

## Multilingual Training for Chemical Engineering Students - Scholar Circle at the Department of Chemical Engineering at UCTM

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### ABSTRACT

*This paper presents the results of the teamwork conducted by lecturers in specialized disciplines and foreign language teaching in a scholar circle. This scholar circle aimed at complementing and enriching students' knowledge of chemical engineering, German and English language majoring "Chemical Engineering" taught in German at the University of Chemical Technology and Metallurgy (UCTM) Sofia. The academic circle is a continuation of a previous project with similar focus. To objectively evaluate the achievements of the Circle as such, a survey was conducted among students who participated in the classes to obtain their opinions on the effectiveness and results of additional classes of this nature.*

***Keywords:** multilingualism, English for Specific Purposes (ESP), engineering science, scientific terminology, interdisciplinary approach.*

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### INTRODUCTION

In the context of modern globalization, the policies foreseen in the European Qualifications Framework (EQF) for multilingualism are entirely relevant. The development of foreign language communicative competences is a key element that contributes to the effectiveness of education systems, where proficiency in only one foreign language has long been woefully inadequate. A good and very good level of foreign languages (Pl.) proficiency is expected, with English, which has become the world's working language, taking first place.

Engineering students also face the challenge of 'multilingualism' as business and industry organizations impose their own requirements on engineering staff (multilingualism refers to a person's ability to speak several languages, Council of Europe [1]). It is for this reason that the system of higher education in Bulgaria creates conditions for learning activities applying a multilingual approach, which is most evident in educational programs that are conducted in a foreign language. Not only does communication appear as a desirable soft skill in the portfolio of competencies, but it is also part of the hard skills, as

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fluent and accurate foreign language(s) speaking is the content of their majors [2]. An example of this is the German-taught Chemical Engineering degree program at UCTM, a degree program with a long history, established in partnership with the Technical University of Hamburg, where students complete their studies with a double degree. A similar specialization is Chemical and Biochemical Engineering in French, which is accredited by the CTI in France. The trend in the European education area for engineering qualifications is to make English language proficiency a prerequisite (key competence). This provides a reason to conduct research in the learning process in foreign language majors, in this case the focus is on the German-taught major, to find effective methods for improving first and second language skills when dealing with educational content. "English for Specific Purposes" (ESP) is a branch of applied linguistics and focuses on all aspects of language that is related to a particular special area of professional activity. Hutchinson and Waters define English for Special Purposes as a learner-centered approach rather than a product. This approach perceives knowledge as an ever-changing process that builds on learners' previous experiences [3]. At present, foreign language is a subject of skills, knowledge and culture [4], and at best a mediator that influences the overall life of the individual [5]. The fact that speakers can use their entire linguistic repertoire means that multilingualism provides access to more or different knowledge, particularly in the academic world, as speakers of different languages can provide new perspectives on familiar concepts [6]. In the real conditions of the teaching environment, in which curricula currently do not provide the necessary time for foreign and specialized language teaching, foreign language lecturers strive to develop innovative methods to present educational content to compensate for the time deficit. These inventive concepts aim to unite the improvement of foreign language competencies (working with scientific

terminology) and the development of engineering competencies [7].

Based on many years of experience and personal observations, the authors of the present work (lecturers from higher education institutions - HEIs) gather around the idea of generating original educational tools and materials that include integration of educational content (in foreign languages) and at the same time improving communicative language competences. For this purpose, various materials have been developed for integration in the cross-curricular classes (under the project "Chemical Engineering and Foreign Language Training - Scholar Circle at the Department of Chemical Engineering at UCTM" - lasting until December 5<sup>th</sup>, 2022, which is a continuation of the project "Chemical Engineering Dynamics and Foreign Language Training - Scholar Circle at the Department of Chemical Engineering at UCTM", NIS 2021). The focus of the classes is on complementing and enriching students' knowledge of chemical engineering, German and English language in the 3rd and 4th year of studies, majoring in "Chemical Engineering", taught in German, at the UCTM-Sofia, as well as students from other majors at the Department of "Chemical Engineering".

## **EXPERIMENTAL**

The implementation of the circular sessions focuses on two objectives:

- Improving the quality of chemical engineering education by implementing a Chemical Engineering and Foreign Language Teaching scholar circle at the Department of Chemical Engineering at the UCTM.
- Enhancing students' general and specialized foreign language (German and English) training through the teamwork of lecturers in specialized disciplines and foreign language.

An interdisciplinary approach has been applied to design the materials for this academic

circle. Interdisciplinary research uses the methods of two or more disciplines within the subject matter of one or more of them to solve a problem. Interdisciplinary teams consist of experts from several disciplines. In interdisciplinary teams, each member has their own area of responsibility, which at best ensures that the whole problem area is usually covered better than in multidisciplinary teams. Interdisciplinary (cross = across, intersecting; from-to) research brings together different types of disciplines and training, often involving comprehensive research and reporting skills, presentation skills, and performance skills. It typically involves research that “crosses” two or more disciplines in a way that enables the researcher or team members to see something from the “other side” [8].

The following types of classes were held within the circle:

- Dynamical systems modelling classes (including hydrodynamic, heat and mass transfer processes, chemical and biotechnological processes) in English or German.

- Application of simulation programs to quantify the consequences of accidental releases of hazardous chemicals into the environment.

- Classes to increase students’ general knowledge of German language including German grammar exercises covering certain grammar topics that are difficult for learners and require special attention, e.g.:

- pronouns and participles (Pronomen: Personalpronomen, Reflexivpronomen, Demonstrativpronomen, Possessivpronomen, Indefinitpronomen, Interrogativpronomen, Relativpronomen und Kasi);

- adjective declensions (Deklination der Adjektive);

- regimen of adjectives (Rektion der Adjektive);

- the passive voice (Passiv);

- subjunctive (Konjunktiv I);

- subjunctive (Konjunktiv II);

- compound sentences (Satzgefüge).

In the German language classes, selected films, reports, interviews, etc. were presented to the students in German, followed by a discussion in German.

- Classes to increase students’ general knowledge of English language including English grammar exercises covering certain grammar topics that are difficult for learners and require special attention. Such topics are:

- Present, Past and Future tenses;

- Passive Voice;

- Gerund;

- Reported speech;

- I Conditional;

- II Conditional;

- Phrasal verbs.

Classes usually follow an established structure that includes:

- a brief review of the material from the previous class, a presentation of the material covered in the current class;

- work on selected problems;

- summary and discussion.

In the classes aimed to enhance the communicative skills in English, selected films, reports, interviews, etc. in English with subsequent discussion in English were presented to the students.

- Classes to increase students’ specialized foreign language skills in the field of chemical engineering (classes in English and German for targeted acquisition of specialized terminology).

Exercises students worked on included:

- identifying and marking passive constructions in a scientific and technical text;

- recognition and labelling of concepts in specialized texts and translation of the same; and as an additional task: independent formulation of the definitions of each of them - both in native and foreign language;

- filling in missing words in a scientific and technical text;

- listening to presentations (in the respective foreign language);

Table 1. Part of the questionnaire given to students to evaluate the effectiveness of the scholar circle they have attended.

No	Statements	Answers, %				
		Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
A. Working in a multilingual environment with subject and language content is:						
1	easy	28.56	28.56	0	42.85	0
2	interesting	28.56	57.14	0	14.28	0
3	motivating	14.28	71.43	0	14.28	0
4	challenging	14.28	71.43	0	14.28	0
B. Working in a multilingual environment has helped me to:						
1	better understand the subject and language content	57.14	28.56	0	14.28	0
2	recall information learned in the past	42.85	42.85	0	14.28	0
3	apply my knowledge in my native language to English and German language tasks	14.28	42.85	42.85	0	0
4	incorporate English and German content into my subject knowledge	0	57.14	42.85	0	0
C. Working with educational content in a multilingual environment has an effect on:						
1	the better opportunity to establish connections between knowledge of the mother tongue and the target languages (English and German)	57.14	42.85	0	0	0
2	the motivation to continue learning languages	14.28	57.14	14.28	14.28	0
3	making the subject content more attractive for learning	0	28.56	57.14	14.28	0
D. Working in a multilingual environment with subject and language content:						
1	is useful for the future profession	85.71	14.28	0	0	0
2	can be applied more frequently	28.56	71.43	0	0	0
3	increases my interest in the subject	14.28	28.56	57.14	0	0

- discussions on specialized topics (in the respective foreign language).

Classes dedicated to specialized terminology in the field of Chemical Engineering in German and English are a foreign language supplement to part of the Chemical Engineering courses taught in German. Preliminary observations of some of the team members have shown that most of the students of the Chemical Engineering major taught in German have a sufficiently good level of English, which makes

it possible to conduct classes in English. This fact motivates the ambition to enrich/unify the students' vocabulary with specialized terminology in Chemical Engineering in both German and English. For this purpose, lesson units were selected from German- and English-language textbooks in the respective professional field, so that students are given the opportunity to work with textbooks and textbooks/journal articles that their counterparts in related educational institutions around the world are working with.

This is of considerable importance and relevance for the future professional development of these students.

## **RESULTS AND DISCUSSION**

After the completion of the scholar circle, a survey was conducted among the students regarding their opinion on the classes. The available results indicate that the learners are highly motivated to participate in them, and that the materials and presentations provided are extremely useful - both in terms of their general and professional foreign language training, and in terms of improving the quality of the chemical engineering education.

Claims from Section A: Working in a multilingual environment with subject and language content is:

- easy 57.12 % affirmative responses and 42.85 % negative responses;
- interesting (85.7 % affirmative answers), 14.28 % negative answers;
- motivating (85.7 % affirmative), 14.28 % negative;
- challenging with 85.71 % affirmative answers and 14.28 % negative answers.

It becomes clear that just over half of the students find this type of exercise work in a multi-lingual environment easy, while the remaining learners give a negative response to this statement. Here, one can comment as follows: not all students are equally proficient or very proficient in both languages, hence the different perceptions of doing well or not well with the educational materials. 85.7 % found working with the tasks thus proposed in the circle motivating, which in turn guided the lecturers in selecting future relevant methods and materials for working with students to suit their specific needs. It is also important to note that 85.71 % of students found this endeavour challenging. Relating this statement to the first one, we can conclude that placed in a multilingual environment, students experience some difficulties, which are not

necessarily due to a poor command of the subject content, but rather to the need to continuously “switch” to different languages.

From Section B: Working in a multilingual environment has helped me to:

- better understand subject and language content (85.7 % affirmative responses);
- recall information learned in the past (85.7 % affirmative);
- apply my knowledge in Bulgarian into English and German language tasks (57.1 % affirmative responses);
- incorporate English and German content into my subject knowledge (57.1 % affirmative responses).

It is evident here that in addition to better understanding of subject and language content, the materials offered also help recall information learned in the past. Moreover, students apply their foreign language knowledge to their subject knowledge, which is precisely part of the purpose of the scholar circle.

From Section C: Working with educational content in a multilingual environment influences:

- the better opportunity to establish connections between knowledge of the mother tongue and the target languages (English and German) (100 % affirmative responses);
- the motivation to continue learning foreign languages (100 % affirmative responses);
- making the subject content more attractive for learning (28.56 % affirmative responses, 57.14 % neither agree, nor disagree, 14.28 % disagree).

Here we see a high percentage of affirmative responses to key questions about the objectives set by the lecturers who worked on the circle tasks. The third statement is interesting - working with subject and language content in a multilingual environment does not necessarily increase students' interest in the subject. In this case, we are talking about chemical engineering students who enrolled in this major driven by professional interest. The multilingual environment does have an impact (for 28.56 % of the students), which



is also important, but is not leading and key to determine the interest they have in the major with or without the multilingual work environment.

From Section D: Working in a multilingual environment with subject and language content:

- is useful for the future profession (100 % affirmative responses);
- could be applied more frequently (100 % affirmative);
- increases my interest in the subject 42.84 % affirmative responses and 57.14 % neutral (neither agree, nor disagree).

Regarding the first two statements the message is clear. We can link the third statement to the third one from Section C, which once again proves that these chemical engineering students do feel motivated by working in a multilingual environment. However, it is not the key to their interest in the subject.

The results of the academic circle sessions can be summarized as follows:

- Students learn more thoroughly the material taught in Chemical Engineering, and particularly the dynamics of chemical engineering processes.
- Acquisition of quantitative risk assessment skills with modern software products.
- Improvement of the students' general training in German and English (opportunity to review basic grammatical structures, but also to catch up on missed topics, as well as to consolidate specific grammatical units they have difficulties with).
- Enrich students' vocabulary with specialized terminology in English and German in the field of chemical engineering. Since most of the students are proficient in both foreign languages at a good and very good level, the foreign language lecturer's motive is to unify the foreign language specialized terminology in English and German. To this end, students work with specialized technical texts in both English and German from selected engineering textbooks.

## CONCLUSIONS

The classes in the scholar circle are aimed at improving the general and vocationally oriented training in German and English. The purpose is also to improve the quality of chemical engineering education of the students of "Chemical Engineering" taught in German at the Department of Chemical Engineering at UCTM. From the results gathered in the survey, the students' attitude towards their participation in the scholar circle sessions becomes clear, namely: motivation to learn foreign (specialized) languages, as well as aspiration to continuously upgrade their subject and language knowledge in the respective professional field.

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