XI JORNADAS DE REDES DE INVESTIGACIÓN EN DOCENCIA UNIVERSITARIA

Retos de futuro en la enseñanza superior: Docencia e investigación para alcanzar la excelencia académica

XI JORNADES DE XARXES D’INVESTIGACIÓ EN DOCÈNCIA UNIVERSITÀRIA

Reptes de futur en l'ensenyament superior: Docència i investigació per a aconseguir l'excel·lència acadèmica
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Evaluation in the new Degrees: experiences in continual assessment.

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ABSTRACT
The Bologna plan implementation means that a new concept of teaching and evaluation has to be considered, i.e. traditional lectures and final tests to evaluate the students must be transformed into interactive lectures, combined with self-learning activities on the student’s side and a continual assessment, where the final test is just a part of the global assessment. Thus, a more objective and complete comprehension of the subject can be achieved, and the student’s success would depend not only on the ability of the lecturer but also on their own capacity of work, dedication and interest. As an example, the methodology followed for teaching and assess the subject “Chemistry” in the first year of the mathematics degree at the University of Alicante is exposed. A combination of interactive lectures, problems self-resolution, virtual laboratory experiments and participation on the class are used for their continual assessment. Finally, the experience of the results obtained, on one hand, with students following the traditional lectures and, on the other, with students following the Bologna process, is compared.

Keywords: Bologna process, continual assessment, interactive lectures, self-learning,
1. INTRODUCTION

With the aim to ensure comparability in the standards and quality of higher education qualifications in Europe, a series of ministerial meetings and agreements between European countries started in 1999, named the Bologna Process after the place it was proposed, the University of Bologna. It means the creation of the European Higher Education Area (EHEA) [1], based on cooperation between ministries, higher education institutions, students and staff from 47 countries, with the participation of international organisations.

With its implementation, a new concept of teaching has to be considered: the interactive teaching, in which the student must take an active part. Traditional lectures and final tests to evaluate the students must be transformed into interactive lectures, combined with self-learning activities on the student’s side and a continual assessment, where the final test is just a part of the global assessment. Thus, a more objective and complete comprehension of the subject can be achieved, and the student’s success would depend not only on the ability of the lecturer but also on their own capacity of work, dedication and interest.

For about ten years, the University of Alicante has been developing a Teaching Research Program (TRP), known as Teaching Network [2], which objective is to improve the teaching quality and adapt its methodology to the European Higher Education Area (EHEA). My particular experience began at 2006, with a project called “EHEA Teaching Network for the Geological Engineering first year”, with the aim to establish and try a new methodology for teaching the subject “Chemistry” in the first year of Geological Engineering. The experience was continued at 2007 with the project “EHEA Teaching Network: Design of new materials for the Geological Engineering first year”, going into detail about the materials used for teaching the above mentioned subject. The meetings of the network members allowed us to share different points of view and analyse different ideas which helped everybody to achieve better results with the students.

Thanks to these Teaching Networks, when in 2010 the EHEA began to be implemented at the University of Alicante, we were ready for work.

That year, at the Department of Inorganic Chemistry, a Teaching Network was created to coordinate the methodologies used, in the different subjects taught by the Department professors, at the first year of the new degrees (Chemistry – Mathematics Degree, Chemistry II- Chemistry and Geology Degree, and Applied Inorganic Chemistry - Chemical Engineering
Degree) [3]. At the same time, every Degree created a Teaching Network for its own first year.

The experience obtained working at the “Mathematics Degree first year network”, and the methodology followed for teaching the subject “Chemistry” to our students is explained below.

2. METHODOLOGY: TEACHING GUIDE

To define the fundamental points in the learning process (methodology and evaluation), a Teaching Guide has been designed for the subject “Chemistry” in the first year of the mathematics degree at the University of Alicante.

2.1. Learning objectives

First of all, and considering that the Teaching Guide should lead the student through his learning process, the learning objectives (Competences), were defined, as follows:

To learn the atomic structure basic principles, as well as the chemical elements classification, the different possible bonds in the chemical compounds and the various chemical reactions.

To find the relationships between the bond theories and the chemical compounds structure, properties and reactions.

To solve Chemistry problems, using mathematic methods (trying to show the students the interrelation of mathematics and chemistry).

To solve Chemistry problems, using informatics applications.

2.2. Subject contents

Once the objectives were defined, the subject contents necessary for their accomplishment were established:

Unit 1: “The Chemistry basis”. Here, in three lessons (“atomic structure”, “periodic table of the elements” and “chemical bond”), the student will learn the fundamental concepts in the chemistry field.

Unit 2: “Reactions and energy”. In this second section (which includes the lessons “introduction to the chemical thermodynamics”, “kinetic and chemical equilibrium” and “chemical reactions: acid-base, oxidation-reduction and precipitation”) the students will learn the different chemical reactions which may take place between elements or chemical compounds. They will also understand the energy changes involved in those reactions.
2.3. Methodology

After the definition of the subject contents, the teaching methodology was decided, according to the different activities developed for the acquisition of the learning objectives. Table 1 summarises the different learning times dedicated to every teaching activity and the methodology used in each of them.

Table 1. Learning times dedicated to every teaching activity and the methodology used in each of them.

<table>
<thead>
<tr>
<th>Teaching activity</th>
<th>Methodology</th>
<th>FFI¹</th>
<th>SLT²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interactive lectures</td>
<td>Lectures supported by the use of blackboard, power point presentations, videos and connexions to suitable web links</td>
<td>33</td>
<td>59</td>
</tr>
<tr>
<td>Problems resolution</td>
<td>Resolution of chemistry problems, using the suitable informatics supports.</td>
<td>18</td>
<td>18</td>
</tr>
<tr>
<td>Virtual laboratory</td>
<td>Experimental approach to chemistry, showing the reactivity of the chemical elements and compounds, as well as the basis of a chemistry laboratory.</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Seminars</td>
<td>Preparation and exposition of a monographic work and its power point presentation</td>
<td>3</td>
<td>7</td>
</tr>
<tr>
<td><strong>Total time (hours)</strong></td>
<td></td>
<td><strong>60</strong></td>
<td><strong>90</strong></td>
</tr>
</tbody>
</table>

¹ FFI: face-to-face instruction and ² SLT: self-learning time

Following the EHEA idea, the teaching methodology includes both face-to-face instruction and self-learning time. The face-to-face instruction time will be dedicated to interactive lectures (in which the student will learn and discuss the contents described above), supported by the use of blackboard, power point presentations, videos and connexions to suitable web links. It will also be used for problems resolution (resolution of those problems which may show a higher difficulty for the students, clarifying any possible doubt), virtual laboratory experiments (the virtual option, videos of laboratory experiences, is used for time optimisation, allowing the students to view and discuss many more experiments than they would if they had to carry them out in a laboratory) and seminars. Depending on the activity developed, the number of students per class will be different, going from 75 students in a lecture to 20 in a problems resolution class or 15 in a seminar.
During the self-learning time, the student implication in the learning process is fundamental. This time will be used for problems self-resolution, preparation of a monographic work and its power point presentation (which exposition will take place during the seminar face-to-face time), and revision of the material discussed during the face-to-face instruction. The different activities comprised in the self-learning time may be done individually or in groups, depending on a previous agreement with the teacher. Fig. 1 shows the distribution of the face-to-face instruction and self-learning time (in hours) dedicated to the different activities developed in the subject Chemistry.

![Fig. 1. Distribution of the face-to-face instruction and self-learning time (hours) dedicated to the different activities developed in the subject Chemistry](image)

2.4. Chronogram

Once the objectives, subject contents and methodology were stated, the elaboration of a chronogram was the next step. It is fundamental to help the student to understand the unit and lessons distribution and their correlation with the problems resolution times. With the chronogram, the students will know when to prepare a theoretical class, solve the problems of a certain lesson and prepare a test.

As an example, in Table 2 is shown a small part of the chronogram prepared for the teaching guide of the subject “Chemistry” in the first year of the mathematics degree.
Table 2. Extract of the chronogram prepared for the teaching guide of the subject “Chemistry” in the first year of the mathematics degree.

<table>
<thead>
<tr>
<th>Week</th>
<th>Lesson number</th>
<th>FACE-TO-FACE INSTRUCTION</th>
<th>SELF-LEARNING TIME</th>
<th>DESCRIPTION</th>
<th>Total time per week (h)</th>
<th>DESCRIPTION</th>
<th>Total time per week (h)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>T1</td>
<td>Interactive lecture (2h)</td>
<td>2</td>
<td>Revision and problems self-resolution</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>T1</td>
<td>Interactive lecture (4h)</td>
<td>5</td>
<td>Revision and problems self-resolution</td>
<td>7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>T2</td>
<td>Interactive lecture (4h)</td>
<td>4</td>
<td>Revision and problems self-resolution</td>
<td>6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>T1-T3</td>
<td>Interactive lecture (2h)</td>
<td>5</td>
<td>Revision and problems self-resolution</td>
<td>6</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>....</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18-19</td>
<td></td>
<td>Final test</td>
<td>60</td>
<td>Final test preparation</td>
<td>9</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2.5. Evaluation

Finally, one of the fundamental points in the learning process, evaluation, was defined. As said before, one of the key aspects in the EHEA methodology implementation is the use of an evaluation system which allows the active participation of the student during the learning process [4, 5]. This implies the use of a continual assessment that brings information, both to the student and the teacher, about the students’ progress and understanding on the topics exposed.

With that objective in mind, the evaluation tools include two periodic tests (mid-term tests after each two lessons, 1-2 and 3-4), which, if passed with a mark equal or above five on
ten, will allow the student to eliminate these lessons (avoiding them to be evaluated twice on the same subject) and go to the final test with just the two final lessons (5 and 6). Those students that have not passed the mid-term tests will have to go to the final test with all the lessons. Others tools used for the evaluation is their participation, attitude and aptitude in class, seminars and virtual laboratory, the resolution of chemistry problems and, finally, the preparation and exposition (power point presentation) of a monographic work. All this aspects make easier to pass the subject if the student is really implied in its learning process and devoted to it. Table 3 summarises the evaluation tools chosen for the subject Chemistry, with their description and the percentage that each of them has in the final mark. Fig. 2. shows graphically the percentage in the final mark of the different evaluation tools used.

Table 3. Evaluation tools, their description and percentage of each one in the final mark.

<table>
<thead>
<tr>
<th>Evaluation tool</th>
<th>Description</th>
<th>Percentage in the final mark</th>
</tr>
</thead>
<tbody>
<tr>
<td>Periodic tests</td>
<td>Evaluation of the acquired knowledge after each two lessons (1-2 and 3-4) with two mid-term tests.</td>
<td>40%</td>
</tr>
<tr>
<td>Teacher considerations</td>
<td>Participation in class, seminars and virtual laboratory</td>
<td>10%</td>
</tr>
<tr>
<td>Exercises book</td>
<td>Resolution of chemistry problems</td>
<td>10%</td>
</tr>
<tr>
<td>Preparation of monographic works</td>
<td>Preparation and exposition of a monographic work and its power point presentation</td>
<td>20%</td>
</tr>
<tr>
<td>Final test</td>
<td>Exam, with a maximum of 10 theoretical-practical problems.</td>
<td>20%</td>
</tr>
</tbody>
</table>
3. RESULTS

To analyse the results obtained with the new EHEA methodology, a statistics comparison between the pass, fail and not attending the exam results, obtained on one hand, with students following the traditional lectures and, on the other, with students following the EHEA methodology, is made below. The results obtained are shown in Figure 4.

![Figure 4](image-url)

Fig. 4. Final mark percentages (fail, pass and not attending the exam) for either the students following or not the EHEA methodology.
As it can be observed above, the new methodology, with a higher participation of the students and a continual assessment, improves considerably the final results obtained. The pass percentage has increased from a 42% to a 76%, while the fail and not attending the exam percent decrease from 5 to 3% and 53 to 21%, respectively.

4. CONCLUSIONS

The Teaching Guide, prepared while working at the “Mathematics Degree first year network”, has established a teaching and evaluation methodology which proves to be effective for a better understanding of the subject Chemistry, as shown by the comparison results above.

Nevertheless, it can surely get better. For that reason, in a near future, different changes in the methodology will be made to try to improve the results obtained.

5. REFERENCES

[1] www.ehea.info


