El compromiso académico y social a través de la investigación e innovación educativas en la Enseñanza Superior

Rosabel Roig-Vila (Ed.)

El libro que aquí se presenta, El compromiso académico y social a través de la investigación e innovación educativas en la Enseñanza Superior, es un compendio de investigaciones e innovaciones educativas llevadas a cabo en el contexto de la Educación Superior.

En la primera parte de este libro se recogen investigaciones que analizan problemas o métodos para mejorar los Resultados de investigación sobre la docencia en la Educación Superior en prácticamente todas las ramas, campos, ciencias y disciplinas universitarias (capítulos 1-80). En la segunda parte, más específica, se atiende a la Innovación docente en torno a los procesos de enseñanza-aprendizaje inclusivos (capítulos 81-88). Sigue una tercera parte, de similar número de capítulos, en la que se desciende al detalle de la generación de Acciones de apoyo, orientación y refuerzo al alumnado para la mejora de la formación y de los resultados en la Educación Superior (capítulos 89-99). A continuación y de nuevo con extensión similar, se encuentran las aportaciones a las Nuevas metodologías basadas en el uso de las tecnologías (TIC o TAC) en la Educación Superior (capítulos 100-116), para terminar en la quinta parte del libro en la que se desarrollan los trabajos referidos a la Investigación e innovación en enseñanza no universitaria para tender puente con la Educación Superior (capítulos 117-122).
El compromiso académico y social a través de la investigación e innovación educativas en la Enseñanza Superior
1. No effect of teaching language on learning Organic Chemistry

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ABSTRACT

The Organic Chemistry Department of the University of Alicante offers students the possibility of studying all compulsory organic subjects in English or Spanish. In this study, three different subjects offered in English and Spanish are selected. The reasons of the students when choosing to be taught in English or Spanish are analyzed by means of a survey. The results of learning acquired by the students of both groups are evaluated by comparison of the marks achieved by the students both in the continuous assessment and in the final exam. The mains reason to study chemistry subjects in English is the acquisition of the specific terminology and the improvement of the language skills, the results achieved by the students in both groups are not influenced by the teaching language. Offering the possibility to learn chemistry subjects in English has increased the number of exchange students taking those subjects and therefore the internationalization of the University of Alicante.

KEY WORDS: English, Continuous Assessment, Student Assessment, Organic Chemistry, Science

1. INTRODUCTION

Globalization is a fact in our current society, therefore learning foreign languages is considered as an essential feature in modern education. Indeed, European citizens need to know foreign languages to move, work and study across Europe. In European countries where English is not the language of instruction, education in English is predominantly offered at the master’s level with a share of almost 80% of all programs. Since 2002, when the postgraduate studies in English were standing at 68%, the number of second cycle studies at higher Education Programs in English started to increase (Wächter, 2008). Despite this continuous growth (Tilak, 2011), the English education in Europe is still in an early-stage. In this context, one of the operational aims related to the European Higher Education involves actions related to the student mobility. Since 2013, European exchange programmes related to studies and works were integrated into the new Erasmus+ plan.

English is the language of communication in the scientific community (van Weijen, 2012). Science students should achieve certain language (i.e. English) skills at the end of their degree. Indeed, students at the University of Alicante (UA) must certify a B1 level (in a foreign language) before graduation. Therefore, the implementation of teaching groups in English can improve the student technical language skills while acquiring the degree contents, skills and competences.

In this context, the Organic Chemistry Department has begun to teach subjects of the Chemistry degree in two language groups (English and Spanish). Nevertheless, it is important that this teaching
experience does not interfere in the learning process of the degree matters, the analysis of this question being the main objective of the present study. Moreover, we wanted to know the opinion and assessment of the students about the possibility of learning some subjects in English, and if they were aware of the advantages of this choice, such as obtaining an internal language level accreditation.

2. METHOD

2.1. Description of the context and participants

Some teachers from the Organic Chemistry Department have been involved in the implementation of teaching groups in English for several years, preparing and adapting the necessary subject materials and activities. In the Chemistry degree, and after a pioneering experience in the academic year 2015/2016 in the subject Structure Determination of Organic Compounds, all compulsory subjects taught by the department are also offered in English. In addition, the Department has been teaching in English the subject “Chemistry” in the high academic performance group (ARA group) of the Biology degree since its creation in 2011. Moreover, our teaching staff in the Medicinal Chemistry Master have been imparting several subjects in English during the last few years.

In the last years, our teaching research group has been involved in different studies, mainly focused in evaluation activities. Thus, we have prepared and reorganized materials, contents and continuous assessment activities in many subjects of our teaching area. The experience acquired during these years gave us the ability to gauge the similarity of the language teaching groups for a subject. In this study, we have considered three different compulsory subjects from the Chemistry degree: Organic Chemistry (OC), Structure Determination of Organic Compounds (SDOC) and Advanced Organic Chemistry (AOC). For two of them (OC and SDOC), we have acquired data from two academic years (2016/2017 and 2017/2018), for AOC only being from 2016/2017 since the results from the current academic year were not yet available.

The subject Organic Chemistry (9 ECTS) is taught in the second year of the Chemistry degree, and the subjects Structure Determination of Organic Compounds (6 ECTS) and Advanced Organic Chemistry (6 ECTS) are taught in the third year. In the three subjects, the mark corresponding to the continuous assessment (CA) represents 50% of the final Grade and a Final Exam (FE) provides the other 50%.

2.2. Instruments

The Moodle platform has been mainly employed to obtain the data. Additionally, hardcopy surveys have been taken to collect part of the data employed in this study. Then, all the data were treated and analyzed in an appropriate way, using different software, such as IBM SPSS v.24.0 and Microsoft Excel Professional Plus 2013.

2.3. Procedure

Our working group involved in teaching research at the Organic Chemistry Department (UA), has developed the present work. The planning was organized during the corresponding meetings, and the members of the group were involved in different activities, such as preparation of surveys for the language teaching groups, collecting the surveys and qualification data, organizing and processing the data, analyzing the results and writing up the report.

A survey was prepared for the students of the groups taught in Spanish to know if they knew about the possibility of taking the subject in English, and the reason why they chose to learn it in the Span-
ish group (Table 1). Likewise, another survey for the students of the groups taught in English was prepared to know the reasons why they chose that group, and also to identify difficulties during the contents learning process (Table 2).

Table 1. Survey given to the students in the groups taught in Spanish

<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q1 When you signed up in this subject, did you know that one of the groups would be taught in English?</td>
<td>Yes No</td>
</tr>
<tr>
<td>Q2 Did you know that you could obtain internal accreditation (UA), for the evaluation of the Final Project and access to mobility programs, passing subjects which are taught in English (12 ECTS for level B1 and 24 ECTS for level B2)?</td>
<td>Yes No</td>
</tr>
<tr>
<td>Q3 Related to the reasons why you took the course in Spanish, select the option that best suits your case: [a] My knowledge of English is not enough to take the subject in that language. [b] I have a sufficient level of English, but I prefer to take the subject in Spanish. [c] I already have English level B1 or B2, accredited by other entities different from the UA. [d] I have already obtained enough credits in English, in the Degree in Chemistry at the UA, to get internal accreditation. [e] Other reasons (specify).</td>
<td></td>
</tr>
</tbody>
</table>

Table 2. Survey given to the students in the groups taught in English

<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q1 Has it been more difficult to follow/study the subject being taught in English?</td>
<td>Yes No</td>
</tr>
<tr>
<td>Q2 Did you know that you could obtain internal accreditation (UA), for the evaluation of the Final Project and access to mobility programs, passing subjects which are taught in English (12 ECTS for level B1 and 24 ECTS for level B2)?</td>
<td>Yes No</td>
</tr>
<tr>
<td>Q3 Related to the reasons why you took the course in English, select the option that best suits your case: [a] To obtain level B1 or B2 for internal accreditation (UA). [b] I have sufficient knowledge of English, but I want to acquire specific language of the degree. [c] To improve the level of English, in general. [d] Other reasons (specify).</td>
<td>[a] To obtain level B1 or B2 for internal accreditation (UA). [b] I have sufficient knowledge of English, but I want to acquire specific language of the degree. [c] To improve the level of English, in general. [d] Other reasons (specify).</td>
</tr>
</tbody>
</table>

The data collected was analyzed and the corresponding results are presented and discussed later.

3. RESULTS
Considering the last two academic years (2016/2017 and 2017/2018), for the 3 subjects included in this study, the first evidence that we have realized is that the number of students taking the subject in English has increased from 19% to 25% of the total number of students. The data of the number of
students taking subjects in each language group are shown in Table 3. As we expected, the increase of students in the English group is bigger for the third year subjects, being almost a third of the students in these groups (29% in SDOC and 30% in AOC). We think that the experience of being in an English taught group during the second course of the degree has been positive for the students and they have realized the usefulness of this training. This previous experience and the fact that marks are not significantly different between both groups [vide infra, (Albert-Soriano, 2017)], have probably encouraged more students to take subjects in English during the third course.

Table 3. Number of students in the groups of Spanish and English for the different subjects in the last two courses

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ESP</td>
<td>57</td>
<td>42</td>
<td>57</td>
</tr>
<tr>
<td></td>
<td>ENG</td>
<td>12</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>2016/2017</td>
<td>ESP</td>
<td>55</td>
<td>45</td>
<td>46</td>
</tr>
<tr>
<td></td>
<td>ENG</td>
<td>10</td>
<td>18</td>
<td>20</td>
</tr>
<tr>
<td>2017/2018</td>
<td>ESP</td>
<td>55</td>
<td>45</td>
<td>46</td>
</tr>
<tr>
<td></td>
<td>ENG</td>
<td>10</td>
<td>18</td>
<td>20</td>
</tr>
</tbody>
</table>

Figure 1. Results of the survey to the students of Spanish (ESP) groups

Next, we analyzed the results of the surveys fulfilled by the students. The number of students answering them was significant. Thus, 75 people responded in the Spanish groups and 31 in the English ones. Regarding the survey given to the Spanish groups (Table 1), the results are summarized in the Figure 1. Only 10% (Figure 1, Q1) of the students did not know about the possibility of taking the subject in English. Such a small percentage may be explained because this is the second year in which this possibility is offered. More surprising was that 30% (Figure 1, Q2) of the students did not know about the possibility of obtaining an internal accreditation at the UA after passing subjects taught in English, taking into consideration that this information is given to the students before starting each academic year. Concerning the reasons for not choosing the group in English, the majority (44%, Figure 1, Q3 [a]) considered that they do not have enough knowledge of English to be able to take the subject in that language. Interestingly, almost a third (32%, Figure 1, Q3 [b]) declare to be able to...
study the subject in English, having the language level for that, although they prefer to do it in Spanish. These students together with another 15% (Figure 1, Q3 [c]), who recognized to have already accreditation of level B1 or B2 in English, can be considered as potential members of the group in the foreign language.

Related to the survey given to the group in English, the results are depicted in Figure 2. The most significant of these results is that 90% (Figure 2, Q1) of students consider that the language has not been an added difficulty to the subject. Truly, the marks obtained by the students in the English groups are in the same average than the ones from the students in the Spanish taught groups [vide infra, (Albert-Soriano, 2017)]. We detected that 10% (Figure 2, Q2) of the students taking the subject in English did not know about the possibility of getting an internal language level accreditation at the UA. As for the reasons for having chosen the English group, only 10% (Figure 2, Q3, [a]) of the students plan to obtain an internal accreditation for taking subjects in English. Actually, most of the students in these groups already have an accreditation by other organisms. Consequently, most of the students refer to improving the level of this language, either in general (16%, Figure 2, Q3, [c]) or by learning specific terminology of the degree (68%, Figure 2, Q3, [b]). In addition, 6% of the students who gave other reasons mentioned mainly another fact associated with the English groups as the small size (at least for the moment).

![Figure 2. Results of the survey to the students of English (ENG) groups](image)

From an academic point of view, the educative experience of teaching science subjects in a foreign language must not interfere in the acquisition of knowledge, skills and competences of the degree. To evaluate this, we have analyzed the results obtained by the students in both teaching groups (English and Spanish) for the subjects Organic Chemistry (OC) and Structure Determination of Organic Compounds (SDOC) during the two academic years 2016-2017 and 2017-2018, and in the subject Advanced Organic Chemistry (AOC) during the academic year 2016-2017. We have considered the marks obtained in the Continuous Assessment (CA), Final Exam (FE) and the final Grade. The data has been previously analyzed (Albert-Soriano, 2017) but the number of cases in the English group was too small. Thus, the analysis of the complete data allowed us to get a more precise answer of the query of this study. The analysis was performed with a total of 202 students from the Spanish groups and 62 from the English groups, the ones who did not take the final examination being not considered in the study. The statistical analysis is given in Table 4 and the histograms are shown in Figure 3.
Table 4. Statistics for all students in English (ENG) and Spanish (ESP) groups and T-test\(^a\) values

<table>
<thead>
<tr>
<th>Lang.</th>
<th>N</th>
<th>Mean</th>
<th>Std. deviation</th>
<th>Std. Error Mean</th>
<th>Sig. (2-tailed)</th>
<th>Mean difference</th>
<th>Std. Error difference</th>
<th>95% Confidence Interval of the Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>CA ENG</td>
<td>62</td>
<td>7.29</td>
<td>1.074</td>
<td>0.136</td>
<td>0.000</td>
<td>1.250</td>
<td>0.189</td>
<td>0.878 - 1.623</td>
</tr>
<tr>
<td>CA ESP</td>
<td>202</td>
<td>6.04</td>
<td>1.366</td>
<td>0.096</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FE ENG</td>
<td>62</td>
<td>4.85</td>
<td>2.166</td>
<td>0.275</td>
<td>0.074</td>
<td>0.569</td>
<td>0.317</td>
<td>-0.056 - 1.193</td>
</tr>
<tr>
<td>FE ESP</td>
<td>202</td>
<td>4.28</td>
<td>2.190</td>
<td>0.154</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Final Grade ENG</td>
<td>62</td>
<td>6.08</td>
<td>1.518</td>
<td>0.193</td>
<td>0.000</td>
<td>0.937</td>
<td>0.228</td>
<td>0.489 - 1.386</td>
</tr>
<tr>
<td>Final Grade ESP</td>
<td>202</td>
<td>5.15</td>
<td>1.583</td>
<td>0.111</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

[a] Test for equality means with equal variances assumed.

Figure 3. Histograms of the marks obtained in the subjects in English (ENG) and Spanish (ESP) groups for the (a) Continuous Assessment, (b) Final Exam and (c) Grade

Figure 4. Correlation of final Grade with Continuous Assessment and with the mark in the Final Exam for the groups in English (ENG) and in Spanish (ESP). Subject: *Organic Chemistry*
Among the three marks shown in this study, the statistical analysis (Table 4) revealed that for Final Exam marks there were no significant differences between the two groups for a 95% confidence rate, assuming equal variances. Actually, both groups presented comparable dispersions for the Final Exam marks (Figure 3[b]). The mean difference between the two groups resulted less than 0.6 points (out of 10). On the other hand, the distribution for the Continuous Assessment marks showed to be a bit dissimilar for both groups (Figure 3[a]), although this fact can be attributed to the different size of the groups. Furthermore, the final Grades, which are weighted averages (50:50) of CA and FE, resulted a midpoint (Table 4, Figure 3[c]) between CA and FE, being not possible to validate the hypothesis that there was no significant difference between the English and Spanish Groups (Table 4).

**Figure 5.** Correlation of final Grade with Continuous Assessment and with the mark in the Final Exam for the groups in English (ENG) and in Spanish (ESP). Subject: *Structure Determination of Organic Compounds*

**Figure 6.** Correlation of final Grade with Continuous Assessment and with the mark in the Final Exam for the groups in English (ENG) and in Spanish (ESP). Subject: *Advanced Organic Chemistry*

Following our study, we analyzed the correlation, for each subject, of the final grade with the marks obtained in both the CA and the FE. The results are graphed in Figure 4 for Organic Chemistry subject (2016/2017 and 2017/2018 academic courses), in Figure 5 for Structure Determination of Organic Compounds subject (2016/2017 and 2017/2018 academic courses) and in Figure 6 for Advanced Organic Chemistry subject (2016/2017 academic course). The data from both groups (English and Spanish) has been represented in each graph to facilitate the comparison of them. The marks obtained in the CA activities are, in general, higher than the final Grade and, in contrast, the FE marks are lower than the final Grade. This circumstance has been observed previously in chemistry subjects (Trillo, 2015; Trillo, 2016). The marks obtained by students in the English groups are similarly distributed than those from the students in the Spanish groups (Figures 4-6). The most significant differences are in the SDOC subject, being the CA marks obtained by the English group students slightly higher.
Figure 5. The differences in the FE marks (for SDOC) are lower between language groups, being actually better results for many of the Spanish group students.

4. DISCUSSION AND CONCLUSIONS

The students from the Chemistry degree have accepted quite well the action of teaching subjects in a foreign language. The number of students taking different subjects in English has been increasing from the academic year 2016/2017 to the 2017/2018, this increment being mainly in the third year subjects (SDOC and AOC). The students in the second year of the degree are less willing to take a subject in English, almost half of them (44%) considering that they do not have enough English level to take a subject in that language. Likewise, on the other subjects the fraction of students, bearing in mind not to have the required language skills, is similar. We can assume that the other half of the students taking the subjects in Spanish are potential members for the English group. Consequently, we can expect an equal distribution of the students in both groups after a certain time.

During the academic year 2015/2016, our Department offered the subject SDOC in both languages English and Spanish in a pioneering action. Some students proposed to that the offer of English teaching subjects should be increased, so they could obtain an internal language accreditation, which is needed to finish the degree. Surprisingly, a small amount (10%) of the students taking the subjects in English declare this motivation, most of the students in these groups having enough language skills. Nevertheless, the students can improve their level, both in general and in technical terminology, by taking the organic chemistry subjects in English.

Another interesting aspect, which has not been represented in the surveys, is related with the exchange students. During the last decade, we have observed few exchange students (mainly from the Erasmus program) in the organic chemistry subjects to improve their Spanish skills. Furthermore, in the last two years we got also few students from abroad coming to the English group. Consequently, with this type of action we are doubling the options of taking exchange students coming to our university. In our opinion, the action of teaching groups in English has interesting benefits for the students (internal accreditation, language skills) and for the university (internationalization). Similarly, other studies reported also the benefits of integrating contents and foreign language during the education process (Lorenzo, 2009; Angulo-Jerez, 2013). Therefore, the institution should consider including this type of teaching groups (in English) in the teaching plan, since to date the realization of this project has been done without due credit.

It is worth to mention, at this point, that the assessment from the students in the English group was very positive, mentioning that the language was not an extra difficulty to learn the contents related to the subject. From the statistical study, we observed that in the Final Exam there are no significant differences between both groups of students (English and Spanish), the final examination being the same objective question paper for both teaching groups. Thus, we can conclude that the subjects were taught in a manner that students could follow and study the contents independently of the language employed, being equally possible the acquisition of knowledge, skills and competences in both groups.

Regarding the evaluation part referred as CA, the study revealed that we cannot validate that there are no significant differences between the teaching groups. Nevertheless, students in the English group achieved slightly higher marks, being an indirect prove that the foreign language does not have a negative effect on the student learning. This difference has been commented in a preliminary study (Albert-Soriano, 2017) and in other studies related with evaluation (Trillo, 2016), being the size of
the teaching groups a significant factor. Indeed, the lower the student/teacher ratio makes the process of CA easier. Moreover, a low student/teacher ratio favors the student-teacher interaction during the teaching-learning process. Actually, few students from the English group pointed the smaller size of the group as the reason of choosing it. Finally, the small differences observed in the final Grade between both groups (English and Spanish) has to be with the fraction of the evaluation from the CA.

We can conclude that the teaching-language has no influence in the learning process, and the student’s results are statistical comparable in both teaching groups, being the study conducted for three different subjects and during two academic years (for two of the subjects). The possible differences during the CA activities could be more related with the size of the group than with the language, the foreign language being favored. In general, this type of action is useful not only for the students, but also for the institution.

5. REFERENCES


