Using a Periodic Table Multimedia in Order to Simplify a New Universal Language, the Chemical Language

María del Mar López Guerrero, Gema López Guerrero.
University of Malaga, Faculty of Science, Department of Analytical Chemistry (Spain)
mmlopez@uma.es; gemalopez@uma.es

Abstract

This article will be described approaches to teaching chemistry as a language. There is a little bit analogy between chemistry and foreign languages. Most languages have different alphabets for each one. In order to learn a second language, one needs to know the new symbols. After knowing the alphabet, the students are ready to begin the formation of chemical words. After a few classes of chemistry, the students are ready to attempt intelligent conversation by combining the chemical alphabet words into sentences, reactions.

In this work, we report a study that employed computer simulations. The proposal of this study is intended to design and implement a teaching strategy for teaching and learning the chemical language, first of all the chemical alphabet,the Periodic Table and then, the language which it is built the chemistry. For this proposal we will use some multimedia application (Information and Communication Technologies (ITC)), which consists in a interactive periodic table. Student will be able to push one element and they will be able to see the properties of this element and which other element will be able to combine with it, and furthermore, if this element will be able to combine with itself. When they know properly the simple language, they will be able to continue studying more complex words, in this case, the reactions. With this multimedia application, the students will be able to watch how the atoms will change, one atom changes to a new atom during a whole reaction. And finally, they will be able to watch how these new atoms have new properties, and they combine each one.

The results of this study are based on a survey purpose after the use of an interactive application in order to improve the learning process of the chemistry language. This information is valuable since students could watch these animations on a computer, at the same time they will improve their knowledge about chemistry.

1. Introduction

Chemistry has been developed greatly throughout the 20th century. Chemistry is included in the curriculum of elementary and secondary education. In general, students are not interested in science, and because of this students tend not to make an effort to learn and understand the meaning of concepts and the chemistry language that are being taught to them.

Chemical education researches have recognized that students often have difficulty learning chemistry concepts and language, and have proposed several suggestions as to the reasons for this difficulty, including frequent overloading of student working memory [1-4]. These isolated facts tend to get memorized for a test and are forgotten soon after because these terms have no importance to students.

As it is known, the most effective factor contributing to students decision to study is their interest in the subject [5,6]. When students feel familiar with the concepts or issues from their previous studies, and confident enough to explain them, their motivation and achievements are positively affected. Such data are very important for developing learning materials and for planning teaching strategies [7].

As it is known, the technology has been used for foreign language instruction the last two decades in developing countries. The number of computer applications, communications technologies, and etc… has embraced these new technologies as useful instructional tools [8] and furthermore, studies of student attitudes regarding learning with technology have been reported in a good way [9]. Nowadays, technology provides second language learners with novel and varied chances for language learning (CD-ROMs, Web pages, software …). Nevertheless, the technology effectiveness depends on how it is implemented. And because of this, we need to reconsider any methods to language acquisition [10].

The main goal of this work is to identify ways in which language learners can effectively take advantage of these rich resources to enhance their learning and improve their chemistry language skills, due to the fact that chemistry is taught as a second foreign language. For the students who would like to practice their new language outside of the classroom, a wealth of opportunities now exists through the web and the Internet.

One of the main benefit of the ITC use is that we can increase the motivation, the improvement in self-concept and mastery of basic skills, more student-centered learning and engagement in the learning process, [11,12].
If we consider that there is a little bit analogy between chemistry and foreign languages. In order to learn a second language, one needs to know the new symbols, a different alphabet. It is necessary to learn more than 103 symbols, the chemical alphabet. After that, the students are ready to begin the formation of chemical words. In this case, learning the compounds names is easier when only two elements are involved, but when there are more than two, the chemical language is more complex.
Students need increased exposure to the general academic language in chemistry and classroom time in which will be practiced this chemistry language. Because of this, teachers need to rethink how they provide opportunities for learners to process the input and practice the output of the chemistry language. Students need to think about the foreign language, and they need time to internalize the formal language and be able to translate this chemical language into their own words. They are able to translate between Spanish and Chemistry.
As a foreign language, chemistry demand hard work in the form of many hours of repetitions examples and problems. Consequently, learning chemistry is like learning a new language, but a language which is unique and universal. These languages express conceptual content, structural content and finally, form of expression. There are three forms to express the chemical language: in words and sentences, symbolically and with pictures with spheres and clouds, atoms and electrons.
At the same time, chemistry is divided in three fields, macroscopic, symbolic and microscopic. And for a huge number of students the real world and the chemistry are disconnected. Due to this fact, many students have difficulties in translating chemical language into their own world view.
The proposal of this study is intended to design and implement a teaching strategy for teaching and learning the chemical language, first of all the chemical alphabet, the Periodic Table and then, the language which it is built the chemistry. For this proposal, we will use some multimedia application (Information and Communication Technologies (ITC)), which consists in a interactive periodic table. Students will be able to push one element and they will be able to see the properties of this element and which other element will be able to combine with it, and furthermore, if this element will be able to combine with itself.
When students push one element, learners can identify the substance as an element and reflect the element´s physical state in which it was usually found.
When they know properly the simple language, they will be able to continue studying more complex words, in this case, the reactions. With this multimedia application, the students will be able to watch how the atoms will change, one atom changes to a new atom during a whole reaction. And finally, they will be able to watch how these new atoms have new properties, and they combine each one. With this Periodic Table, the student learn chemical formulas and equations.

2. 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 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 instructors. 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 were there, they do not love chemistry, and they were there simply because they needed to pass the exams to obtain the degree. Each student made 1 test. The two groups which participated had the same experience in working with chemicals in lab, 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 Agree to 5 = Certainly Disagree.

3. Results and discussion

In this study, the use of multimedia application in chemistry language learning is studied. In the interactive multimedia field, learning objects are digital assets, for instance, animations, in context.
In this case, the learning process will be improved because this learning experience would involve student to observe a chemical phenomenon 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.
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 learning the new foreign language 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.

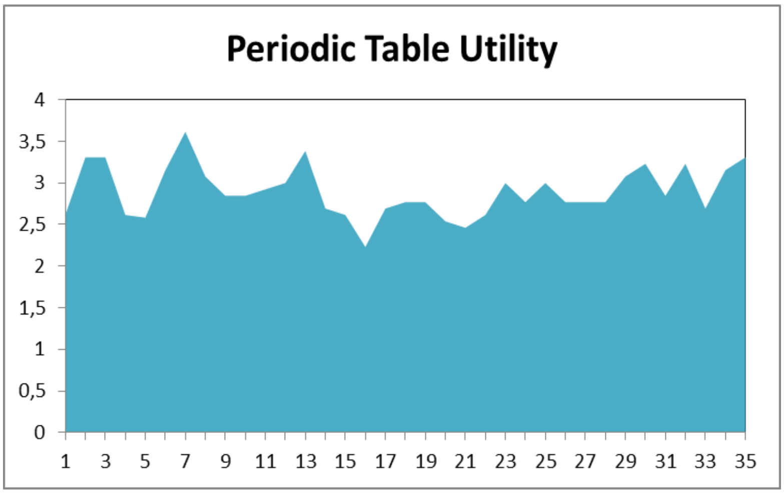

Figure 1. Students´average responses to the application utility on the learning process in chemistry.

Students were administrated the questionarie after the use of the mutimedia application.The survey contains 13 statements. Each category had a mixture of positive response statements and negative response statements. A selection of five on the positive 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 multimedia application.
First of all, it was examined the distribution for each varaible.

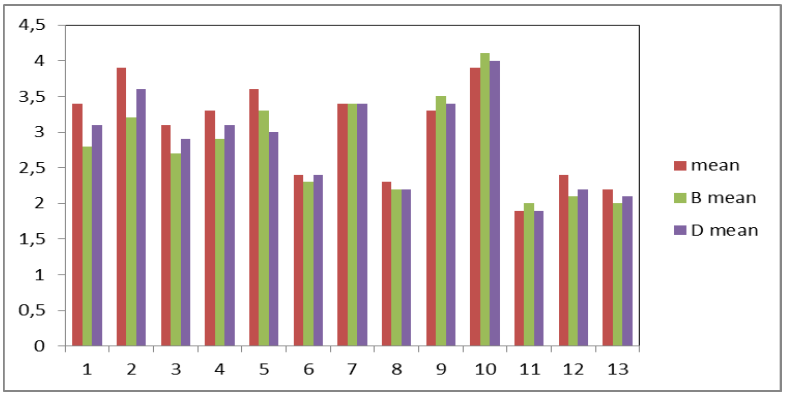

Figure 2. Descriptive statistics about the utility of the multimedia application in the two groups

The descriptive statistics were performed for each items. The average scores for each item ranged from 1.9 to 4.1.
In Figure 1, 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.
The mean and the standard deviation for the different variables acording 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, Figure 2.

4. Conclusion

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 this study are based on a survey purpose after the use of an interactive application in order to improve the learning process of the chemistry language. This information is valuable since students could watch these animations on a computer. 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 [13,14]. 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.

5. Acknowledgments

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

References

[1] Carlson, R., Chandler, P., Sweller, J., J. Educ. Psych., 95, (2003) p. 629.
[2] Johnstone, A. H., Chem. Educ. Res. Pract., 7, (2006) pp 49.
[3] Johnstone, A. H., J. Chem. Educ., 87, (2010) pp 22.
[4] R. Tasker, R. Dalton, “Research into practice:visualisation of molecular world using animations”. Chem. Educ. Res. Pract., vol. 7, pp 141-159, 2006.
[5] N. Milner, R. Ben-Zvi, A. Hofstein. Variables that affect students´enrollment in science courses, Research in science and technological education, 5, 201-208, 1987.
[6] B. Lindahl Changing the subject to get more students´ to science and technology. A paper presented at the GAST 11 conference, Mauritius, 2003.
[7] H. Arzi, ,R. Ben-Zvi, U. Ganiel, Forgetting versus saving: the many facets of long term retention, Science Education, 70, 171-188, 1986.
[8] Leloup, J. W., & Ponterio, R. (2003). Second Language Acquisition and Technology: A Review of the Research. Eric Digest. EDO-FL-03-11.
[9] Salaberry, M. (2001). The use of technology for second language learning and teaching: a retrospective. The Modern Language Journal, 85(1), 41-56.
[10] Chapelle, C. (2007). Technology and second language acquisition. Annual Review of Applied Linguistics. 27, 98-114.
[11] Dwyer, D. (1996). A response to Douglas Noble: We're in this together. Educational Leadership, 54(3), 24-27.
[12] McGrath, B. (1998). Partners in learning: twelve ways technology changes the teacher-student relationship. Technological Horizon In Education, 25(9), 58-62.
[13] Pavio, A. 1986. Mental representations: A dual coding approach, New York, Oxford University Press.
[14] Mayer, R.E. 2001. Multimedia Learning, New York: Cambridge University Press.