New Methodologies to Improve the Chemistry Learning at University

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Abstract.

The main objective was to improve the learning of Chemistry subject using Flipped classroom, because it makes class time more engaging. The lecture portion of General Chemistry courses in engineer’s degrees have been pushed outside the classroom using prerecording technology and steaming delivery of content, to make classes more interactive and participative. The Flipped classroom model has become one of the main topics in the higher education space in recent years thanks to improvements in technology.

Those videos where recorded by the students about themes like radioactivity, chemistry bonds, the evolution of the atom theory, and so on. Those videos were showed on classes and after the videos were evaluated using a rubric.

Statistical significance of the data has shown, and proved with, that implementing the Flipped classroom model could not only benefit professors, but also it could also help us adapt the classes to the various learning styles that exist among the students.

Keywords: learning sciences, multimedia application, flipped classroom, higher education
1. Introduction

Science in general and Chemistry and Physic in particular are subjects with a high level of difficulty for students. There is a wide variety of reasons to understand that question. The image of sciences has been decreasing in decades, especially last years. Many students think that science is irrelevant to their personal interest and goals and are unaware of how many jobs require this type of knowledge (Aschbacher, Li, & Roth, 2010). The most 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 special language 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 and nomenclature 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. Garcia-Carmona et al (2014) analyzed the science education promoted by the national curriculum of primary education in Spain. The analysis pays attention to different aspects regarding the school science: nature and sociology of science; axiology; psychology in science learning; goals, competences, contents and evaluation criteria; activities, didactic and methodological resources and teaching strategies. Results indicate that primary school science proposed in the national curriculum does not completely adjust with current trends in Science Education. Similar results have obtained in other studies about school science (De Pro y Miralles, 2009; Banet, 2010). Consequently, in view of the lacks detected in the curriculum, a group of several re-commendations were proposed (Garcia-Carmona et al, 2014).

In a subject as Chemistry, concepts often present under three levels of representation: macroscopic, microscopic and symbolic levels (Gilbert & Treagust, 2009). The most of phenomena are available to direct experience (macroscopic level), but in their explanation is necessary a little of knowledge about molecular structure and the interaction between atoms and molecules (called as microscopic level). To represent this phenomenon, chemists have designed specialized symbol systems like molecular formulas, which help them to communicate and visualize chemistry concepts (Hoffman & Laszlo, 1991).

So, teaching of chemistry presents different problems and difficulties such as lack of interest in students, very low motivation, a specific language and nomenclature for chemical compounds … Therefore, chemistry is linked to environmental pollution, to products and dangerous industries, toxic compounds and risking activities (Rojano, 2014). For all reasons, the actual image of
chemistry is negative; it is well known with the word chemophobia (Kafetzopoulos, Spyrellis, N., & Lymperopoulo-Karaliota, A., 2006).

Students learn content online by watching video lectures, usually at home, and homework is done in class with teachers and students discussing and solving questions. Teacher interaction with students is more personalized-guidance instead of lecturing (Christopher Nwosis et al., 2016).

Furthermore, research regarding teaching and learning science is increasing every day. Science teachers and researchers have pointed their worries about the outcomes of science education. George & Kaplan (1998) have researched about the lack of interest in science in high school and university.

In the present study, the experience is developed of using flipped classroom to understand chemistry. The main objective was to develop and carry out a didactic proposal for teaching chemistry topics using didactic resources as virtual environment, the use of videos in which could be possible to watch different concepts as an excellent opportunity to understand better the content.

2. Methodology

Thus, it was thought that the use of flipped classroom could be very beneficial for students in order to achieve an adequate learning about this subject and this type of processes. We are sure that it could increase participation and motivation of the students in the development of the subject.

So, 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 or in laboratory class, and learn at a shorter time in a systematic way. Computers are usually much more enjoyable and always more patient than classroom teachers (Bayrak, 2008; Cotton, 1991; Sentürk, 2005; Usun, 20040). It represents a factor that we could to take advantage.
The experience consists of using flipped classroom to understand chemical processes.

Figure 1. Flipped classroom developed by students

The flipped classroom, a teaching method that delivers lecture content to students at home, complete opposite of the way a traditional teaching class. The most important thing for the success would be to promote visualization as a learning strategy is the practice and application of the visualization 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 or topics or new substances in chemical reactions. Furthermore, it will be possible that the student use their models to understand new chemistry concepts that require an atomic/molecular level at the beginning. These materials can help students to 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 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, because Chemistry is an obligatory subject in their grades. On the other hand, introductory chemistry course taught by the same chemistry instructor.
3. Results and Discussion

The study is designed as a quantitative research about a questionnaire to know what they think about the utility of this tool in order to improve the teaching and learning process.

Each student did one questionnaire. The questionnaire consists of several 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 the flipped classroom 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 Disagree to 5= Certainly Agree.

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.

Figure 2. Data from the questionnaire

![Figure 2. Data from the questionnaire](image-url)
Firstly, they were questioned if they had preferred the flipped classroom regarding face to face classroom when it was used in classroom. The data can be seen in Figure 2.

Four items from the questionnaire showed value over 4.5, which means that students are certainly agree with the statements, for example: The flipped classroom more fun than conventional classes; Students would prefer to use this new methodology in other subjects; Students believe that the innovative activity, shows the interest of the lecturer for the learning of the concepts by the students. On the other hand, it can be seen that the negative statements showed values under 2.5, which will be a neutral opinion, being a positive opinion about that, so students said that The use of the flipped classroom technique do not waste their valuable time and Lecturers should not stop using this innovative methodology, flipped classroom.

4. Conclusions

From the obtained results, it showed that the study population considered useful the flipped classroom strategy. The utility does not transcend the interest in studying because the difficulty is seen as an attitudinal obstacle to face to the subject of chemistry. This is an important fact, an attention 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 flipped classroom, the vast majority of the responses are above 4.5, 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, all the answers to positive questions showed a value greater than 4, and those with a negative nature showed a value less than 3. It would indicate that the flipped classroom is evaluated positively in general.

Students wrote that they would have preferred the flipped classroom instead of traditional face to face classic. Therefore, student showed that the flipped classroom is more effective than traditional class.
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References


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