30 Years Chemistry Education in South-West University
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INTEGRATED ENGINEERING EDUCATION: THE ROLE OF ANALYSIS OF STUDENTS' NEEDS

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Abstract. The requirements of professional practice require the development of competences that combine both professional (technical) and communication skills, including English language. To support the development of both areas of competence, an integrated course on technological discipline and English for specific purposes (ESP) was developed and applied, based on an analysis of students' needs of language competencies. The data from students' self-assessment is analysed in relevance to the measured communicative needs in English. Statistical analysis verifies the effectiveness of the new approach based on students' needs assessment.

Keywords: integrated academic education, communication skills, ESP in biochemical engineering

Needs analysis

New competences of engineers, described in the qualification, necessitate new educational approaches. The integration of educational content, learning tasks and activities is one way to provoke students' thinking and activate their potential to work in dynamic situations. Integrated education has been applied in some disciplines in Biotechnology and English for specific purposes. The learning content was designed on the basis of students' needs analysis and stakeholders' requirements; student-cantered learning; non-traditional teaching approaches focused on the learning outcomes (Bess, 2000; Carlsson et al., 2010).

The first step in the course design is the needs analysis. The learning activities have been designed according to the students 'attitudes, self-assessments and expectations so that they acquire knowledge, skills and competencies in the engineering discipline and in the same time study and reproduce English for specific purposes (ESP) in professional communication (Cummins & Hornberger, 2010). The learning process goes through authentic tasks for interpretation and transformation of scientific and professional content (Barrie, 2004; Bankel et al., 2010).

Method

A survey was conducted with 90 students from the University of Chemical Technology and Metallurgy - bachelors, masters and PhD students. The questionnaire is aimed at diagnosing the needs for communication skills and the English language learning objectives - cognitive and professional, the expected results of the foreign language courses at the university and the attitudes towards continuing education in the sphere of communication in a foreign language.

Based on the results an integrated training in technological disciplines and English is designed and conducted, which allows the assessment of the effects of the joint development of professional and communicative skills of the students (Terzieva & Kolarski, 2014).

Results of the needs analysis

Fig. 1 presents the distribution of objectives and the respondents are able to indicate percentages for the expected language skills to be obtained from the course. Due to the option to choose responses with a step of 20%, a pattern of expected results is obtained that does not form complete 100% for each item of the proposed options.

The need to use English to complete the learning assignments is most clearly demonstrated. This is complemented by the need for professional communication skills (correspondence, reading and translation of scientific literature). The distribution of objectives is highly indicative of the students' expectations and the ways in which they believe they can achieve them. Here is the discrepancy with the possibilities of the traditional general English courses and the limited number of tuition hours. What the students expect is to apply and develop their language skills in their specialized training subjects.

Figure 1. Distribution of the answers to the question: what are your objectives in learning English (the answers present the objectives by significance in %)

Beyond these figures there is a part of the students who do not have their own views on the course objectives and would follow the curriculum (without pursuing any specific

personal objective). These constitute 8% of the total number of respondents, and within this group there is a different share in the course of the development of certain skills. The most significant is in professional communication – which was suggested by 40% of 15% of the respondents.

The main conclusion of the results is that the students expect to apply and develop their language skills in their specialized training subjects.

The students clearly intend to continue their English language education after graduation (Fig. 2). As shown in the figure, only 2% do not state such willingness. On the one hand, this demonstrates the students' conviction that this part of their professional training is of great importance for their realization and at the same time it is a sign of their self-assessment as regards the level of their own communicative skills. Obviously, they assess the gaps and weaknesses in their foreign language competence and the need for continuing education.

A response to these expectations is a new learning approach to replace the general English course with an English for Specific Purposes (ESP) one to respond to the specific needs of learners and materialize the idea of student-centred learning.

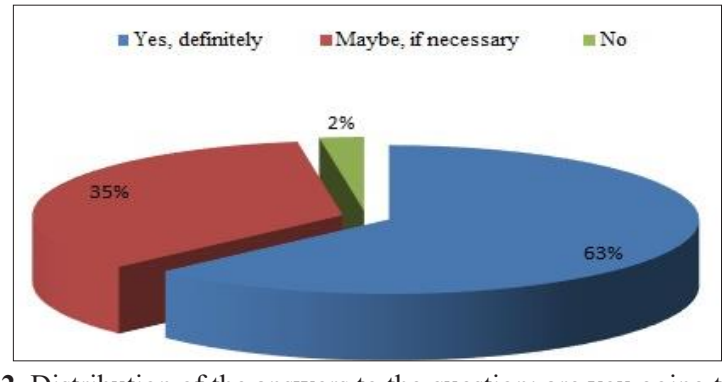

Figure 2. Distribution of the answers to the question: are you going to further improve your English proficiency after completing your higher education

Becoming aware of the needs is the first step towards optimizing ESP learning. The direct focus of such a course on concrete results implies an integrated approach to designing the content. The expected results recorded in the survey are a benchmark for identifying training components as "ready-made" educational content cannot be applied. The new approach consists in integrating technological learning tasks and ESP with presentation of each methodological each unit in two versions - in Bulgarian and in English.

In practice integrated training is applied in BT (pharmaceutical biotechnology and bioanalytical technics) and is designed to provide a balanced learning environment that is characterized by: (i) scientific content in optimal volume, structure and sequence of tasks; (ii) stimulating the learning of the target language; (iii) information and communication in

the environment of assignments in Bulgarian and English and interference in the use of the training materials in both languages; (iv) external monitoring and self-monitoring of students' learning activities, supporting the development of the expected learning outcomes.

The creation of a bilingual learning environments is based on the students' available academic skills and the initial knowledge of the subject. Thus, the design of the course and of each methodological component is consistent with the fact that students enter a specific cognitive activity with their individual motivation and expectation of the results, which gives them reason to have an idea of the results of the "Can do" learning. This component aims to guide the process of forming self-regulation of students' own learning. By presenting what is expected after completion of the work, the training package supports: (v) teacher management; (vi) providing and forming cognitive knowledge and experience; (vii) meaningful perception of the learning tasks; (viii) self-monitoring of the tasks and evaluation of the next self-monitoring methods in the lesson; (ix) a general idea of a step in the process of working with learning materials, which is in essence is assignment and a sequence of actions to deliver the expected results and performance assessment

Results of the integrated learning

The course was delivered to 52 students majoring in Biotechnology. The external assessment and self-assessment of the students involved in the survey demonstrated success in the completion of the learning tasks, and the levels of the marks were above the average for the term when compared with the control procedures and experts' assessments of traditional training teachers. When diagnosing foreign language skills using the Oxford Placement Test, students are allocated to levels A1, A2, B1 and B2. For the purpose of the survey, the self-assessment scale for the level of foreign language skills is analogous to the one used for formal assessment in Bulgaria. Students are divided into 4 categories: low – 10; average – 16; good – 14; excellent – 12.

The results of the survey are examined by the students' foreign language proficiency self-assessment levels. The data show the individual assessment of the students' satisfaction with the bilingual BT and ESP training and provide a realistic picture of the attitudes of learners towards the integrated learning environment the way they see their own progress based on communication skills in the classroom. The questionnaire is divided into two parts, the first one containing 26 questions, three of which are multiple choice. The evaluation is done on a five-point scale. The second part contains 12 closed-ended questions with a different structure and choice of answers (Appendix).

The statistical analysis shows correlation coefficients levels > 0.81, between the survey responses and allows suing the results for a detailed assessment of the dependencies between the individual statements of the students (Table 1).

The results of the survey show, in the first place, that students are able to perform the tasks and to perform at a level above the average. This encourages teaching to extend the application of the integrated learning approach. The detailed students' self-assessments are a guide for the future organization of the task environment and are structured to sup-

port the active learning of all groups of students, regardless of their underlying level of foreign language skills (Kolarsky et al., 2015).

Table 1. Survey of the students

№	QUESTION	low				intermediate				good				excellent				TOTAL
		YES		NO		YES		NO		YES		NO		YES		NO		
		N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	
1	**Do you understand your classes held in English?**	**7**	17,5		0	**14**	35		0	10	25		0	**9**	22,5		0	40
2	**Are you embarrassed to ask questions in English?**	**3**	7,50	4	10	**6**	15	8	20	**4**	10	6	15	**1**	2,5	8	20	40
3	**Does English help you as a learning environment to improve your communication skills?**	**7**	17,07		0	**13**	31,71	2	4,88	**10**	24,39		0	**9**	21,95		0	41
4	**Do you prefer your classes to be held in Bulgarian only?**	**5**	12,20	2	4,88	**10**	24,39	4	9,76	**6**	14,63	5	12,20	**3**	7,32	6	14,63	41
5	**For you, bilingual training is:**																	
	useful	7	17,50		0	14	35		0	10	25		0	9	22,5		0	40
	easy	7	17,50		0	6	15	8	20	6	15	4	10	9	22,5		0	40
	interesting	2	5,88		0	13	38,24	1	2,94	9	26,47		0	5	14,71	4	11,76	34
	hard	5	12,82	1	2,56	7	17,95	7	17,95	5	12,82	5	12,82		0	9	23,08	39
	boring	1	2,86	2	5,71		0	14	40		0	9	25,71	6	17,14	3	8,57	35
	not important	1	3,45	1	3,45	1	3,45	7	24,14		0	10	34,48	6	20,69	3	10,34	29
	very important	4	12,50		0	10	31,25		0	9	28,13		0	9	28,13		0	32
	important	1	4,17		0	3	12,5	2	8,33	9	37,5		0	9	37,5		0	24
6	**Do you think it is necessary to change / reorganize the course in English in order to take into account the technological specifics**	**7**	17,50		0	**8**	20	6	15	**8**	20	2	5	**9**	22,5		0	40

First of all, we need to work with group assignments to provoke free communication between the majority of the students. In order to achieve this the teachers' role is to be changed. The most important conclusion is that teachers and students are convinced in the benefits of an integrated learning approach and are willing to work with information in English in the specialized courses. However, in order to have this effect on the development of communicative skills in the target language, a specific design of the training is required. The data from the initial application of the approach confirm the capabilities of the experimental modules in the ESP course to develop the students' motivation skills, self-study and continuing learning. The development of methodological tools is towards combining the scientific content of the disciplines and ESP.

APPENDIX

Self-assessment of the Bilingual learning performance

№	Question	Possible answers			
1	How do you assess your English language proficiency?	Excellent	Good	Average	Low
2	Do you understand the lessons delivered in English?	Yes	No		
3	Are you interfering with asking questions in English?	Yes	No		
4	Does English help you as a learning environment to improve your communication skills?	Yes	No		
5	Do you prefer to have the lectures /practical exercises delivered/ conducted only in Bulgarian?	Yes	No		
6	For you, bilingual training is:				
	Useful	Yes	No		
	Easy	Yes	No		
	Interesting	Yes	No		
	Difficult	Yes	No		
	Boring	Yes	No		
	Not important	Yes	No		
	Very important	Yes	No		
	Important	Yes	No		
7	How do you prefer to express yourself in English?	verbally	in writing	both	
8	In which language skills do you perform best?	listening	speaking	reading	writing
9	Do you think it is necessary to change/reorganize the English language course to take into account the technological peculiarities?	Yes	No		
10	Should the English language course be changed with a focus on the profession, what do you think should be included?				
	Knowledge in the specialized field of education	Yes	No		
	Reading comprehension strategies	Yes	No		
	Coping with technical vocabulary	Yes	No		
	Applying communication skills	Yes	No		
	All listed	Yes	No		

11	Which skills should be included in the course?				
	Reading and listening	Yes	No		
	Reading and Writing	Yes	No		
	Reading and speaking	Yes	No		
	Listening, speaking, reading and writing	Yes	No		
12	Why did you choose English?				
	Personal challenge or knowledge	Yes	No		
	Because of work	Yes	No		
	Requirement of the University	Yes	No		
	Other	Yes	No		

NOTES/БЕЛЕЖКИ

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