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Integrated Teaching for the Chemistry Subject "Water Chemistry" with the Use of an Educational Site

Anna Thysiadou[1,*], Athanasios Mitropoulos[1,2] and Panagiotis Giannakoudakis[3]

[1]*Petroleum and Mechanical Engineering Department, Eastern Macedonia and Thrace Institute of Technology, Greece*
[2] *Department of Chemistry, International Hellenic University, Kavala, 65404 Greece*
[3]*Department of Chemistry, Laboratory of Physical Chemistry, Aristotle University of Thessaloniki, Greece*

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Abstract

The demands of modern society require of all citizens to understand and handle technology in all its aspects. The Internet is today the largest source of information on the planet, a fact that makes possible the search for all kinds of information on any subject on it. The role of Information and Communications Technology is also very important and decisive in the transformation of the educational, learning and knowledge diffusion processes, with promising prospects. Information and Communications Technology (ICT) is a powerful tool that can support the creation of learning environments concerning Chemistry.

On this paper, an educational site is presented that was structured having as a goal the creation of educational material and lesson plan for the teaching of subject matter "Water". The motivation was the desire to solve the misconceptions faced by students in the process of understanding the concepts being taught. The educational material included in this website is enriched with explanatory images, diagrams, graphic representations, and video recorded educational experiments. These experiments describe the exact process required to identify whether a water sample is suitable for drinking or not, taking into consideration the relevant chemical parameter in question.

The chemistry teaching with the use of ICT has attracted the interest of learners and their attention. It is a different matter to conduct the lesson without using the book and by using only the computer. In this way, the student does not consume himself/herself on passive memorization of events and in combination with the holistic, creative and entertaining learning offered by the use of computer, can become a cognitive subject for which learners have a positive perception as long as they are being actively involved in a learning process combined with the motivation that their interests can be useful in the classroom.

Keywords: Environmental Education; teaching; self-evaluation; educational site; water.

1. Introduction

Modern technological achievements and new social priorities require the renewal of education to better meet the real needs of young people. In addition, while the role of the citizen is emerging as decisive in handling environmental issues, the majority of citizens are characterized by a lack of knowledge concerning the environment. In this context is formed the need to develop environmental education that will seek to educate citizens who will be well aware of matters concerning the environment and its problems and will also be aware of the ways in which they will be able, of their own accord, to work towards the solution of these problems [1]. Competent bodies such as information centres, non-governmental organizations, and scientific institutes are dealing with environmental information and awareness raising issues as well as with the production of educational material.

Online courses provide a number of advantages compared to the traditional courses, such as the elimination of location and distance issues and the need for real-time attendance (asynchronous courses) etc., while at the same time exhibit unique characteristics [2]. In this direction, online courses provide a valuable tool for professors, who can organize and set up their courses online, while at the same time distance students can attend courses remotely and asynchronously, discarding barriers that might prevent them from doing so in a traditional way such as, for several reasons, in a classroom.

Educational and communication environments justify the placement of interactive multimedia in learning, and consequently in teaching strategies, highlighting the leading role of the computer in technology and in the support of the learning process. Research data [3-7] emphasize the substantial role that educational technology can play in the creation of supportive interactive multimedia teaching environments and in the study of how to integrate them without it being assimilated by educational practices but being the beginning of substantial changes in the learning process.

The effective use of interactive environments provided by educational technology is linked to the greater involvement of students in the process of learning and self-

* E-mail address: thysiadou@hotmail.com
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learning, to a better relation to the act of acquiring knowledge, to a better collaboration with each other and to the cultivation of a research culture that leads to a more comprehensive learning outcome [8]. Students interact with the Interactive Multimedia Environment and are exposed to an organized learning environment that offers exceptional educational abilities, shifting at the same time the student-professor relationship in the direction of collaboration, by introducing an educational philosophy that shows hidden techno-educational methods and suggests different educational methods, strengthening their cognitive abilities [9-10]. Its function is a source of information in the context of a singular educational process that overcomes the student's passivity, by adopting learning techniques, such as learning by doing, learning by exploring and case-based learning.

The teaching approaches that anticipate integrating the use of multimedia applications into the learning process stem from learning theories, such as the Behaviorism, Cognitivism and Constructivism [11]. However, the need for new reality creates respectively new learning approaches with new perspectives, such as the Computer Support Collaborative Learning (CSCL), [12]. The central idea that characterizes the new approaches is not aimed at burdening the school curriculum but on ways to integrate new technology with modern teaching methods that lead to the effectiveness of education [13].

Aiming at the pedagogical exploitation of a new way of teaching and learning, educational software is a tool to use in teaching or laboratory practice, stimulating students' interest, offering audiovisual experiences, through the multifaceted presentation of the curriculum.

The choice of the “Water Chemistry” module was based on the fact that it covers a significant part of the curriculum of the school Chemistry Course. The teaching of the module “Water Chemistry”, brings difficulties to students. The creation of the educational site responds to the desire to have a way of using the computer in teaching, in order to attract the student's interest by escaping from the routine, to facilitate the work of the professor, relieving him/her of time-consuming work without taking more time than the usual teaching in order not to lose precious hours and of course not to require complicated and expensive machines, nor hard to find software. The design of educational projects for Environmental Education ought to utilize modern technological learning environments, because the effectiveness of using models, digital representations, and computer simulations has been repeatedly substantiated [14-15]. In the light of this, an educational site was designed and developed by the Laboratory of Physical Chemistry and Environment of the Department of Chemistry, of the Aristotle University of Thessaloniki (AUTh), having as a purpose the support of the students-future professors in the studying of “Water”.

2. Material and method

The creation of the web page was achieved with Adobe's Dream Weaver web development tool, a top-of-the-line program for creating and editing websites using HTML code, CSS, and a system of supporting php code that is particularly easy to use and user-friendly. The program supports other technologies that help non-programmers and novices in the implementation of web pages with many embedded design techniques. An example is java script functions that are very useful in a web page and web application, creation. Dream Weaver is a great solution for web designers and beginners who want to create forms, frames, tables and other HTML objects. Furthermore, Dream Weaver can also be used for the creation of multimedia applications.

The program offers the ability to create static and dynamic HTML web pages with php code support technologies and it supports features such as timeline movement, absolute positioned content, layer creation, and scripts writing. It contains its own behaviours, which are ready-made scripts that can be easily added to an object.

The most important benefits of using Dream Weaver are:

1. The ability to create a website in a short time.
2. The ease concerning the security, and the addition and management of materials/content through the FTP protocol.
3. Easy configuration with the use of applications - inserts - add-ons - templates.
4. Anyone can use it, modify and explore its potential.
5. The administrator can also create web pages, incorporating various, additional tools that enhance capabilities and functions.
6. The possibility is given to select a presentation template from a wide variety of ready-made models (free and not free of charge) and also to construct, leaving to the designer only the configuration.
7. There is a possibility of menu creation that leads to specific content. The appearance of content on web pages can be configured according to the preferences and needs of the creator.
8. It offers a Media Manager for uploading and managing files and multimedia.
9. It provides the Really Simple Syndication, namely RSS, feed.
10. It supports various languages, including Greek.
11. It supports various user levels such as: Administrators, registered users.
12. It supports the integration of dozens of additional applications, whose installation is relatively easy. Additional applications can relate to a variety of applications that cover every design need and functional requirement of the website [16].

The website's banner was created with Adobe Photoshop CS6. Each web page has the date, which updates daily, as well as buttons for its easy printing but also buttons for the instant search of information on the web and more specifically on the search engine www.google.com. The website is configured to open in any browser used by the student in a new window.

3. Results and discussion

The educational site under the title: “Environmental education: A Chemical - Pedagogical approach to water, through the chemical analysis of water samples in Kavala region” was created during the two year period of 2013-2015 and is an integrated educational platform, which can accept

material such as texts, images, videos and other educational scenarios (Fig 1.).

It is offered as a supportive educational aid for the teaching of chemical parameters for the assessment of the quality of drinking water. The choice of control parameters was mainly based on the requirements of European Directives 98/83 and 2000/60. The analytical methods used were in line with the formal procedures required by the European Directive. Water quality is influenced by a wide range of natural and human factors. According to the results of these analyzes, it can certify with certainty whether a sample of water is suitable for drinking or not, by following the requirements of the legislation.

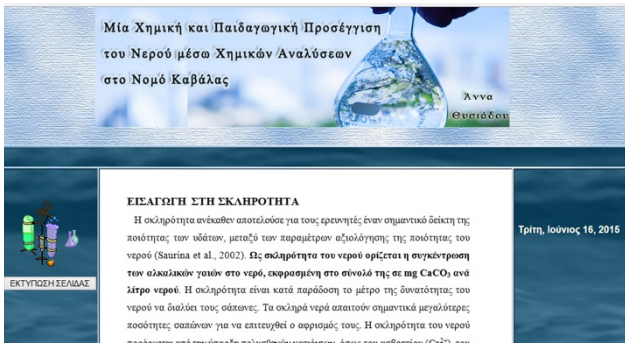

Fig 1. Snapshot of the educational site.

The theoretical educational material was created for the four evaluation parameters of drinking water quality. In the theoretical training material on hardness, alkalinity, conductivity and pH, the various methods of analysis of the specific parameters are mentioned, with the ultimate purpose of enabling the student to perform the analysis and then determine the parameter. "Water" is the most important factor in the development and preservation of life. Knowledge is provided in an interdisciplinary way because environmental problems are mainly social issues in which values and the lifestyle play an important role.

As mentioned before the chapters are made up of relevant units. These modules follow a structure that guides the learner through the learning process. First, he/she will begin by reading the theory, followed by the examples-applications that will give him/her the necessary skills to be able to answer the upcoming questions of understanding and then solving the proposed exercises and problems.

It is an easy-to-use learning tool, aimed at students, it incorporates image and sound, and aims at developing specific classroom activities. The central axis of the educational site is to build knowledge pleasantly. It is easy to use and does not require special knowledge from professors and students. The purpose of this specific educational activity is to give them the opportunity to conquer new knowledge via navigation and at the same time entertainment with the use of new technologies.

Professors, in combination with a good knowledge of this teaching tool [17], should make a careful planning that defines the framework of teamwork, support, point out the use of learning strategies, and apply educational processes that involve students in self-reflection, self-evaluation and collaboration. In addition, the flexibility and the design of diversified assignments are also prerequisites for all students to experience the joy of creativity and to feel confident [18].

On the web pages where it was deemed necessary, a menu was inserted to facilitate the student's study so that he or she could use the menu to be transferred to the next subunit with great ease (Fig 2.).

The educational material has been developed both in the form of web pages as well as in the form of printable .pdf files, to provide the possibility of either reading it on screen or on paper. The above was done out of respect for the particularity of a portion of students who are not very familiar with reading texts on a computer screen (Fig 3 and 4).

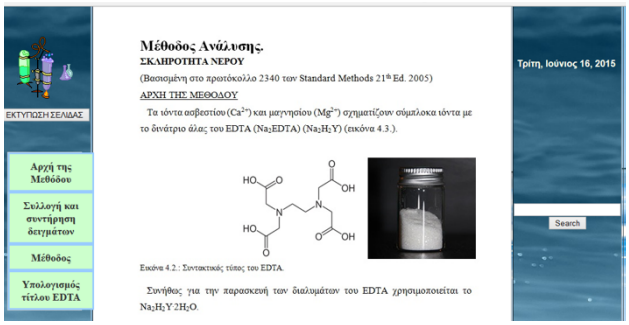

Fig 2. Snapshot of the educational site where a menu was inserted.

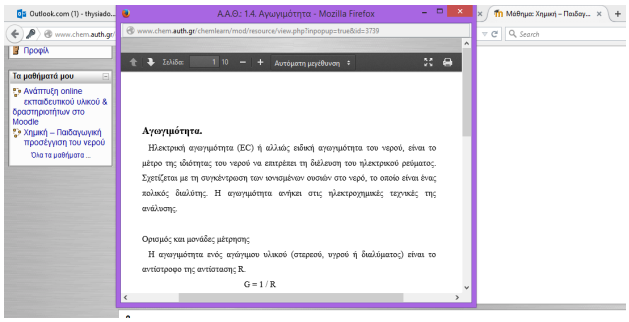

Fig 3. Preview of the .pdf file containing theory.

In the printable notes of the theory of each parameter, there are visual representations such as diagrams, structures of chemical compounds and reactions because they maintain the students' desire for learning unimpaired. In the field of natural sciences, visual representations play a decisive role both in the way of presentation as well as analysis of physical concepts and processes.

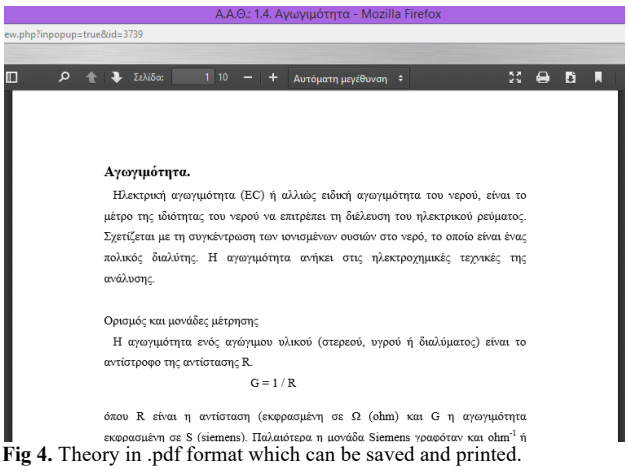

Fig 4. Theory in .pdf format which can be saved and printed.

In the present study 106 students, from the department of Chemistry of the Aristotle University of Thessaloniki, Greece, have answered a questionnaire with 12 questions. The students were divided into two students groups. The first group conducted the test without the use of the

educational site while the second group have answered immediately after the use of the educational site. Fig 5 shows the correct answers given by the two groups to the 12 questions.

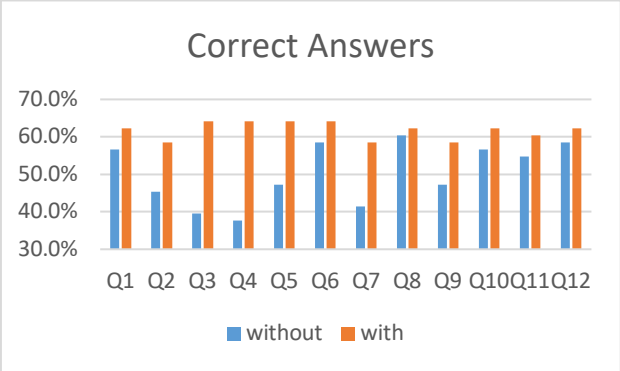

Fig 5. The correct answers of the two students groups

In the Table 1 there are the basic statistics for the individuals examined without using the educational site and those who used the educational site. According to the results the percentage of the correct answers of the first group is 50.3% while for the second group is 61.8%. In order to carry out a statistical analysis, we use the paired samples T test, because both groups of students are similar (dependent variables).

Table 1. Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Without educational Site	50,3145	12	8,13863	2,34942
	With educational Site	61,7925	12	2,29327	,66201

The value of the T test, whose the initial hypothesis is the equality of average values [19], will be checked to determine if it is valid for the two groups of students.

Table 2 illustrates the results of the T test. The value of Sig (2 tailed), whose significance level is set at 5%, has as a result to reject the initial hypothesis. In this hypothesis, the value of Sig (2 tailed) is equal to 0.001 and therefore the initinal hypothesis is rejected at a 1/1000 significance level.

Average values for correct answers to questions vary considerably. In addition, according to the results is obvious that the biggest differences exist in the 3, 4 and 7 questions (Fig 5), while the smaller differences are found in the questions 8 and 12.

Table 2. Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Without educational site – with educational site	-11,47799	8,22270	2,37369	-16,70244	-6,25353	-4,836	11	,001

It is concluded that educational site, which has a particular emphasis on the module water, plays an important role in its comprehension. As a result of the student group that used the educational site achieved better performance to the answers of the relevant questionnaire.

4. Conclusions

The Chemistry course can feed the educational process with innumerable stimuli for the development of the student's critical thinking, provided that the full range of a chemical phenomenon is exploited. New technologies provide a unique opportunity for experiential learning through the search for sources and the collection and comparison of information beyond the monotony, the one-sided presentation and the statism of the school manual. The comparison of information triggers thought, edified a student, and thus a person, who questions, doubts, compares, draws conclusions, perceives messages beyond what may be imposed on him.

The whole teaching process achieved a lot and had positive results not only in the cognitive but also in the affective and psychomotor level. This way the teaching goals were achieved. Of course, to accomplish this whole process and teaching with as many positive results as possible, prior must precede very good organization by the professor. The organization of the material on the educational site includes the presentation, bibliographical references and supporting material usually in the form of hyperlinks to other educational sites. The professors in their interviews point out that reading on the screen may be tedious but as they got used to the navigation through the hypertexts, they have been particularly pleased to be able to choose what they learn, given that each one was following a reading path of interest to them.

The educational site creation has shown that group work helps students develop their critical abilities, but also their interpersonal relationships. Furthermore, this way their self-esteem is increased, as they feel that they cultivate their communicative skills and they are freely expressed. The collaborative-holistic approach has also contributed to the development of the democratic behaviour of students, taught them how to learn and increased their sense of satisfaction from schoolwork. The ultimate goal was the gradual transition from the integration of ICT into the traditional ways of the organization of teaching in order to exploit the potential they provide, for innovative approaches to the learning process.

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