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USING ITC IN ORDER TO IMPROVE CHEMISTRY LEARNING AT THE UNIVERSITY DEGREES.

Abstract:

Introduction. The teaching of chemistry has several difficulties for several reasons: the lack of interest and motivation in students and little connection between the curriculum of compulsory education and university. This causes a negative idea about Chemistry. For these reasons, it was thought that the use of ICTs could be very beneficial for chemistry teaching and learning. In general, ICT can help us to increase participation of students in the area and would improve the direct intervention of the students which motivates their learning. On the other hand, every students have smartphone and internet access, therefore they are able to take photos, search on internet and download videos.

One experience consists of developing a blog, where the students are responsible for the design, development and inclusion of material in the blog. Thus, they are developing the blog and are enhanced since they are looking for materials to include in the blog.

On the other hand, it was identified student misconceptions and misinterpretation for Mechanical Engineering students as they are attempting to interpret and explain the chemical processes. Oxidation-reduction reactions were identified the most difficult concept. The objective has been to carry out a proposal for teaching contents of chemistry using didactic resources for virtual environment, the use of a simulation that lets students to construct useful mental models.

Experimental – The first experience was based in a comparative test of 10 questions related with the topics of the subject. Two groups of 60 students of Science education have participated. A group of students, who participated, designed and entered the blog and another group that was not involved in the blog.

And the second experience, the survey technique was used. The sample consisted of 50 volunteer students from the first course of Mechanical Engineer degree. Both experiences took place during the course 2013/14.

Results. The blog study demonstrated that developing blogs by students significantly increased the number scientifically acceptable ideas in student´s conceptions of science.

The use of animation has been demonstrated that showing animations to students, allows them to practise, so significantly increased the number of scientifically acceptable ideas in student's conceptions of redox reactions.

Conclusion. The use of either the blog or the simulation can be helpful in improving problem solving. This encourages students to develop new ideas about science, and allow them to create a memory from viewing animations, leading to confirmation or modification of the existing mental model.

Keywords:

ITC, Chesmitry, Blog and Multimedia Animation

JEL Classification: I20, I21, I20

1. Introduction

There is a continuously increasing of research regarding teaching and learning science. Science teachers and researchers have expressed their worries about the outcomes of science education. Some previous works has pointed out the lack of interest in science among high school and university students. (George & Kaplan, 1998). Many students consider science irrelevant to their personal interest and goals and are unaware of how many jobs require this type of knowledge (Aschbacher, Li, & Roth, 2010). This fact has a direct effect on how students perceive themselves in relation to a field such as science, and this perception influences their career choices or persistence as well as their future performance.

Furthermore, chemistry is not a popular career choice for students. Many works have attempted to shed light on students´ alienation from school chemistry, and several aspects have been identified. The public image of chemistry, the difficulties arising from the nature of school chemistry and the students' attitudes towards chemistry are some of them.

Chemistry has a negative connotation due to the environmental pollution caused by the products of chemical industry and the incorrect use of chemicals. This is called "chemophobia", a term denoting the absurd fear for chemical and chemistry (Kafetzopoulos, Spyrellis, N., & Lymperopoulo-Karaliota, A., 2006). Students also have images of scientist and chemists as being in white coats and Chemistry is often associate with poisons, pollution, witches, wizards crazy scientists and so on. Such images might be perpetuated by the media and might influence pupils´ decission making (Kniveton, 2004).

Aschbacher et al. (2010) ascertained that few adults at home or school encourage students to learn about science. It is often that students who like science, are good at it and show a sense of passion towards science, in consequence of having parents or teacher who act as guides.

Chemists generally present concepts at three levels of representation: the macroscopic, microscopic and symbolic levels (Gilbert & Treagust, D. , 2009). Many phenomena are available to direct experience (macroscopic level), but their explanation requires knowledge of the molecular structure and the interaction between atoms, molecules (microscopic level). To represent these phenomenons, chemists have invented specialized symbol systems like molecular formulas, which help them to communicate and visualize chemistry (Hoffman & Laszlo, P., 1991).

Many of the students´ difficulties in learning chemistry are directly related to the specific nature of chemistry which requires students to move from the macroscopic to the microscopic level, to use chemical symbols, and to visualize also abstract concepts such as the shape of a molecule into a two dimensional page (Charistos, Teberekidis, V.I., Tsipis, C.A., & Sigalas, M.P., 2003) (Chittleborough & Treagust, D., 2008).

Another barrier to chemistry learning, the one related to the formal and abstract nature of the scientific language and the commonly used communication code in standard chemistry or science textbooks (Halkia & Mantzouridis, D., 2005) (Stefani & Tsaparlis,

G., 2009). Due to every issue exposes previously, the chemistry course seems to be one of the least enjoyed among science subjects (Reiss, 2001).

Some of the reasons are related to the content of the chemistry curriculum, the limited amount of time for chemistry lessons, the methods of teaching chemistry and the lack of laboratory experiments. In Spain, chemistry is usually taught in a theory oriented approach without hands on activities and this practice decreases students´ interest for the course.

1.1. Context.

With the rapid advancement of information and communication technology, teachers are faced with the challenge of integrating ITC tools into de classroom setting for effective teaching and learning. These changes are influencing the educational systems in general and instructional methods in particular. Among these the use of computers in instructional lessons, computers can be used on their own or along with other instructional tools to ameliorate learning practices (Akgun, 2000). In general, it is observed that face-to-face instruction is the most commonly used instructional practice.

In order to remove the barriers stemming from the abundance of abstract knowledge, several cognitive strategies are assumed. In this respect, computer assisted instruction can be considered as a fruitful endeavour to integrate science and technology and improve the quality of learning experiences (Yenica, 2003). This allows learners to progress at their own pace, control their learning, participate in the learning endeavours more willingly, learn more effectively, get a richer variety of instructional materials, keep track of the learning experiences, get direct answers for their unique questions, get instant feedback regarding their strengths and weaknesses, conduct experiments which are hard to realize in real-life, and learn at a shorter time in a systematic way. Computers are usually more enjoyable and always more patient than classroom teachers (Bayrak, 2008; Cotton, 1991; Sentürk, 2005; Usun, 2000) (Bayrak, 2008) (Cotton, 1991) (Sentürk, 2005) (Usun, 2004).

One ITC tool, which has been used in this work, is blog. Blogs provide opportunities for people to publish thoughts, opinions in an on line environment (Deng & Yuen, 2011). Blogs share individual ownership, posted updates displayed. On the other hand, the technological features allow them to be used for different purposes as an educational tool. Blog can be used as one of the major tools for sharing knowledge (Hsu & Lin, 2008). Goktas and Demirel (2012) find that integrating blogs as a tool for learning can positively influence the learners´ Information and Communication Technology (ITC) perception as well as the acquisition of ICT competencies.

Many studies have found the interaction that takes place between teacher and learners enhances the perceived learning of the learners (Kreijns, Kirschener, & Jochems, 2002). Furthermore, blog can be used to enhance reflective thinking due to blog posts are sequenced chronologically and allow users to see how their thinking has changed over time (Ellison & Wu, 2008) and help them to express themselves and practice knowledge and skills.

Although the potential of blog use in increasing student interactivity and collaboration has been explored by many educators, research conducted on the effectiveness of blog use in the educational context is still quite limited (Kim, 2008). These research aims to suggest a way to integrate blogs for improving the teaching and learning process. Using blogs also allows an instructor to better understand their students´ struggles with the course. It encourages students to engage in deep and productive reflection during their

studies so as to be competent in their subject matter. This encourages them to modify their own beliefs and behaviours in relation to the subject studied (Kilic & Gökdas, 2012).

In computer assisted instruction case, a simulation using a multimedia application, an obvious advantage is the ability to concurrently present multiple representations to visualize chemical phenomena (Arasasingham, 2005). The materials can provide logical links between various representations to aid students´ understanding. These materials can help students build mental links to strengthen their logical framework of conceptual understanding and to achieve mastery level understanding of chemical concepts, contributing to learner motivation and active engagement. A high level of intrinsic motivation and active engagement are essential to the success of a project based learning lesson (Morgil, 2008).

The main purpose of computer assisted instruction or blog is to deliver the contents of the course through computers and realize instructional endeavours through the help of computer applications.

The current studies use a simulation program named Oxidation-Reduction Reactions (REDOX) in order to teach students redox reactions and a blog to teach a topic of the subject. The studies are designed as a quantitative research, which uses the pre-test and post-test control group design in the case of blog, and in both cases a questionnaire to know what they think and, about the utility of these ITC tools in order to improve the teaching and learning process.

It aims to investigate whether computer assisted instruction realized through simulation or blog are more effective than face-to-face in increasing student success in Science, and if they think that computer assisted is useful to learn more easily the subject.

2. Methodology

It was used a case study design to examine factors that influence students decision to study Chemistry during their degrees. With this study, we are trying to capture real world contexts.

Survey research design was used for the current study. How do students perceive learning with blogs in instructional design course?

This study was created as a descriptive study in which the survey technique was used.

2.1. Participants

The computer assisted instruction study, simulation, was carried out during the course 2013-2014. The sample consisted of 35 volunteer students from two different classes, at the first course of Mechanical Engineer degree at University of Málaga, during the first semester; introductory chemistry course taught by the same chemistry instructor. The other computer assisted instruction, blog, was carried out during the course 2013-2014, at the Didactics of Natural Sciences subject of Pre-school Education Degree. The sample consisted of 122 volunteer students from two different classes, at the third course of Pre-school Education degree at University of Málaga, during the second semester; introductory science course taught by the same chemistry instructor.

The students came from a variety of socioeconomic and cultural backgrounds. The student attitudes towards taking chemistry were varied. However, the vast majority of

them were there, they do not love chemistry, and they were there simply because they needed to pass the exams to obtain the degree.

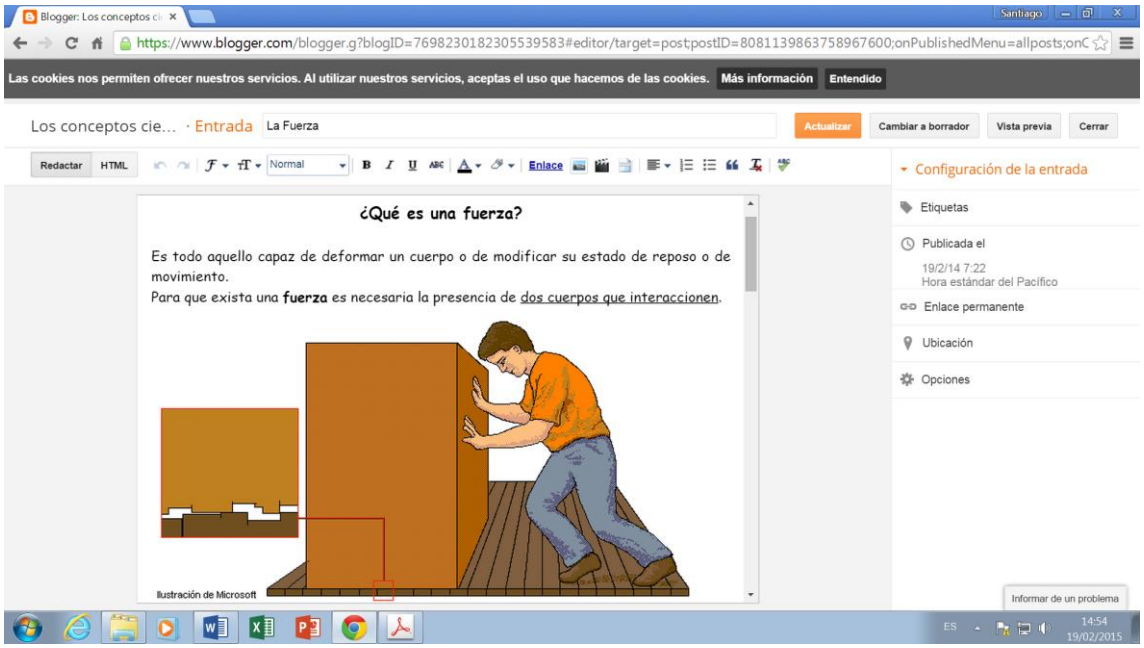

Figure 1. One image of the blog web page.

Each student did one questionnaire, a pre-test and a post-test. The two groups, which participated, had the same experience in working with chemicals in lab, attended the same computer simulations, in simulation study. The questionnaire consists of 8 items and it is a five point Likert type scale.

Students´ questionnaire responses were analysed using a Likert scale, and they were referred to the utility of this computer assisted instruction and their thoughts. The scale of the test was a five point Likert type scale with a range of five options. The positive items range from 1= Certainly Agree to 5 = Certainly Disagree.

Previously to use the surveys, the surveys were validity by three experts in the field of Educational Science.

In blog study, one group is the experimental group who participated in the blog development and one control group, who did not use the blog.

In REDOX study, the two groups are experimental groups, who have been used the simulation about REDOX reactions.

The computer simulation used to demonstrate the redox reactions to students in the extent of application has been provided by McGrawn Hill. This program is available on Internet and is consisted of two redox experiments.

3. Results

In both cases, the data consisted of the pre-test and post-test results obtained from the achievement test. The data were analysed through t-tests. Findings were obtained through conducting the parametric tests with SPSS 11.0 for Windows.

Pre- and post-test results of the knowledge about the studied topic were been compared with paired sample t-test and a statistically significant difference in favour of the post

test was determined in both cases. Statistical results of the achievement test administered after the study in the Didactics of Natural Sciences students are shown in Table 1. In order to investigate the prior knowledge of students, both the experiment and control groups were administered pre-test. Students´ prior knowledge measured through the achievement tests did not differ significantly.

Table 1. Paired samples t-test results for post results survey, experimental and control group

Group	Mean	SD
Experimental	8.00	0.20
Control	5.90	0.12

The results of the independent samples t-test comparing the experiment and control groups in terms of the post-test results are provided in Table 1. A statistically significant difference between the post-test scores of the experiment group and the control group was found ($p<0.5$). The mean of the students who were exposed to computer assisted instruction was significantly higher than that of the control group.

A carefully analysis indicate that the students in the control group who were exposed to the face-to-face instruction had significantly higher scores in the post-test in comparison to their scores in the pre-test. This finding suggested that the control group who were exposed to face-to-face instruction was also more successful in the post-test.

In the Mechanical Engineering Degree, it was used a redox simulation. This program was about the zinc-copper reaction, it was animated as two dimensional and when two objects approach each other, they were animated as colliding and bouncing off each other. The total viewing time for this animation is less than 1 minute.

The animation started with several zinc atom circles in an organized patter placed against a grey background (water). Floating freely in the water were some copper atoms with a “2+” symbol on them (cation of copper) and the double number of atom clusters containing atom with a “-“ symbol on it surrounded by nitrate ions. The reaction occurs when one copper atom approach one zinc atom and the electrons are transferred from zinc to copper. And now, the zinc atoms have “2+” symbol on it and become smaller and at the same time, each copper atom becomes larger and loses its “2+” symbol. With this example, the students are able to see how the micro level works as a macro level, and how some changes occur in the atom structures.

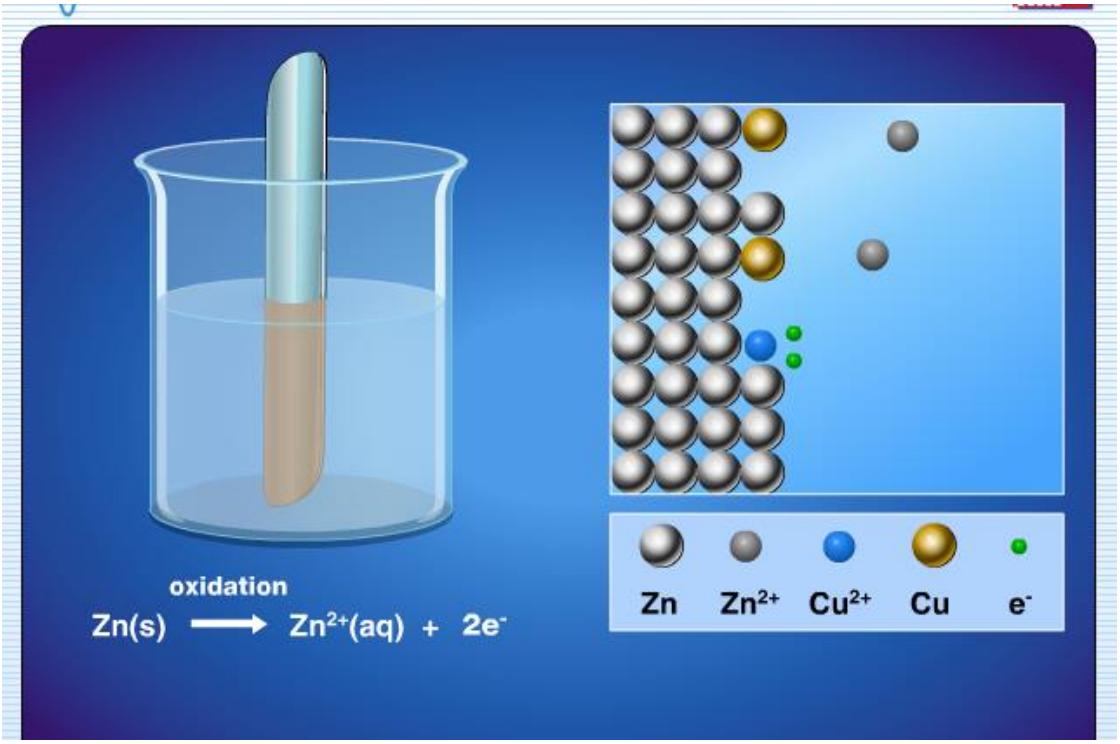

Figure 2. Cupper and Zinc reactions, multimedia application provided from http://highered.mheducation.com/

This design described below it can be used for any chemistry topic that will require a scientifically acceptable mental model of the molecular world. In this case, the learning process will be improved because this learning experience would involve student to observe a chemical phenomenon, in particularly, a chemical reaction as a lecture demonstrations and then, it will be viewed an animation multimedia application about the phenomenon at the molecular level, which will be explained by a narrator. And eventually, the students will adapt their mental model to explain a similar phenomenon with an analogous substance or reactions.

The most important thing for the success of this multimedia application to promote visualisation as a learning strategy is the practice and application of the visualisation skills developed.

And with this type of learning we obtain some advantages as construct scientifically acceptable mental models of substances and reactions at the molecular level which will be able to apply in other new models to new substances and reactions. Furthermore, it will be possible that the student use their models to understand new chemistry concepts that require a molecular level.

The highest post test scores about the knowledge were obtained by students with high prior knowledge. And greatest gains were achieved by students with low prior knowledge who had high disembedding ability and used deep learning strategies. Hence, it can be said that animation encourages students with low prior knowledge to develop new ideas to create their mental models.

Turning to some qualitative aspects of the use of the simulations, discussions with the students after the intervention showed that most students initially assumed that the simulation did not help them in the solution of the problems but were useful in helping with the proper application of the equations. Further discussion revealed some

interesting aspects of the students´ actions and attitudes, with several of them admitting that through the simulation cleared something in their minds.

Students were administrated the questionarie after the use of the mutimedia application about REDOX reactions.The 13 stametements of the survey were divided in two categories. A selection of five on the positve response statements indicated a favorable attitude about the utility of the application whereas a selection of one on the negative response statements indicated a favorable attitude about the REDOX multimedia application.

The results showed that the vast majority of students think that the use of the application is a good way to understand the microscopic level of these types of reactions. In general the values were higher or equal to 2.5, which is meant, they think in a positive way about the application utility.

First of all, it was examined the distribution for each variable and each group study. The mean and the standard deviation for the different variables according to the two investigated groups, demostrated that there was no significant difference in the level of interest or utility that they give to the multimedia application. The descriptive statistics were performed for each items. The average scores for each item ranged from 1.9 to 4.1

In Figure 2, it can be seen as mostly the average of these statements showed an overall positive response statements .The majority of the each student average of the response statements shown are positive, more than 2.5.

Furthermore, if we focus on the responses of the two question, it can be seen that the majority of the question answered by each student are positive, the mark is more than 2.5.

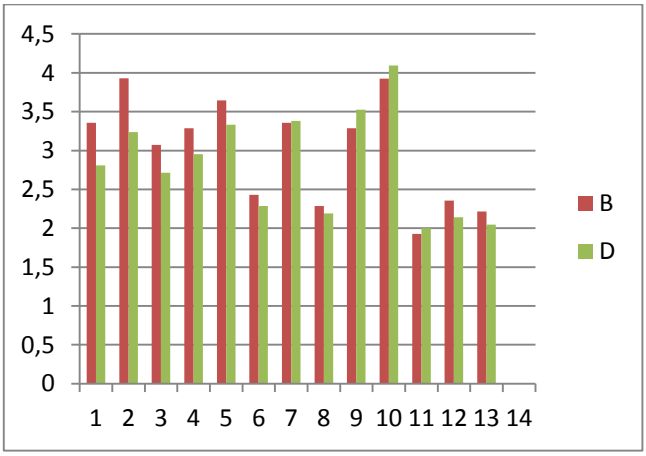

Figure 3. Comparation of students´average responses to the application utility on the learning process in chemistry from B and D groups.

In Figure 3, we can see that the question answered by students of grupo B and D, and practically are the same, although we can see as group B gave higher values when they answered the questionnarie.

4. Conclusion

Results of the Pre-school Science Education study suggested that students in the experiment group who were exposed to computer assisted instruction in Pre-school Education Degree were more successful in the learning process than the control group students who were exposed to face-to-face instruction.

In this study, studying the students with major attitude changes in one educational setting was found that essentially the same factors in the educational setting had affected students with negative and positive attitude shifts. Even though the same factors had affected students the balance in experiences was very different. Students who showed positive attitude shift exhibited few negative ideas of factors in the educational setting, tilting the balance favourably, while students with negative attitude shifts show the opposite pattern.

The use of virtual application can be helpful in improving problem solving. We recognize that other types of intervention might have been equally effective; but the issue here was whether a particular approach would be effective.

The results of the Mechanical Engineering Degree study are based on a survey purpose after the use of an interactive application in order to improve the learning process of the chemistry, REDOX reaction. This information is valuable since students could watch these animations on a computer. As a result, many of the students´ misconceptions and misinterpretations identified may not have existed if the students had seen the previous lesson This is based on the cognitive theory of multimedia learning, which assumes that learners process information through a dual coding capability involving a auditory/verbal channel and a visual/pictorial channel (Pavio, 1986) (Mayer, 2001). Students would learn better with words and pictures.

Nevertheless, the vast majority of students recognize that chemistry knowledge is useful to interpret aspect of their everyday life, but not many of them express their wish to continue chemistry studies.

As we know, students attitude regarding the difficulty of chemistry lesson are related to concepts, symbols, etc. Because of this, the students find the use and application useful to transfer from macroscopic level to microscopic or/ and symbolic level. Chemistry teachers can transfer rapidly form one level to the other, without problems, but students can not do the same.

In both cases, several concepts and conceptual relations covered in the chemistry or science courses were provided in a concrete way though the help of computer simulations or blog, which improved the student success significantly.

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