Teaching symbolic language to non-native speakers

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INTRODUCTION

In this paper, we describe how an on-line resource, primarily intended to improve the proficiency in a foreign language, can also facilitate the understanding of the symbolic language in an engineering degree course. We think that thanks to the use of this resource, a course in an engineering degree can tackle both the challenge of teaching symbolic language to non-native speakers and the challenge of doing this without losing insight into the concepts that appear in the course.

European universities have the challenge to adapt their curricula following the guidelines that emanates from the European Higher Education Area (EHEA). According to the basic principles of quality, mobility, diversity and competitiveness, a good command of a foreign language is a core competence in order to be internationally competitive and multiculturally aware and is a major contribution to make to the EHEA’s language learning goals.

The so called Content and Language Integrated Learning (CLIL) methodology aims to improve the proficiency of a foreign language in non-linguistic subjects. It's an approach based on language immersion for learning content through a foreign language, thus teaching both the concepts of the subject and the foreign language. The European Commission states [1]: “It can provide effective opportunities for pupils to use their new language skills now, rather than learn them now for use later.” The first question that arises when this idea is presented is how to introduce a new knowledge, the foreign language, without losing insight into the knowledges that are intrinsically related with the subject. Again the European Commission states: “It provides exposure to the language without requiring extra time in the curriculum...”

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How it can be strictly done is a kind of mystery, although it is clear that the methodology tries to minimize the ratio of extra time to new knowledge doing some arrangements in order to balance the achievement of both, foreign language and specific competences. A general overview of CLIL in Spain and Europe is available in [2] and [3].

A shared competence in engineering degrees is handling mathematical symbols and formalism. In this communication we focus on how to teach symbolic language in English to non-native speakers. We have designed an on-line resource that helps handling mathematical expressions. This resource, named multilingual formulae, is available at http://mformulae.epsem.upc.edu. It contains a set of formulas with its corresponding written and oral version in different languages. Currently the resources are all in English and some in French, the foreign languages, and in Catalan and Spanish, the native languages. This resource is being developed by a faculty of the Universitat Politècnica de Catalunya.

ACADEMIC CONTEXT

In autumn 2009, five four-year degree offered by the Universitat Politècnica de Catalunya (UPC) were launched at the School of Engineering of Manresa (EPSEM). In autumn 2010, another one was launched. One of the differences between the old and the new degrees is that the new ones must give a sufficient proficiency in a foreign language in the way determined by the university to converge to the EHEA.

This can be done in different ways, among them the development of a minimum of courses taught in English. Although the European Commission suggests the presence of trained teachers who are native speakers of the vehicular language to facilitate the introduction of CLIL approaches, this is not the situation in our university. So, the EPSEM decided to collect information about the teaching staff and about the students in order to plan the best way to introduce CLIL approaches in the new degrees.

1.1 Teaching staff

A voluntary questionnaire was answered by 70% of the full-time teaching staff. Figure 1 shows the percentage of lecturers holding each level of accreditation. As language accreditations are not mandatory and have no positive impact on the promotion of the teaching staff, this information is not relevant.

![Teaching staff accreditations](chart.png)

Fig. 1. Teaching staff accreditations.

To avoid this inconvenient, the questionnaire included questions about their own perception of the level of communication skills in English. Figure 2 shows the level of written and oral
comprehension, and written and oral expression. This perception is expected to be quite realistic since it has had many opportunities to be verified in conferences abroad. We see that more than 50% of the teaching staff believes that their level is good or very good in all the skills. On one side, as expected because people have less opportunities to develop it, the oral expression skill shows a lower proficiency than the others. On the other side, this is the skill in which CLIL approaches are based.

**Fig. 2.** Teaching staff questionnaire results.

**Fig. 3.** Willingness to teach partially and completely in English.
A very important result from the questionnaire is the willingness to teach a course completely or partially in English. Figure 3 shows the greater willingness to teach a course partially in English than completely.

1.2 Students

A voluntary questionnaire was answered by 400 students enrolled in the new degrees. Figure 4 shows the percentage of students holding each level of accreditation and Figure 5 shows students’ own perception of the level of communication skills in English.

**Fig. 4. Students accreditations**

<table>
<thead>
<tr>
<th>Written comprehension</th>
<th>Oral comprehension</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Low</strong></td>
<td><strong>Low</strong></td>
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<tr>
<td><strong>Weak</strong></td>
<td><strong>Weak</strong></td>
</tr>
<tr>
<td><strong>Good</strong></td>
<td><strong>Good</strong></td>
</tr>
<tr>
<td><strong>Very Good</strong></td>
<td><strong>Very Good</strong></td>
</tr>
</tbody>
</table>

**Written expression**

- Low: 7.11%, 8.70%
- Weak: 31.62%, 37.94%
- Good: 31.62%, 37.94%
- Very Good: 31.62%, 37.94%

**Oral expression**

- Low: 7.91%, 15.81%
- Weak: 22.53%, 38.74%
- Good: 22.53%, 38.74%
- Very Good: 22.53%, 38.74%
Fig. 5. Students questionnaire results.

From these results the EPSEM concluded that scaffolding material was really necessary to support teaching content through English. With the aim to produce this material, the research group named Linguatech-Rima (Research group on Scientific and Technological Multilingual Communication) was worn. This group is integrated by more than 20 lecturers involved in different engineering areas such as mathematics, electronics, electricity, ICT, chemistry, mechanics... At present, the main work of this group is the construction of the website Multilingual Formulae, presented in this paper.

ACADEMIC RESOURCES

2.1 Phrasebook resource

The first step was to facilitate the communication between lecturers and students. Class-Talk, an on-line trilingual university teaching phrasebook, was developed in collaboration with the Language and Terminology Service of the UPC. The aim of this phrasebook, available at http://www.upc.edu/slt/classstalk/, is to help lecturers and students to communicate more effectively in a generic university classroom in a foreign language. It contains about 600 expressions classified according to the situation: starting the lecture, delivering the lecture, in the laboratory... Audio files are provided to improve listening and speaking skills.

Fig. 6. Sample of the symbolic language test related to electronics.
2.2 Symbolic language resource

Going one step further, this group investigated the relation between symbolic and natural languages [4]. As formulas and algebraic expressions are widely used in an engineering degree, teaching in English can be a problem if students and lecturers don’t feel comfortable using them. Moreover, some authors state that mathematical expressions aren’t different than the words they represent, so they should be punctuated accordingly. Also, they need to be complete sentences, thereby preventing meaningless expressions [5]. In this sense, parallelism between mathematical language and usual language can be used to improve constructions on both languages.

Tests with linked audio files were designed to check the real oral comprehension of formulas read in English. They were implemented in the digital campus of our university, based on Moodle. A surprising result was the power of this test to work as a self-learning tool. But the most important result was to realize the difficulties that both, lecturers and students, had in answering the test. These difficulties change with speaking speed, the speaker’s gender, native or non native speaker …. Therefore, the next step was the development of an appropriate resource for learning to read the symbolic language in an engineering environment. The details are described in the following section.

MULTILINGUAL FORMULAE

Multilingual formulae is an open access on-line collaborative resource available at http://mformulae.epsem.upc.edu. It contains tables of symbols and a set of formulas classified in different subjects. More concretely it contains tables to support English speaking of symbolic language as binary relations, symbols, scientific notation, etc. Tables and formulas include examples and audio files. More than 600 formulas of different engineering areas have also been introduced. Each formula is described in symbolic language, text and audio with the speech in several languages: all in Catalan, Spanish and English, and some in French.

The project has been developed using the Content Management System Plone, and the Javascript library MathJax to render mathematics in LaTeX. It is the result of the research group Linguatech-Rima, who is basically in charge for the design of the application and to suggest, review and classify formulas in different subjects. It can not be considered complete because new formulas are being added after technical and linguistic review.

The resource is addressed to lecturers and students as a support for the lack of fluency, to ensure the effective communication when symbolic language is used. It also highlights the mathematical part of the formulas, improving content learning. Furthermore, it can also be helpful to increase the self-confidence when oral presentations in a foreign language at professional or research level are involved.
**INTRODUCTION**

**MULTILINGUAL FORMULAE** is an application to support multilingual verbalization of formulas and symbols.

The purpose of this application is to show the verbalization in several languages of symbolic language, mainly based on mathematics, which is widely used in scientific and technical content in both academic and research. Fluency in verbal expression of symbols is essential to facilitate direct communication (expression and understanding) especially in the new model of the EHEA that promotes mobility and the teaching of subjects in a foreign language.

Aimed primarily to teachers and students using the symbolic language in oral communication in a foreign language, both academic and scientific use.

Currently under construction, since the formulas and their speeches have to go through the appropriate review process.

The application was designed to allow the collaborative work and is open to participation for experts in scientific and technological scope, to propose formulas and their corresponding written expressions, and for experts in language to propose corrections. The aim is to be extended both in language and formulas.

Contact us if you want to participate!

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**Fig. 7.** Introduction page of the website *multilingual formulae*.

**Fig. 8.** Reflection coefficient equation: symbolic language, text and audio.
ACKNOWLEDGMENTS

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REFERENCES


