Introduction

1. The transformation to the new EHEA framework of the degrees taught at the University of Oviedo, with the introduction of credits (ECTS), gives the student a major role. It is based on the workload that each of the students must achieve and the objectives to overcome the subjects. All of this supposes a great challenge both for the institutions and for the people involved in this process. However, it is also a great opportunity for the development and innovation of the methodologies used, the main objective being the student’s learning improvement [1-3].

Given this perspective, a rubric has been developed in order to evaluate in a homogeneous way the students who take the subject of Experimentation in Chemical Engineering II: Heat Transmission and Mass Transfer. This subject is taught in the second semester of the third year of the Degree in Chemical Engineering of the University of Oviedo.

This subject is mostly experimental and it involves organizing students in working groups of 2 or 3 students that will be supervised all time by the teacher. Moreover, students received handouts manual before the subject starts.

A series of experiments involving both mass and energy transfer are carried out. In total 11 experiments are performed, 9 of which are developed in two sessions of 3.5 hours while the other two remaining experiments are performed in a single session.

Each group of students must make a report of each of the experiments performed. In this report, they must detail the experiments carried out, show the experimental data taken and include a series of calculations answering the questions proposed in the handouts, which are delivered to students before the subject starts. In this manual are detailed the data required in relation to the materials and methods used. Moreover, instructions in terms of format and length of the corresponding reports and the final one are also given to the students.

During the third week of teaching the subject, the students must submit a report in relation to the experiment that they performed in second place. This will allow the teachers to correct the observed format errors and avoid systematic errors in the reports of the other practices delivered in the final report.

On the other hand, each group should also make an oral presentation of one of the experiments that was previously selected by the instructors.

A theoretical exam is made in order to evaluate the individual knowledge about each of the experiments performed.

Related Works

In the Degree of Chemical Engineering of the University of Oviedo, in addition to the subject under study,
the Chemical Engineering area imparts two other experimental subjects. Therefore, the three subjects of the Degree in Chemical Engineering present the same type of activities:

- Theoretical lessons and lessons about Quality and Safety in the laboratory
- Laboratory experiments
- Industrial visit
- Initial report about the experiment performed in second place
- Oral presentation of one of the experiments selected by the instructors
- Preparation of a final report of all the experiments performed
- Written exam

The overall percentages of evaluation of each of the sections are the same for the three subjects.

- Laboratory work/Professionalism: 25%
- First written report: 5%
- Evaluation of final reports and industrial visit: 20%
- Oral presentation: 10%
- Written exam: 40%

However, the evaluation within each section is made by the corresponding professor, without a general guideline. This entails considerable differences in the final evaluations, since each professor has different criteria.

A good manner to minimize this problem is to develop assessment rubrics. This type of practice has already been settled in previous studies allowing the evaluation in a homogeneous way [4-9].

3. Experimental

Two different rubrics are developed by the three professors involved in the aforementioned subject for the evaluation of two aspects:

- Evaluation of final reports
- Oral presentation

For the oral presentation several aspects have been analysed and evaluated: technical quality, slides quality, oral exposition and quality of the answers to the questions proposed by the professors.

For the correction of the final report correction two main parts can be distinguished: the first one (25% of the final mark) corresponds to the technical quality of the results obtained and their correct explanation, and the second one (25% of the final mark) is due to the formal aspects, such as the correct presentation of graphs and tables, references, correct expression and spelling.

Each professor is responsible for 3 or 4 experiments. An individual rubric is developed for the technical part of each experiment since not all of them has the same amount of calculations, questions and difficulty. For the formal aspects of the experiments a common rubric is developed by the three professors.

This work allows the professors to evaluate students in a homogeneous way. Moreover, it also allows to make an exhaustive analysis of the marks obtained in each section. Thus, the professors can identify the most difficult sections for students in order to pay special attention on them and make additional explanations.

As an example, a rubric for the evaluation of the oral presentation is presented in Table 1. As it was mentioned, oral presentation represents the 10% of the final mark, and in previous years, it was observed that, as a general trend, oral presentation is one of the aspects that students should improve.

<table>
<thead>
<tr>
<th>A. ORAL EXPOSITION (40%)</th>
<th>Yes (4 points)</th>
<th>Yes, but... (3 points)</th>
<th>No, but... (2 points)</th>
<th>No (1 point)</th>
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<tbody>
<tr>
<td>Knowledge (10%)</td>
<td>Can express in a fluently and spontaneously way the main ideas of the experiment. Answer the question correctly.</td>
<td>Demonstrate clearly enough their ideas, however not in a fluently way. Answer questions in an imprecise manner.</td>
<td>Unable to communicate properly and to expose his thoughts clearly. There are no contradictions in their explanations. Do not answer questions.</td>
<td>Unable to communicate properly and to expose his thoughts clearly. Moreover, there are contradictions in their explanations. Do not answer questions.</td>
</tr>
<tr>
<td>A2</td>
<td>Oral expression (5%)</td>
<td>Speaks with an adequate volume and clear pronunciation. Moreover, places greater emphasis on the most important aspects.</td>
<td>Speaks with an adequate volume and clear pronunciation.</td>
<td>Either speaks with low volume or not in a clear way.</td>
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<tr>
<td>A3</td>
<td>Non verbal communication (10%)</td>
<td>In all moment speaks to the targeted audience. Keeps a dynamic attitude.</td>
<td>Speaks to just one person of the audience. Keeps a dynamic attitude.</td>
<td>In some moments do not look at the audience. Do not keeps a dynamic attitude.</td>
</tr>
<tr>
<td>A4</td>
<td>Vocabulary (5%)</td>
<td>Uses rich and adequate vocabulary</td>
<td>Uses adequate vocabulary but limited and uses fillers.</td>
<td>Uses poor vocabulary and fillers. However, adequate words for the technical aspects are used.</td>
</tr>
<tr>
<td>A5</td>
<td>Adjustment to allotted time. (10%)</td>
<td>Keeps exactly to the allotted time or even finish a couple of minutes before</td>
<td>Keeps approximately to the allotted time (takes as maximum 5 minutes more).</td>
<td>Takes between 5 and 10 minutes more than the allotted time.</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>B. SLIDES PRESENTATION (35%)</th>
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<tbody>
<tr>
<td></td>
</tr>
<tr>
<td>B1 Slides design (10 %)</td>
</tr>
<tr>
<td>B2 Slides content (10%)</td>
</tr>
<tr>
<td>B3 Graphs and tables (10%)</td>
</tr>
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</table>
C. TECHNICAL CONTENT (25%)

<table>
<thead>
<tr>
<th></th>
<th>Yes (4 points)</th>
<th>Yes, but... (3 points)</th>
<th>No, but... (2 points)</th>
<th>No (1 point)</th>
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<tbody>
<tr>
<td>C1</td>
<td>Main results are presented and discussed in a clear way.</td>
<td>Main results are presented, however, some of them are not discussed in a clear way.</td>
<td>Some of the main results are not presented.</td>
<td>Some of the main results are not presented and the ones that are presented have poor and non-clear discussion.</td>
</tr>
</tbody>
</table>

Final assessment will be balanced to 10 points

4. Main Results

In the subject related to the experimentation in Chemical Engineering II, both the oral presentations and final report have been carefully evaluated.

The application of the assessment rubric for the evaluation of oral presentations allowed identifying the specific aspects that required some additional work by the students. In this sense, in the subsequent editions, it will be necessary to indicate them how these aspects can be improved in order to obtain better results.

Figure 1 shows each of the evaluated contents in the oral presentation and the percentage of the total grade obtained in each section. Each of the analyzed parameters are described in Table 1.

On viewing these results, the aspects in which the students obtained lower marks were the following: i) adjustment to the allotted time (A5), ii) non-verbal communication (A3), and iii) figures and tables (B3).

The first two evaluated contents are referred to the oral presentation made by the students, being the ones which required more practice and effort. It was also observed that students do not usually make eye contact with the audience, they either tend to read the slides or their own notes. Besides, they do not adjust to the allotted time, sometimes even using twice the time assigned.

The last aspect with low mark is the quality of figure and tables. In general, they are not well presented, either by the lack of units in the axes or tables or by the absence of the title in the axes of figures. In many cases, the font size in the figures is not appropriate.

Additionally, the weighted average of each of the evaluated parts indicated that the final mark is similar in all of them (Figure 2).

![Figure 1. Average of the percentage of the score obtained in each of the analyzed contents.](image1)

![Figure 2. Weighted average of each of the evaluated parts](image2)
The uses of assessment rubrics for the evaluation of the final reports indicated that the students should improve their responses to the questions mentioned in the subject handouts. Moreover, they should improve the description of the objectives and methodology of the experiments and thereferences included. Thus, in these parts average scores of approximately 65% and 67% were obtained and the average mark obtained in the final report was around 7 over 10 what indicates that not significant differences are found between the evaluated parts of the final report.

5. Conclusions

The assessment carried out by different professors leads to a certain heterogeneity in the evaluation of the students. This a common practice in experimental courses in which several professors are involved.

The application of assessment rubric is a useful tool to homogenize the professors’ criteria.

The assessment rubric for the evaluation of the oral presentations showed that formal aspects should be enhanced, thus being necessary to put more time and effort in the practice of oral presentations. Besides, the format of figures and tables should also be improved.

The assessment rubric for the evaluation of the final reports proved that the questions indicated in the handout should be answered more carefully by the students. Besides, the students should pay more attention to the objectives and the description of methodology and should include references.

References


[2] Iborra M., Ramírez, E., Tejero J., Bringué R., Fité C., Cunill F., (2014). Revamping of teaching-learning methodologies in chemical engineering in laboratory subjects in chemical engineering undergraduate degree of the University of Barcelona for their adjustment to Bologna process, Education for Chemical Engineers, 9, 43-49


