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Article

Utilization and application of new technologies

Utilization and Application of New Technologies and Programming Environment in Physics Science: A Teaching Proposal for Acids and Bases

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Abstract
The present didactic proposal concerns the teaching of the subject of Physics Science of the sixth grade of Greek primary school in Chapter 11 "Acids-Bases-Salts". The teaching applies the didactic practices of ICT in education and the multimodal texts, while at the same time is structured both worksheets that support the interaction between the students and the use of educational software that can meet the objectives set by teaching. The purpose of the teaching intervention is to understand the concept of acids and bases through students' everyday experience. The processing of the subject, as well as the evaluation, is designed by using appropriate software to maintain an environment of cooperation and integration of knowledge.

Keywords: acids, bases, ICT applications

JEL Classification: Z00 Other Special Topics: General

Introduction

Teaching Science is a sector that is developing rapidly in recent years and also is a complex attempt for the teacher. This is because each teacher should use knowledge from different cognitive sectors such as physics science, sociology, psychology and epistemology with main purpose of a gentle and gradual transition of students from the empirical and everyday way of thinking into science.

The utilization of New Technologies is an integral part in our daily life, and for this reason it plays an important role in educational practice as it offers multiple benefits to students. Using ICT has enabled significant educational applications both in teaching and learning process and the management of school setting (Komis, 2004).

Therefore, the integration of ICT in daily educational practice and, by extension, in teaching of physics science, plays an important and beneficial role in the effectiveness of teaching as well as in developing attitudes and skills for students in cultivation of

critical thinking, but also, in promoting collaborative learning (Raptis & Rapti, 2003).

Makrakis (2000) mentions that the teacher who is making use of New Technologies' capability in teaching, converts from a simple 'transferrer' of knowledge into an active member in the learning process and a critical thinker . Thereby, students are not treated as passive receivers, but as independent and responsible individuals who actively participate in the learning process (social - constructive approach).

Regarding the teaching of Physics science, the current teaching should follow certain steps with ultimate goal of shaping the child thought of a student to the science thought. According to Ravanis (1999), these are 1) finding difficulties in learning process, 2) defining the difficulties, 3) teaching activities to deal with difficulties and 4) evaluation of activities.

Therefore, the role of the teacher is not defined by the transference of new knowledge, but as a body that encourages, facilitates, supports and mediates the interaction with students and between the students.

Initially to make this possible the teacher should consider both his own perceptions and knowledge about the topic to be developed, and the perceptions and prior knowledge of students. This is very important since it is a condition that forms in a decisive way the result of learning.

This didactic proposal related to the teaching of acids and bases that students have some misconceptions and difficulties on this issue, by presenting false and usual alternative perceptions.

Specifically, although the classification of a substance in accordance with the color indicator does not cause difficulties for students, the difficulty presenting in distinguish pure substances from mixtures, complicate them to understand that the color of the indicator does not necessarily lead to the conclusion whether a substance is an acid or base. The coloring of the indicator only leads us to the conclusion if the substance is acid or base. Many students characterize the cleaners and detergents as acids or bases. In addition, many students believe that they can distinguish the acids by their sour taste, criterion which is often subjective. For this reason it should be pointed out to students that the use of the sense of taste for examining chemicals is very dangerous (Book VI Teacher, Research of Natural World, 2012).

Through this didactic proposal served the general purpose of teaching science, which aims at systematic introduction of the student to the concepts and the way to approach and study physics, reinforcing a) the development of student's personality by cultivating independent thinking, and interest of work and ability to communicate and cooperate with other people, b) the student familiarity with the scientific method (observation, thesis statements, concentration - use of information from various sources and even the use of information technology, their experimental control, analyze and interpret data, draw conclusions , generalization and creation of standards and c) cultivating team spirit and collective work to achieve common goals (CCF – Curriculum, "Research of Natural World" for Primary school.

The teaching scenario based on an edifying approach in which students participate actively in the creation of their own meanings, namely act, collaborate, perform tasks, take initiatives, participate in discussions, make decisions and think about their actions. With the active learning, students understand clearer, retain knowledge longer and enjoy the lesson (Slavin, 2007).

The teacher has an advisory, mediating, guiding and supporting role. He acts not as a knowledge body, but more as a coordinator of active and participatory learning activities and as a facilitator of learning. He pays attention at current knowledge and students' perceptions, and urges them to explore and discover new data through various activities (Aggelakos, 2004; Karantzis & Manessis, 2013; Matsagouras, 2003; Pyrgiotakis, 2009).

Class organization is as basic form of working in groups, which clearly is a student-centered teaching form and takes place within the cooperative action of students. A key component is the active participation of all members of the groups within the communicative approach. The cooperation in groups helps the development of creativity, the critical thinking, and student's emotional development (Matsagouras 2006, 2007). The object of work is common to all groups. In addition, it improves the relationship between the teacher and students and the individual relations among students. Students of each group alternately working on worksheets and computer.

The didactic proposal is part of the science teaching lesson in Chapter 11 "acids- Bases-Salts" of 6^{th} grade and it will be implemented in computer lab. The proposed implementation period is three (3) didactic hours. In teaching process will be exploited the software: a) "Solutions Acid - Base" of the platform PhET, University of Colorado, b) a web browser and c) a Scratch programming software. Regarding the software used, students can handle them after working on them in previous courses and are familiar with their use. The use and utilization of software helps to improve learning process (Kekeris, 2010; Komis, 2004; Samara, 2009).

Goals

Cognitive:
1 To acquaint the students with the basic properties of acids and bases.
2 To recognize the students the usefulness of certain acids and bases in everyday life.
3 To understand the importance of indicators.

Abilities:
1 To realize the students experimentally how to detect whether a substance is or contains an acid or base using an indicator.

Description of activities

At the beginning, the teacher gives the first worksheet to students, which functions as motive for the teaching development. He also gives them the link of a website that is associated with an advertisement of a facial cleanser. This advertisement is accessible to students as showing a student girl that on simple language advertises the cleanser fluid. The advertisement uses the term pH and stresses the numerical value of 5.5 as the value that differentiates the effectiveness of the

advertised product by other soaps that dry out the skin. Once viewing the advertisement, the students are asked to answer three questions which introduce the concept of acids and bases. The first question is about to guess why the soap dries the skin. The second question asks them to suppose the reason why the advertised facial cleanser is better than soap. The third question asks students to assume how they can be sure, according to advertisement, that the facial cleanser that someone uses is good or not. With these questions students use advertisement's information and make their own assumptions about the topic that they will process subsequently. Since this process, they will conclude that they do not know everything they need for an accurate selection of cleanser. This component will retain their interest in the next steps of teaching. Website: https://www.youtube.com/watch?v=EmId0fZWZPY (from 6:25 to 6:58) (Activity 1, Goals: Cognitive 1,2,3, Duration: 15').

Secondly, the teacher gives the second worksheet to the students, which is related to pH and the change of the numerical value of the various products of our daily life. Also, the teacher gives the https://www.youtube.com/watch?v=7QlQGq3-LrY website that presents a video with everyday products that indicate the value of pH. The products are presented starting from those with pH 1 to pH 14. After the first viewing, students observe and record the pH value of the products they saw on the worksheet. This procedure helps the students to realize that different products have different pH. In this way, students will recognize the pH value of the facial cleanser that presented in the previous worksheet as a value from the many. Then, the students are asked to watch the video again and complete a two-dimensional table. The table has two rows and fourteen columns. In the first row the numbers are placed from 1 to 14, while in the second row students should list the product corresponding to each value. For instance, they write "battery liquid" on value 1, "lemon" on value 2, etc., until the value 14 that they write "drain opener." Through this process, students construct their own pH meter after the table they construct contains the values of pH and an indicative substance that corresponds to that value. The construction of the pH paper will help in subsequent teaching activities (Activity 2, Goals: Cognitive 1, 2, 3, Duration: 30').

Then, the students will use the software "Solutions of Acid - Base" of the platform PhET, University of Colorado, USA which is available free of charge. The software is easy to install, and does not require any special function of the computer on which will this be installed, and is also free. In this software is presented a container that can be filled with water, with a strong acid, with a weak acid, with a strong base and a weak base. Simultaneously, the measurement of pH can be made either by the pH meter which directly shows the value or with pH paper, which was used by students with the worksheet given before. Moreover, the teacher gives the third worksheet that has software instructions as well as the successive stages of the activities completion. In activity 1, the students choose the pH meter and note the values it shows in a structured table. The table contains the water, the weak and strong acids and weak and strong bases. Then, they dive the pH meter within the container with these substances and note the corresponding pH value in the table. They repeat the same procedure and by using the pH paper they find the same values. In activity 2, the students construct their own solutions with specific criteria requested. Within the software environment which varies according to students' choices, they try to construct the weaker acid,

the stronger acid, the weaker base and the stronger base. Students are experimenting with the concentration of the acidic or basic substance in the container and based on this, they create more or less acidic and basic solutions. This active contact of students with the solutions provides useful assumption opportunities, control and inference that are evaluated every time by the members of each group. Students eventually announce the conclusions they noted in the table they are given, which indicate the values found for the stronger and weaker acid and the stronger and weaker base. At the same time, they should mention that there is a range of pH=6.50 to pH=7.50 that there is no option to be defined as an acid or base. Students complete the table of the values in which acids and bases are ranging and learn that this range is called a neutral pH. The software provides the ability to create solutions with direct and safe way that otherwise it would complicate the realization of the experiments, while significantly increasing the active participation of students. Finally, making use of the information provided by the textbook, students note their conclusions on the acids and bases in relation to their properties (cleaners or detergents) and in connection with the pH scale (Activity 3, Goals: Cognitive 1, 2, 3 & Ability 1, Duration: 45’).

Next, the students participate in an experiential activity that complements the knowledge they embedded with previous activities. Teacher presents to students ten (10) plastic glasses that are filled with different substances and are listed on them. As an example, we can fill the plastic glass with lemon juice, vinegar, orange juice, beer, coffee, milk, tea, pure water, soap and bleach. Each group uses pH paper to measure the pH of substances in each glass. Finally, they fill in the values in a table with the substances they are given and the measurement results are announced in the class by the representative of each group, while recognizing whether any substance is containing acid or base. Experiential activity helps students to learn and use the application of knowledge assimilated through an artificial laboratory environment or software in the real world. As a consequence, the activity is related to the real existence of acids and bases through personal and realistic experience of students (Activity 4, Goals: Cognitive 1, 2, 3 & Ability 1, Duration: 25’).

In the final part of the procedure, the students come in contact with two other activities, which are designed in a common digital environment, and are used as a final evaluation. The activities were designed with Scratch software, which is free and open source software (FOSS) that enables the design of activities in a simple programming environment. The first activity introduces to students 10 plastic glasses filled with a substance that is not listed. Students drag the pH meter with the mouse, and place it into each of the glass in which appears the pH value of the substance contained. The teacher gives an evaluation worksheet where students complement on each glass, the corresponding pH value they found, and then they mention if each solution contains base or acid. After completing this process, the students place the pH values from the smallest to the largest. In the second activity, four sets of glasses are presented with the software. Each set consists of five glasses. The two sets are named "Acids" and the other two are named "Bases". In each set, there is a glass which does not correspond to the set that it is placed. Thus, in the two sets of "Acids", there are two glasses that the pH value of the solution they contain is base. Instead, in the two sets of "Bases", there are two glasses that the pH value of the solution they contain

is acid. Students are asked to find the four glasses that are placed in the wrong set. These activities will evaluate the degree of achievement points of the teaching process (Activity 5, Goals: Cognitive 1, 2, 3 & Ability 1, Duration: 20').

Weaknesses and recommendations for further research

The presented teaching proposal is a suggestion of teaching that uses multiple teaching practices and approaches through the Information and Communications Technology (ICT). The main purpose is the emergence of a modern educational practice that emphasize on planning activities by the teacher. However, it should be noted that the didactic teaching proposal has not been applied in the classroom and thus there have been no specific educational effects of its implementation. This aspect is the only weakness of this scenario that otherwise, the results of the original school environment could have been more effective. For this reason, it is recommended to apply this didactic proposal in students of the sixth grade of primary school in order to identify weaknesses, possible omissions of it, and those elements which could improve the effectiveness of its implementation for the benefit of students, and potential concerns of students and their difficulties. Through such a research approach will enable the teaching proposal to be evaluated for useful data it presents but also to those who will need modifications and improvements.

Discussion

This didactic proposal is about the teaching of the concept of acids and bases, concepts that many times, because of the short proposed teaching duration from the curriculum, are approached in a superficial way during the teaching practice. That is why the didactic approach uses not only the modern way of teaching teamwork, but at the same time, implements the use of new technology that provide to students the opportunity for a discovery learning that fosters the active participation of students. Students work in groups and gradually learning new knowledge through worksheets. The knowledge gained in each of them unfolds the next steps. The usage of software that uses the didactic proposal is simple, as the software is freely and uses Greek language environment that facilitates their use, while are required minimal specifications for their implementation. At the same time, an attempt is made to connect the digital environment to the daily experience of students, which is achieved by combining digital content activities and realistic measurement situations acids and bases. The data from the implementation of teaching could be used for the teaching process of the neutralization of acids by adding bases, and vice versa. This allows better teaching the concept of salts generated by neutralization. Thus, the dynamic application and programming software that are easy to use could help both teachers as to their effectiveness teaching and students towards knowledge. Also, advertisements that are used are a usual stimulus for students while, from the teaching aspect, they provide a multimodal framework linking text, image, sound, and a targeted message that serve the objectives of teaching. As showing above, it should be noted that the application of modern educational technology can easily be used in the teaching of physics science, as long as it sets clear objectives and is used as an educational way that promotes the learning development of students, and causes their thinking through exploratory problematic situations, while simultaneously placing them in the center of interest for the teaching process.

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Appendices

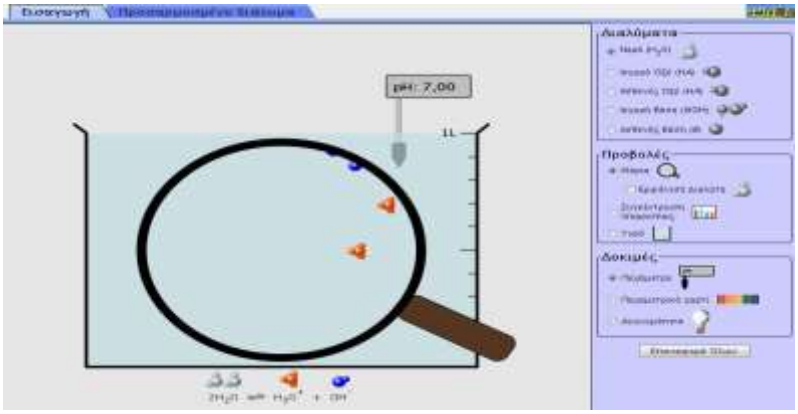

Figure 1: PhET interactive simulation for measurement of pH

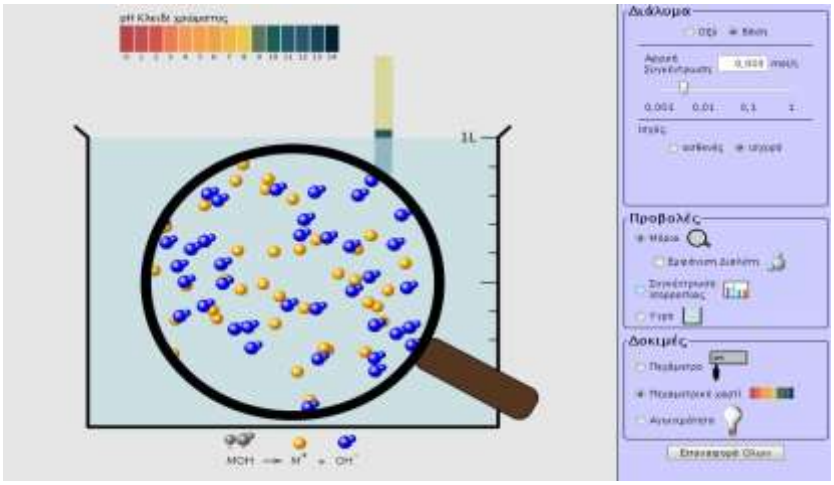

Figure 2: PhET interactive simulation for creating acids and bases

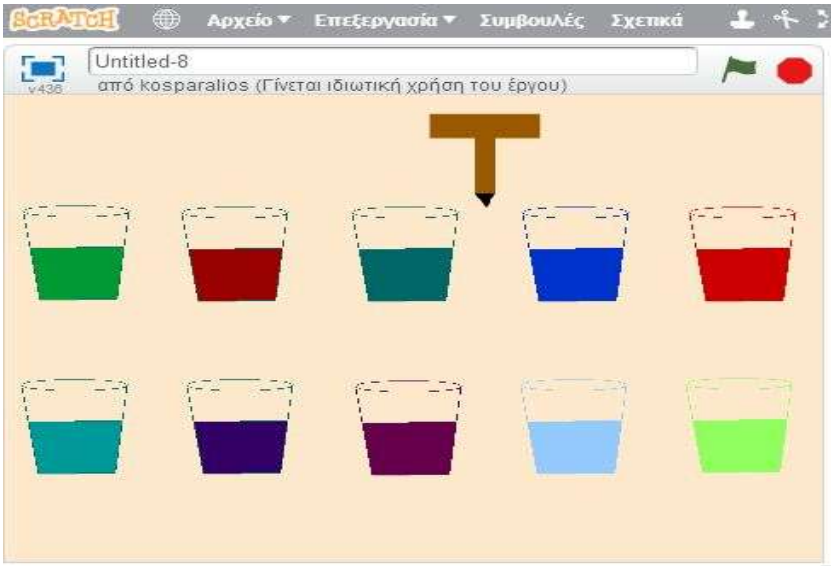

Figure 3: Scratch software to measure the pH of the substance contained in the glasses, Assessment Activity