity to: a) "experience" Earth's spin, through their body b) monitor the Moon as stationery observers on Earth, through their eyesight. The implementation of the intervention showed that bodily modelling helped students realize that Moon's apparent movement is attributed to the simultaneous rotation of the Earth around its own axis and the revolving of the Moon around the Earth, both in the same direction.

Investigation of the learning outcomes of a teaching sequence for its matter and particle nature, mass and volume as a single conceptual set, a basis for building complex concepts.

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The paper explores the learning outcomes of the application of a teaching sequence for building the concepts of matter and particle nature, mass, volume as a single conceptual system, supportive cognitive background in the approach of multidimensional concepts such as density. Student ideas are taken into account in didactic transformation and in the selection of appropriate teaching tools such as introductory textbooks, presentation files, student models of matter and design of particle motions, proportions, dramatic play, simulations, simple experiments. The parallel microscopic and macroscopic didactic approach brought extremely satisfactory learning outcomes, except for small difficulties where mathematical reasoning is required. Keywords: matter, mass, volume, teaching

Pre-service primary teachers' difficulties with implementation of inquiry-based teaching: The integration of experimental activities

Stavrou Ioanna, Stefanidou Constantina, Kyriakou Kyriakos, Galanopoulou Violeta, , Skordoulis Constantine
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This study investigates whether pre-service primary teachers can integrate experimental activities into inquiry-based teaching scenarios. Our sample consists of 170 pre-service teachers' teaching scenarios for Photosynthesis; they were collected in the context of an Introductory Didactics of Science Laboratory course in which participants experienced inquiry-based teaching and learning. A Thematic Analysis of the data shows that the majority of pre-service teachers faced difficulties mostly related to the correspondence of reported hypotheses to the appropriate experimental activities and therefore, they have broader difficulties in integrating the suggested experimental activities into their proposed scenarios - worksheets.

Student teachers' difficulties in explaining phenomena of static electricity: An Inquiry Based Teaching approach using microscopic models

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This paper is part of an empirical research that was conducted during a mandatory Physics Laboratory course in two phases. The sample of each phase consisted of 200 undergraduate primary teacher students. It presents the difficulties students have in explaining the induction as mapped through confirmatory experimental teaching. To overcome these, an inquiry-based teaching approach using microscopic modeling is proposed and implemented. The first findings indicate that most students find difficult to explain the microscopic procedures of an insulator. It seems that the inclusion of microscopic modeling enhances the understanding of the role of electrons in conductors and insulators.

Genetic tests: a socio-scientific issue for teaching Genetics basic concepts

Stefanou Christos, Mavrikaki Evangelia, Galanopoulou Dia

Postgraduate Programme "Chemical Education and New Educational Technologies"

A proposal for teaching Genetics basic concepts was designed and implemented based on the socio- scientific issue "Genetic testing". Teacher students came into contact with the social and ethical implications of genetic testing through case studies, they were taught scientific concepts of Genetics and they had also to deal with socio-scientific dilemmas. Results showed a very positive impact on their understanding of basic scientific concepts of Genetics.

Investigating students' learning of scientific content while interacting with exhibitions at science centers

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This paper presents a pilot study aimed at studying the degree of learning scientific content by students while interacting with the exhibits of a science center during a school visit. For this purpose, we attended student visits at the science center Phänomenta Bremerhaven in Germany and recorded the views of the teachers accompanying them as well as the Center's supervisor. The results show a mismatch between students' learning through exhibits and the views of teachers and the center's supervisor about the learning outcomes the exhibits provide.

Pedagogical University students' experiences and views from the use of experiments in teaching Science at Primary School

Stylos Georgios, Bousda Fani, Kotsis Th. Konstantinos
University of Ioannina

This paper presents the results of qualitative research carried out by pr service elementary students of the University of Ioannina on their experiences and perceptions of the experimental teaching sciences, during their studies in Primary School and in their practical exercises. The qualitative analysis highlights that teaching physics with experiments is carried out by very few teachers in a systematic way, confirms the literature on the reasons why experiments are not conducted, and emphasizes the value and importance of integrating the experiment into teaching practice.

Agrobiodiversity in Greek technological education: pupils' perceptions of Agriculture sector.

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This study investigates the perceptions of the pupils of the EPA.L on the meaning of agrobiodiversity. The research was made in 89 pupils of the 2nd and 3rd grade of agronomic field in three EPALs. A questionnaire of open and closed questions was used to collect the data. The findings show that the percentage of pupils who perceive the meaning of agrobiodiversity is small. Thus, its dimensions are often perceived by them. They also think that school is referring to agrobiodiversity, but their interest in it is mediocre.

A comparison of virtual learning environments in terms of supporting the development of experiment design abilities in electric circuits

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We present a comparative study on the development of experimental skills in high school students in electric circuits when virtual learning environments are utilized in inquiry-based teaching with concrete realistically represented virtual instruments, or abstract diagrammatically represented virtual instruments, or concrete realistic virtual instruments along with an abstract representation dynamically-linked to the concrete representation. Results indicate that within the context of carefully designed inquiry-based teaching series, all of the above virtual learning environments seem to effectively support the development of experiment design and implementation skills in simple electric circuits.

Teaching chemical reaction with multiple analogies

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The design, implementation and evaluation of a constructivist teaching sequence on chemical reaction using analogies to 8th grade students is presented. The experimental design involved 44 students, with 22 participating in the Experimental Group (EG) and the other 22 in the Control Group (CG). The EG was taught using multiple analogies that took into account students' alternative conceptions, while a conventional teaching was followed with the CG. Results indicate that the EG students improved their scores in a statistically significant way, while they achieved significantly higher scores than those of the CG after the interventions.

Enhancing students' interest and learning in order to generate motives about the topic of energy

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In the present paper we briefly describe an intervention aiming at enhancing secondary students' interest and academic achievement for the topic of energy and present the results of its implementation. The intervention was embedded in the introductory physics course in the second class of high school. The total number of the participants was N=110 for the experimental group and N= 96 for the control group. The learning activities were delivered in real classroom settings. The intervention included experimental hands on activities, problem solving situations and use of a software specifically designed for the purpose of our study. The control group was taught about the same topics of energy in a traditional way of teaching. We investigated whether there is a correlation between level of engagement, interest and learning outcomes. The results showed that there are significant positive correlations between interest, academic achievement and level of engagement which highlights that enhancing interest can lead to better learning outcomes.

Approaching the 17 goals of sustainable development through the exploitation of Educational Robotics and Sciences, Technology, Engineering, Arts, Mathematics (STEAM Education)

Topoliati Maria, Plakitsi Katerina
University of Ioannina

This work focuses on the study of applied educational project on the learning area of the sustainable development. The dominant concern is the exploitation of science, new technologies, educational robotics, engineering, arts and mathematics as methodological tools. The research framework is completed by the process of evaluating and disseminating the learning outcomes of the project by the pupils and the teacher to the wider community.

Developing a series of Learning Objects for assisting (self) teaching of the physics of solid bodies through simulation / visualization in 2D and 3D – Experimental application and results

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The use of ICT has drastically transformed the way we approach and solve problems, by introducing new methodologies and tool, aiming to promote active learning, critical thinking and creativity. Accordingly, we initiated a program for the development of a series of Learning Objects (L.O.) aiming to assist in teaching the physics of the solid body. We present the first two L.O. of the series, targetıng the equilibrium condition $\sum \tau = 0$, and the calculation of the moment of inertia I for typical geometric solids and their combinations. An algorithm for verifying integrally calculated expressions of I through numeric approximation is included. Fifty-two students of the third grade of Lyceum tested and evaluated the L.O., while twenty-seven others served as the control group. Well over 70% of the students had a positive approach towards several attributes of the L.O.s. We present the results, along with students' views and comments on the possibility and feasibility of educational software integration in teaching.

Consistency of science teachers' views and practices during a professional learning program.

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This paper focuses on the consistency between views and practices of four primary and secondary science teachers' during their participation in a Professional Learning Program. Results concerning two out of the eight research areas that were studied are presented: content management, and verbal interaction. Data regarding teachers' practices come from classroom observation protocols, while interviews and diaries provided data about their views. Results indicate a transition process, for most of the participants, in an effort to adopt more innovative teaching approaches.

Teachers Education in the Interdisciplinary Framework "Theatre and Science": Course and Transformations of a 15 Year Research and Development Project

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National and Kapodistrian University of Athens

An ex-post qualitative analysis of the objectives, methodologies and results of 15 successive empirical teaching-learning applications, carried out from 2004 to the present, in the context of an interdisciplinary educational program of class teachers' education, is being undertaken. The analysis tool follows the model of a dialectical approach to educational practices as a "dance" between repetitive goals, resistances and accommodations. The results show that effective management of transformed scientific /epistemological ideas by non-experts is achieved by reversing the classical educational processes. In them, learning is an instrument (that works every moment as requested) and not a goal. In this way, a corridor opens for creativity to pass through education.

Middle school students' conceptions about ferromagnetic materials

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Magnetism is a field in science that fascinates almost everybody and leads to a variety of applications. During the conductance of activities which aimed to the investigation of the changes in material properties as the nanoscale was approached, interesting drawings of students were gathered, representing ferromagnetic materials and their interaction with magnets. The qualitative analysis of these drawings focusing on elements and ways students use to describe the materials under study revealed students' relative conceptions, which are presented in this study

Introduction to STEM education and experimentation using open hardware and software

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In the present workshop we will showcase the basic functions of an Arduino board, the programming interface, the sensors, and the actuators. Through a series of hands-on activities, we will introduce the participants on how Arduino communicates with sensors, actuators and mobile devices or a desktop computer. In addition, we will explore possible applications of particular combinations of sensors and actuators in STEM education and science experimentation.

Educational material for introducing Nanoscience-Nanotechnology in junior high school: super-hydrophobicity in lotus leaf and rose petal

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The workshop includes educational material and related activities concerning the salient concepts of nanoscience-nanotechnology (N-ST) as well as the lotus and rose effects via which superhydrophobicity and wetting phenomena are introduced.11 activities have been designed in which participants engage in real experiments, study electron microscope images with the «onlineruler» free java app, measure the contact angle with the «OnScreenProtractor» free java app and a protractor as well, watch videos that provide access to the superhydrophobic plants' surface, express their initial ideas, which they are challenged to revise as the implementation progresses. The activities were pilot implemented to junior high school students.

Exploring preschool teachers' conceptions about biodiversity

Tsolakidou Sofia, Dimitriou Anastasia, Malkopoulou Evmorfia
Department of Education Sciences in Early Childhood, Democritus University of Thrace

The way that teachers understand the concept of biodiversity is important for the successful implementation of biodiversity education so as to produce citizens responsible for a sustainable future. In this paper are presented preschool teachers' conceptions, about biodiversity its dimension and the necessity of conservation as well. The results showed in general that preschool teachers have limited understanding of biodiversity and they are not able to give scientific explanations about its dimensions and the necessity of conservation. It seems that they emphasize in definitions concerning species and they do not recognize the complexity of biodiversity as a crucial characteristic.

Genetic concepts, representations and models in students' and educators' conceptions

Tsopoglou-Gkina Despina, Papadopoulou Penelope
Department of Early Childhood Education, University of Western Macedonia

Scientific literacy is considered, internationally, one of the fundamental goals of education, with genetic literacy being a crucial part of it. In this framework, an extensive literature review of students' and teachers' conceptions on the gene was conducted, followed by a meta-analysis in order to trace in these conceptions the five historical models for the gene and its function. However, the literature on research of students' and teachers' conceptions in genetics reports systematic difficulties and misconceptions, as well as outdated perceptions of the gene model that lacks modern aspects.

Aspects of differentiated instruction in learning communities in elementary education: The case of Science Festival

Tzima Garyfallia, Dimitriadou Catherine, Spyrtou Anna
University of Western Macedonia

This poster concerns the views of primary teachers, pre-service teachers, primary students, and a primary school consultant, regarding aspects of differentiated instruction in learning communities in the case of Science Festival. The research tool was a semi-structured interview protocol and the data analysis was based on the content analysis method. The results show that the participants focused on (a) the fields of differentiated instruction, such as the differentiated teaching process, which was based on students' interests, (b) the collaboration among the members of learning communities, and (c) the development of students' inquiry skills.

Proverbs/Proverbial phrases as a teaching tool for approaching Science concepts in Kindergarden: "A Physics proverb, say it and let's make an experiment"

Tzioli Maria[1], Mitsiniotou Katerina[1], Garifallogianni Evmorfia[1]
[1]*University Of Western Macedonia Department of Kindergarten*

The inclusion of Science Education (SE) in the interdisciplinary of modern Kindergarten curricula is a dynamic effort of improving Science teaching. The present poster concerns the approach of SE through interconnection with literature and specifically through proverbs/ proverbial phrases. It is included in the curricula of school activities of the school year 2017-2018 entitled «Myths, Nature and Realities», regarding the module «A Physics proverb, say it and let's make an experiment». It was developed and implemented within the framework of inter-school cooperation via the electronic platform «eTwinning», which is an exciting learning community for schools in Europe.

Examining the consistency of Primary student's mental models of Force

Vaiopoulou Julie[1], Papageorgiou George[2]
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The present study aims to analyze the experimental activities that are intended for middle school (13 and 14 years old students) with regard to the science practices engaged in them. The analysis of the experimental activities used an analysis framework based on the science practices that have been proposed by the US National Research Council (NRC 2012). Based on this framework, the dimensions of the science practices involved in the experimental activities were identified. The analysis showed that only some dimensions of science practices are engaged in the experimental activities, while other dimensions of science practices, especially important for understanding science ideas, are missing.

Investigating students' characteristics that predict the use of imagistic and analytic strategies

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In the present study the extent to which certain characteristics of students predict their performance in Organic Chemistry problem solving was investigated. The administration of the instruments VACT, BCCI, ROT, RAVEN showed that students' basic chemistry knowledge predict their performance in problems that can be solved using imagistic strategies and also in problems that require the adoption of analytic strategies. None of the studied characteristics was found to powerfully predict students' ability to solve problems that require inhibiting the intuitive response, strongly suggested by visual inspection.

Science practices in the physics experimental activities of middle school

Vomvas Anastasios[1], Skoumios Michael[2]
[1]Secondary Education, [2]Department of Primary Education, University of the Aegean

The present study aims to analyze the experimental activities that are intended for middle school (13 and 14 years old students) with regard to the science practices engaged in them. The analysis of the experimental activities used an analysis framework based on the science practices that have been proposed by the US National Research Council (NRC 2012). Based on this framework, the dimensions of the science practices involved in the experimental activities were identified. The analysis showed that only some dimensions of science practices are engaged in the experimental activities, while other dimensions of science practices, especially important for understanding science ideas, are missing.

The use of informal sources of science learning (science documentaries) in teaching concepts of the Solar System

Vrettopoulou Styliani, Halkia Krystallia
Department of Primary Education, National and Kapodistrian University of Athens

In the present paper, the results of a teaching intervention on K-6 students are presented. Its main purpose was to use science documentaries in teaching concepts of the Solar System. This intervention focused on the age of the Solar System, Sun's and planets' formation order, process of planets' formation, structure and layout of our solar system and relative sizes of Sun and planets. Individual interviews that were held before and after the intervention showed statistically significant conceptual progress of students towards the scientifically accepted standard, regarding to the above-mentioned concepts.

Investigating the relationship between school as learning organization concerning the teaching of physics and the perceived primary school teachers' self-efficacy

Xafakos Efstathios, Stavropoulos Vasileios, Stavrianoudaki Alexandra, Tzika Vassiliki
Department of Primary Education-University of Thessaly

The views of 132 teachers were investigated as to the possible function of the school as a learning organization and its possible relationship with their perceived self-efficacy. The results of the quantitative survey record their positive opinion about their self-efficacy but a neutral attitude towards the functioning of the school as a learning organization, as well as no correlation between the two basic variables. However, individual competence, one of the capacities of the learning organization, the personal interest of teachers in Physics in their free time, and the choice of senior classes, seem to differentiate their levels of self-efficacy.

The concept of environmental fairy tale: storytellers'- animators' experiences and approaches

Xanthopoulou Kalliopi, Ragkou Polyxeni
Aristotle University of Thessaloniki

How the "animators" (teachers, storytellers, drama animators and environmental NGOs animators, both formal and non-formal) who use fairy tales in their work, understand the meaning and the characteristics of environmental fairy tales? For this purpose, the experiences and opinions of 23 "animators" were recorded using semi-structured interviews. The results of the research have shown that four trends are shaped about how animators perceive the concept of environmental fairy tales. In the majority of them, animators attribute characteristics to the environmental fair tales that refer to the principles of Environmental Education and Sustainability, even if the animators ignore the notion of Environmental Education and Sustainability.

Public Understanding of Science andn Technology in the post-modern era: An example of educational action in a non-formal learning context

Christidis Paris
Greek French School Kalamari.

Promoting science to the general public and linking it to technology is a powerful area of interest in community of education. This paper examines the development of students' perceptions of electrical energy generation during their participation in an Erasmus Intensive Program organized by the University of Western Macedonia in 2011. The research was based on the STSE (Science-Technology-Society-Environment) model and - following the qualitative example - highlights the students' understanding of the social and environmental impacts associated with lignite electricity generation in real situations.

When students involved in the design of Chemistry experiments: The case of single replacement reactions

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The purpose of this paper is to investigate the effectiveness of experiments in understanding single *replacement* reactions when they are designed by the students themselves with teacher guidance. In this context, 48 students of the first grade were divided into two groups, one of which performed the experiment according to the classical method and the other according to the proposed method. Questionnaires were provided to students before and after the experiment. Study's findings suggest that the students' attitude towards the Chemistry course and experiments were not significantly different. On the contrary, the understanding of the teaching subject was enhanced in the case of the guided inquiry conducted laboratory exercise.

Pre-service teachers' understandings of Galilean Relativity.

Yfantis Christos, Assimopoulos Stefanos
Department of Primary Education, University of Thessaly

The purpose of this study was to investigate the teaching and learning processes of pre-service teachers approaching basic concepts of Galilean kinematics. Participants were twenty-two sophomore students of the Department of Primary Education of University of Thessaly. Data obtained through the teaching experiment methodology. The qualitative analysis of data conducted by the constant comparative method of analysis showed that the participants were able to manage the basic concepts of Galilean Relativity. Before approaching this topic, the introduction of the concept of frame of reference from which the motion is being observed and the promotion of conceptual understanding of velocity should be addressed.

Secondary school students' explanations of phenomena using particular atomic models

Zarkadis Nikolaos[1], Papageorgiou George[1], Stamovlasis Dimitrios[2]
[1]Democritus University of Thrace, Department of Primary Education; [2]Aristotle University of Thessaloniki, School of Philosophy and Education

The study investigates the consistency/inconsistency of students' mental models for the atomic structure when they are asked to explain specific phenomena. Participants were 225 students of secondary education (10th and 11th grades). Data were collected using an appropriately structured research tool, where students can choose a specific atomic model and explain the situation or phenomenon on its basis. Results support the theory of 'fragmented knowledge', since there is inconsistency 'between' models in all tasks, with the 'task context' affecting students' responses, as well as, there is inconsistency 'within' the models, as pupils' descriptions are not consistent with the model they choose. As a result, 'incoherent pieces of knowledge' appear to exist.

Online Learning Environments: future teachers' experiences and perceptions

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This research aims to study future teachers' experience in Online Learning Environments as well as their perceptions and needs of how these environments can enhance and support their studies and their professional development. Starting point of the current research was the design of an Open Digital Learning Environment in order to support science education. The results report various levels of awareness in these environments, positive attitude towards the benefits of online learning and its potential to support teacher professional development. Finally, the need to link Online Learning Environments with formal education in Greek universities was expressed.

Augmented Reality Applications in the textbooks of Science in Primary School - Research, Suggestions

Ziaka Charikleia[1], Gikopoulou Ourania[1], Kapotis Efstratios[1],Tsakonas Panagiotis[2], Kalkanis George[1]

[1] National and Kapodistrian University of Athens, [2]University of Piraeus

Augmented Reality is a promising technology in the field of education. Taking into account the possibilities offered by its applications and the benefits from their utilization, but also given the limited number of applications for physical phenomena, in this research we try to create applications of augmented reality in the official textbooks of Science in Primary Education and we evaluate their implementation during the educational process. The first results in a sample of 20 5th graders are very encouraging, as a very positive response to the Augmented Reality application was observed, as well as an improved performance after the implementation

Out-of-school learning settings in science teaching and learning

Zoupidis[1] Anastasios, Stavrou Dimitris[2]

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This symposium aims to explore the potential of incorporating out-of-school learning settings (e.g. science centers, research institutes) in science teaching and learning. Related research highlights the fact that visits in such settings are mostly focused on students' entertainment rather than the gain of scientific knowledge. Therefore, this symposium intends, through research findings of the studies that are going to be presented, to cover different dimensions of incorporating out-of-school learning settings in science education and to rise concerns regarding the optimal use of the potential out-of-school learning settings provide for science teaching and learning.

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Ένωση για την Εκπαίδευση στις Φυσικές Επιστήμες & την Τεχνολογία

Region of Western Macedonia

ΠΕΡΙΦΕΡΕΙΑ
ΔΥΤΙΚΗΣ ΜΑΚΕΔΟΝΙΑΣ

Municipality of Florina

ΔΗΜΟΣ ΦΛΩΡΙΝΑΣ

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