'Iceilt International Congress on Eucatin Innovation and Learning Technologies', (23-25 July 2014), 'Instituto Politecnico de Portalegre; Universidad de Extremadura; y otros', 'Biology Faculty of the Barcelona University', 'Instituto Politecnico de Portalegre; Universidad de Extremadura y otros', 'Domínguez, J. R.'

International Journal of Innovative Technology & Adaptive Management (IJITAM)
ISSN: 2347-3622, Volume-1, Issue-10, July, 2014

Using computer animation simulation in chemistry in order to solve students´ misinterpretations and misconceptions about oxidation-reduction reactions.

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***Abstract*— Most chemistry teaching operates at the macro level, and it is well known that many misconceptions in chemistry stem from a inability to visualize structures and processes at the micro level. Thanks to this multimedia application in which the micro level is shown, can be compelling and effective learning resources. However, the multimedia application must be designed and presented with highly regarded care to encourage students and to avoid generating misconceptions.**

The goal of this project was to determine if students´ attitudes about chemistry and performance in chemistry increased as a result of being taught with a multimedia application. During this investigation, 33 students were presented with a chemistry unit, REDOX reactions, taught by the instructor, as usual, in class, and then, it was helped with a multimedia simulation. The results of this study shown that, the students find useful the use of this multimedia application in order to improve the learning process.

Keywords: misconceptions, chemistry, multimedia application, multimedia simulations.

I. Introduction

Chemistry involves observables changes in matter at macroscopic level, what is meant, imperceptible changes in structure and processes at the microscopic level.

There is considerable agreement among science educators on the importance of students´ attitudes toward science lessons [1]. Nevertheless, there is less accordance about how to measure them. Chemical education researches have recognized that students often have difficulty learning chemistry concepts, and have proposed several suggestions as to the reasons for this difficulty, including frequent overloading of student working memory [2-5]. These isolated facts tend to get memorized for a test and are forgotten soon after because these terms have no importance to students. The researches on misconceptions and misinterpretations in oxidation-reductions reactions have focused on students' difficulties in properly identifying oxidation-reduction reactions [6]. As a student, I

International Journal of Innovative Technology & Adaptive Management (IJITAM)
ISSN: 2347-3622, Volume-1, Issue-10, July, 2014

was used to learning with a typical text book, in a traditional way, however, as an instructor, I would like to teach with a new method, which would improve the students' motivation about this topic. One of the major goals in teaching chemistry with a contextual approach is that students will develop the ability to understand a make decision about issued they may face in their everyday lives outside of the classroom [7, 8]. Teachers can better prepare students for the modern world teaching with a modern approach.

In this work, it is reported an investigation that employed computer simulations to demonstrate an experiment that was relevant to the solution of chemistry problems. Teaching chemistry with a multimedia application has an advantage over traditional approaches for several reasons. These applications allow students to be more nearly engaged with complex concepts. On the other hand, traditional chemistry classes tend to focus on the repetition of mathematical problems, and the memorization of chemistry facts and tables [7]. Undergraduates find this uninspiring, and irrelevant to their lives [7, 9].

In this case is going to do research about oxidation-reduction reactions, focused on students' difficulties in properly identifying oxidation reduction reactions [9-11]. One reason for this difficulty is that chemistry teachers and textbooks often use more than one definition for the processes of oxidation and reductions. These definitions include the electron method, the oxidation number methods, the oxygen method, the hydrogen method, and others.

II. EXPERIMENTAL

This study was created as a descriptive study in which the survey technique was used. The study was carried out during the course 2013-2014. The sample consisted of 35 volunteer students from three different classes, at the first course of Mechanical Engineer degree at University of Málaga, during the first semester; introductory chemistry course conducted by one of the researcher of this work. The students came from a variety of socioeconomic and cultural backgrounds. The student attitudes towards taking chemistry were varied. But the vast majority of them did no love chemistry, and they were there simply because they needed to pass the exams to obtain the degree. The two groups which had participated, had the same experience in working with chemicals in lab, and had attended the same computer simulations. Students´ responses were analysed using a Likert scale. 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 Disagree to 5 = Certainly Agree. The relevant knowledge before and after the use of visual tools was identified using a pre- and post- test. What they thought that they knew about the topic was measured using a Questionnaire, before and after the use of the visual tools. And finally, only two groups, the experimental groups B and D, which had used the visual tools, answered the utility test about the visual tools.

Computer animation. 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

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ISSN: 2347-3622, Volume-1, Issue-10, July, 2014

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.

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III. RESULTS AND DISCUSSION

In this case, the learning process will be improved because this learning experience would involve students 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 (micro level).

The result of the questionnaires shown that 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, finally, it was 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.

Each category had a mixture of positive response statements and negative response statements. 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

International Journal of Innovative Technology & Adaptive Management (IJITAM)
ISSN: 2347-3622, Volume-1, Issue-10, July, 2014

unfavorable attitude about the REDOX multimedia application.

In order to develop the results obtained, we need to enumerate the questions that the students had to answer. Table 1 shows the different question which the students had to answer using a Likert scale.

TABLE 1. QUESTIONS ANSWERED BY STUDENTS.

1	The use of the multimedia application is more effective than conventional classes
2	The use of the multimedia application is more effective to understand theory
3	Students enjoy the topic theory more than conventional classes.
4	Students like more this type of classes.
5	They prefer this method in other subjects.
6	The use of multimedia application improves my understanding of the topic
7	The multimedia application removes a valuable study time
8	I think the media application should also be used in other subjects
9	The multimedia application helps me especially.
10	We should stop using the media application
11	I think the multimedia application shows the interest of the teacher for our learning
12	I think the multimedia application is very beneficial for the class
13	Having the multimedia application as part of the
	teaching in this class I like it.

In Figure 1 we can see as 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 this Figure is shown values higher or equal to 2.5, which is meant, they think in a positive way about the application utility.

Following it was examined the distribution for each different variable and each group study. The average and the standard desviation values are presented in Table 2.

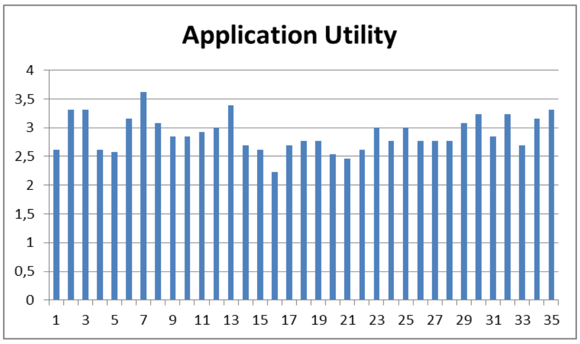

Figure 1. Students´average responses to the application utility on the learning process in chemistry.

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TABLE 2. DESCRIPTIVE STATISTICS ABOUT THE UTILITY OF THE MULTIMEDIA APPLICATION.

Question	Mean	B group Mean	D group Mean	SD	p-value
1	3.03	2.8	3.1	0.95	0.051
2	3.51	3.2	3.6	0.85	0.010
3	2.86	2.7	2.9	0.91	0.091
4	3.09	2.9	3.1	0.98	0.319
5	3.50	3.3	3.5	0.95	0.297
6	1.97	2	1.9	0.90	0.597
7	2.34	2.3	2.4	0.87	0.755
8	3.47	3.4	3.4	0.77	0.793
9	3.43	3.5	3.4	0.88	0.502
10	2.23	2.2	2.2	0.73	0.661
11	4.05	4.1	4	0.80	0.650
12	2.97	3	2.9	0.90	0.597
13	2.15	2.1	2.2	1.12	0.852

The mean and the standard deviation for the different variables according to the two investigated groups, presented in Table 2, demostrate that in the vast majority 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 and the standard desviation from 0.73 to 1.12 .

The results shown that 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 every question, it can be seen that mostly the questions answered by each student are positive, the mark is more than 2.5.

Studying the results, we can see that the questions answer 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.

For the research not only were studied the frequencies to find the relationship between variables and groups, but also one-way ANOVA was applied. The results found significant relationship and differences among these independent factors.

In Table 2, the researcher conducted one way ANOVA. The statistical results indicated the p-value were not less than 0.05, except to question number 2, which was 0.01, the statistical results indicated that the p-value was not reached the significant level, the results were not significant, therefore the hypothesis were rejected in almost the cases. Regard to the 2 question, the p-value indicated that there is significant differences between the two groups, and because of this value, the hypothesis was accepted.

IV. CONCLUSION

The use of computer simulation 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 this study are based on a survey purpose after the use of a multimedia application in order to improve the learning process about REDOX reactions. This information is valuable since students could watch these animations on a computer, a mobile or wherever they want.

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As a result, many of the student’s 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 an auditory/verbal channel and a visual/pictorial channel [12, 13]. Students would learn better with words and pictures.

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 [14]. Chemistry teachers can transfer rapidly form one level to the other, without problems, but students are not able to transfer easily.

The student attitude regarding the utility of the REDOX multimedia application at this lesson, are almost neutral. 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.

ACKNOWLEDGMENTS

My thanks to University of Málaga for allowing us to develop this project and the financial support.

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