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HOW TO MAKE CHEMISTRY INTERESTING FOR ENGINEERING STUDENTS THROUGH INFORMATION AND COMMUNICATION TECHNOLOGY.

Abstract:

Chemistry is a subject many students prefer to avoid, even if they have an interest in science, because of its reputation for lowering grade point averages. However, it isn't as bad as it seems. Chemistry has a reputation as being a difficult subject to master, but there are steps you can take to improve your chances of success. The key to learning chemistry is to take responsibility for your own learning. No one can learn chemistry for you. If you want to be good at something, you have to practice it. If you review chemistry every day and work problems every day, you'll find a rhythm that will make it easier to retain the material and learn new concepts.
Furthermore, in order to improve the Chemistry learning, it was thought that use of ICT could be very beneficial. In general, ICT can help to increase participation of students in the area and would improve the direct intervention of the students which motivates their learning.
After it was identified student misconceptions and misinterpretation in Chemistry for engineering students as they are attempting to interpret and explain the chemical processes. Oxidation-reduction reactions were identified as one of the most difficult concept, following by solubility and formulation.

The objective was 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 in redox reactions and videos in which could be possible to watch the reactions.
The used ITC demonstrated that students significantly increased the number scientifically acceptable ideas in student´s conceptions of science due to the fact that the use of ITC has demonstrated that allows them to practise and improve their knowledge. On the other hand, with this type of learning we obtain some advantages as construct scientifically acceptable mental models of substances and reactions at the molecular level.
The use of the simulation or videos can be helpful in improving problem solving. This encourages students to develop new ideas about science, and allows them to create a memory from viewing animations, leading to confirmation or modification of the existing mental model. Furthermore, it will be possible that the student use their models to understand new chemistry concepts that require a molecular level.

Keywords:

ITC, Chemistry, Multimedia Application, Virtual Simulation, Redox Reactions

Introduction

Teaching of Chemistry has different difficulties in general; especially by the lack of interest, low motivation in students and little connection between the curriculum of compulsory education and university. Chemistry has a negative connotation due to the environmental pollution caused by the products of chemical industry and the incorrect use of chemicals. This causes a negative idea about Chemistry. 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 acts as guides

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. Thus, it was thought that the use of ICTs could be very beneficial for students in order to achieve an adequate learning about this subject. ICT can increase participation and motivation of the students in the development of the subject. The experience consists of using a virtual application to understand chemical processes. 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.

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. The use of 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.

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.

Chemists generally present concepts at three levels of representation: the macroscopic, microscopic and symbolic levels (Gilbert & Treagust, 2009). Many phenomena are available to direct experience (macroscopic level), but their explanation requires knowledge of the molecular structure and the interaction between atoms and 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, 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, touse chemical symbols, and to visualize also abstract concepts such as the shape of a molecule into a two dimensional page (Charistos, Teberekidis, Tsipis, & Sigalas, 2003); (Chittleborough & Treagust, 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, 2005); (Stefani & Tsaparlis, 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.

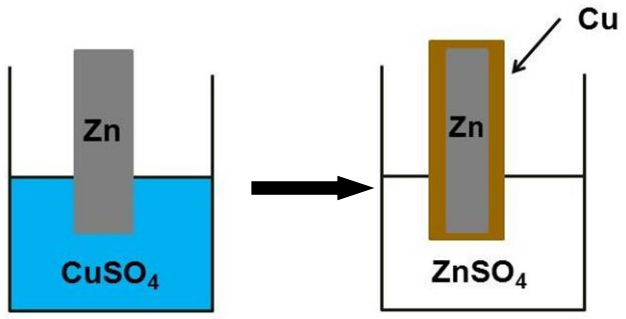
Methodology

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 endeavor 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 endeavors 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).

Thus, it was thought that the use of ICTs could be very beneficial for students in order to achieve an adequate learning about this subject. ICT can increase participation and motivation of the students in the development of the subject. The experience consists of using a virtual application to understand chemical processes. 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 as one of the most difficult concept.



$$Zn\,(s) + CuSO_4\,(ac) = ZnSO_4\,(ac) + Cu\,(s)$$

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.

One of the main advantages of the ITC use is that we can increase the motivation. In this study, 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 visualization 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.

In computer assisted instruction, 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 is to deliver the contents of the course through computers and realize instructional endeavors 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. The studies are designed as a quantitative research, which uses the pre-test and post-test control group design and a questionnaire to know what they think about the utility of these ITC tool in order to improve the teaching and learning process.

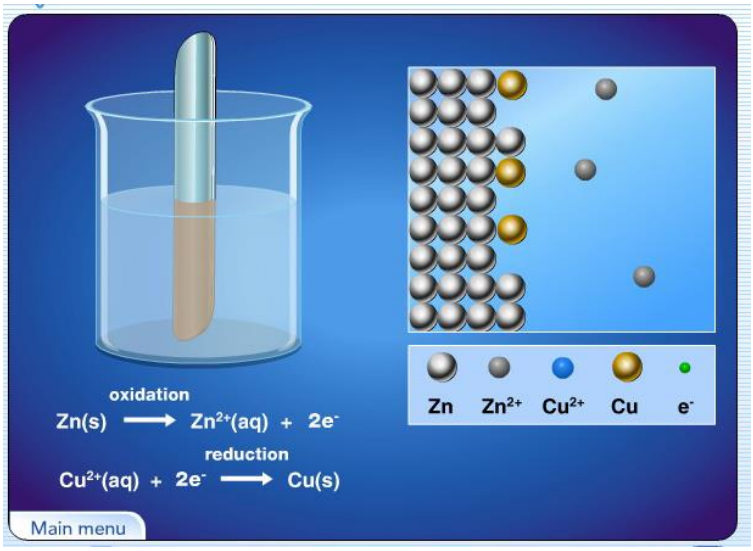
It aims to investigate whether computer assisted instruction realized through simulation is more effective than face-to-face in increasing student success in Science, and if they think that computer assisted is useful to learn more easily the subject.

The computer assisted instruction study, simulation, was carried out during the course 2014/2015. The sample consisted of 32 students from two different classes, at the first course of Mechanical Engineer degree at University of Malaga, during the

first semester. 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. On the other hand, introductory chemistry course taught by the same chemistry instructor. 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. 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 Image 1 shows a multimedia application used for redox reactions

Image 1. Redox reactions simulation (provided from http://highered.mheducation.com/)



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.

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.

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 10 items and it is a five point Likert type scale.

Students´ questionnaire responses were analyzed 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.

Thus for questions positively, a value closer to 5 is always positive. The values are averaged by the number of students, for values between 1 and 5. The value 3 as neutral, values 2-3 moderately positive attitudes and values 4-5 represent very positive attitudes are defined.

The internal consistency of the test was estimated with Cronbach's alpha using the formula of the variance of the items, giving a value of 0,366; indicating that the acts are reliable.

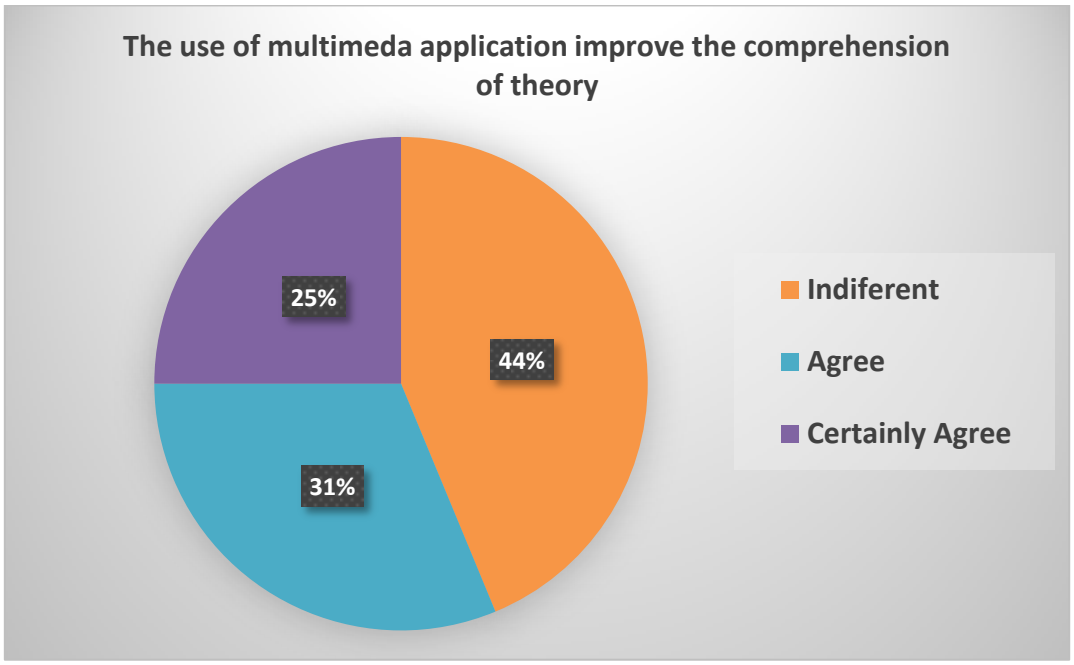
According to the results obtained from the assessments, it can be seen that the qualification starting in both groups is very low; however, no significant differences are obtained between the two groups.

As for the final outcome it is observed that the group that started from a lower rating scored a 7.45, while the other group reached 5.71. However, no significant differences had been founded between groups for a confidence level of 95%.

Regarding the use of multimedia application and the advantages/disadvantages about them, students showed the next opinions.

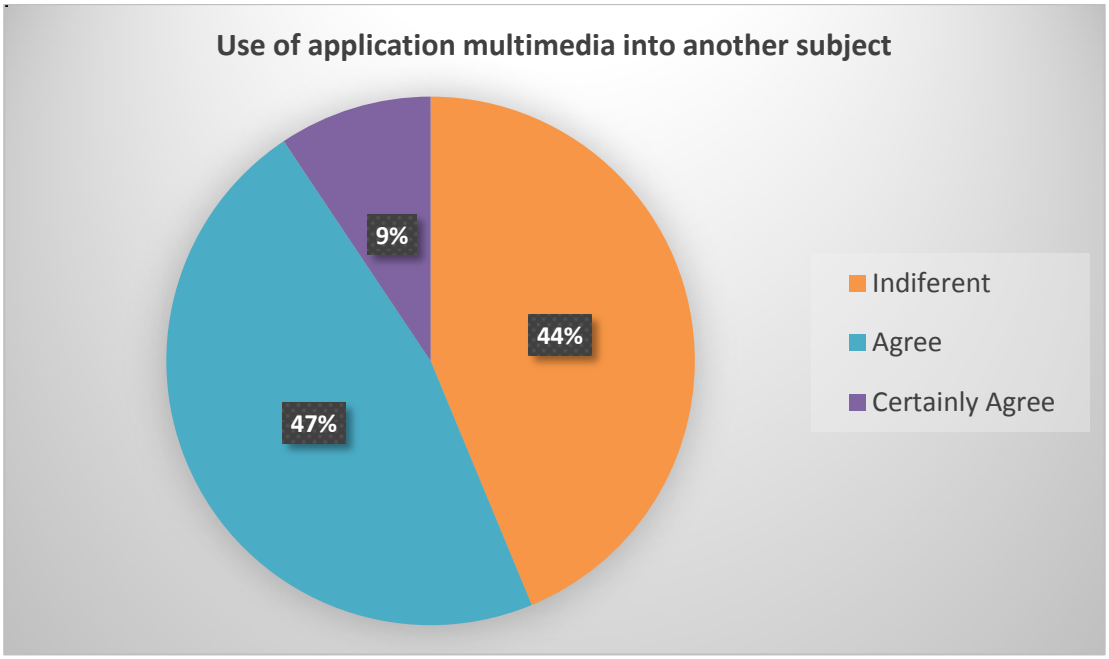
Firstly, they were questioned if the application multimedia supposed a better comprehension of theory when it was used in classroom. The data can be seen in Figure 1.

Figure 1: Results of use of application multimedia regarding comprehension of theory



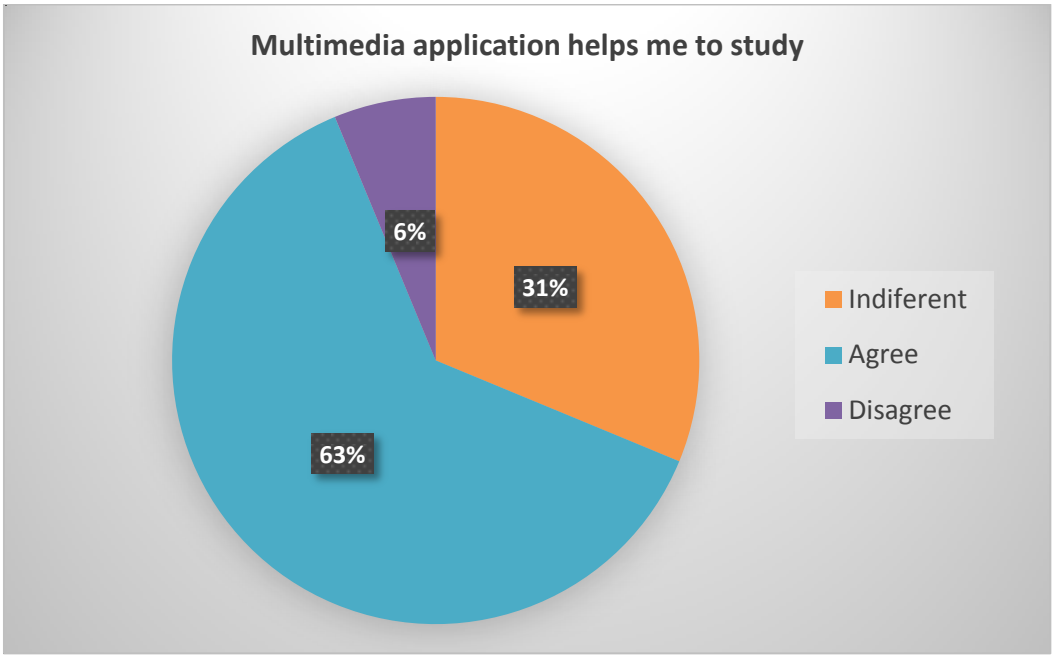
Secondly, students were questioned if they considered that multimedia application should be used in other subjects in Grade. The results can be seen in Figure 2.

Figure 2: Results of use of application multimedia into another subject



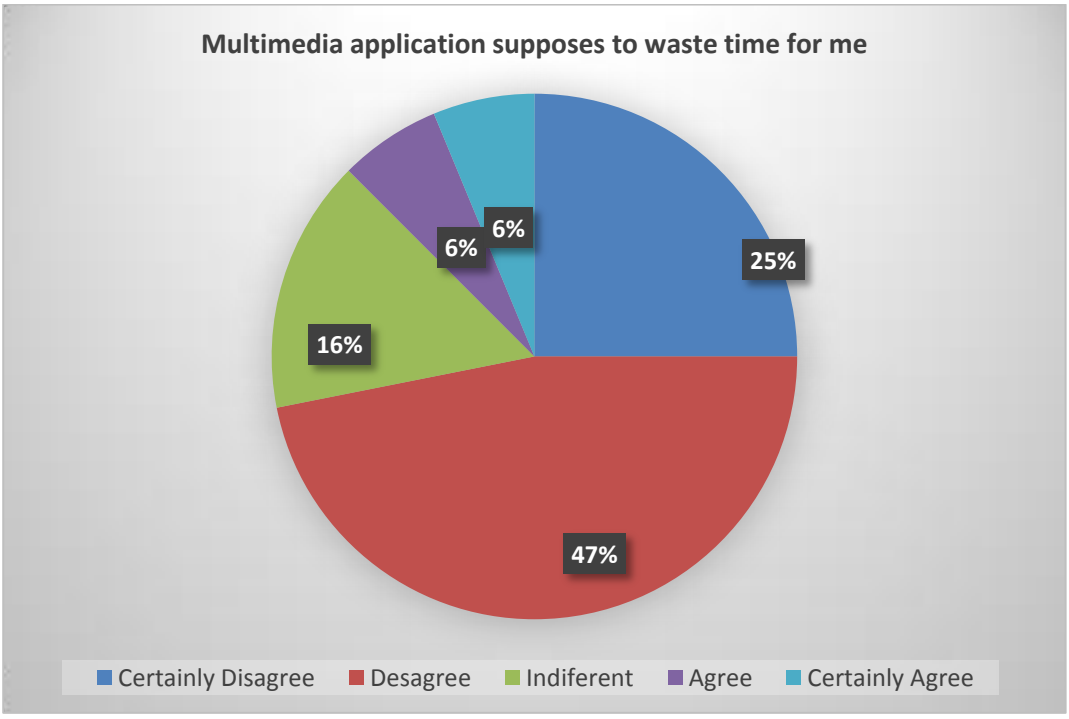
The next question was if students considered that multimedia application helped them to study the redox reactions. The data can be seen in Figure 3.

Figure 3: Results of opinion if multimedia helps me to study



Finally, students were questioned if they had considerated that multimedia application was a waste time in order to study the subject. The Figure 4 shows data about the opinion of students.

Figure 4: Results of opinion if multimedia involves wasting time for students



Conclusions

From the results, the study population considered useful to the media application, but not to get involved in his study, but to understand nature. The utility does not transcend the interest in studying, that the difficulty is seen as an attitudinal obstacle to face chemistry. This is an important fact, a call for teachers to reflect on the need to revise teaching methodologies and evaluation, because while learning requires effort, indicated difficulty goes beyond the lack of interest.

Regarding the results obtained in reference to the utility of the media application, the vast majority of the responses between are above 3, which can be considered as a positive treatment to the use of the application. A value of 3 would indicate that students do not observe improvement or worsening when using this application, however, virtually all the answers to positive questions show a value greater than 3, and those with a negative nature samples a value less than 3, it indicates that the application is evaluated positively, for example the use of multimedia application makes you lose valuable time, shows a value close to 2 indicating that students feel that it is not a waste of valuable time, also occurs identical behavior if they are questions if they should stop using the multimedia application. In general, students considerated that multimedia application supposed an example of good ITC tool in order to achieve the comprehension of theory. They thought that multimedia application and other ITC should be used in another subjects because they considerated that multimedia application helped them to study.

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