Abstract

We look at the problem connected with the phenomenon of English becoming a medium of teaching other subjects in universities all over the world. We show that the foreign language can result in significant difficulties if a student has a low level of English, which is often the case in many non-English speaking countries. The purpose of the present work was to set up the basic principles of successful preparation of students to their further studies in English and design an ESP course for science students aimed at helping them to integrate into the international academic community. The task required target situation and curriculum analyses, detailed description of students’ needs, materials selection and a syllabus design. The methodology applied is based on an adjunct Content and Language Integrated (CLIL) model where language teaching runs parallel to the content so that to develop the ability to achieve higher-order thinking. The work resulted in an ESP course for mathematicians with a special emphasis on calculus. We share practical examples of assignments and demonstrate how the approach increases efficiency in learning English and helps develop and improve student academic skills. The experience, however, can be easily extended to students of any specialization.

Keywords: ESP course; EMI; CLIL; higher-order thinking; English for mathematicians.

1. Introduction

Internationalisation and competitiveness of higher education, rapid increase of academic mobility, attempts of creating a bilingual environment, raising number of foreign students and global competition among higher education
institutions led to the fact that English is becoming a medium of instruction in many universities all over the world. It means we are now living through the era of global shift from English being taught as a foreign language along with many other subjects, as one of them, to English becoming a priority language for teaching academic courses. The phenomenon is growing so rapidly that it requires a change in creating and developing professional development programmes for university teachers and lecturers as well as English courses aimed at helping students to adapt to the new situation.

1.1. What is EMI?

What is the working definition of English medium instruction (EMI)? The British Council defines it as “the use of the English language to teach academic subjects in countries or jurisdictions where the first language (L1) of the majority of the population is not English”. A study of the phenomenon was conducted in 2013-2014 and information on 55 countries was obtained (Dearden, 2014). The main findings of the study are that the general trend is towards a rapid expansion of EMI, that the attitude of the local population to the phenomenon is very controversial and that this trend may limit in some sense access to higher education for lower socio-economic groups or the first language or national identity will be undermined. In the present paper we are not going to discuss positive or negative aspects of the phenomenon, we just take it as a real fact we face with. In this sense we have to admit that the most difficult thing about it is, on the one hand, a shortage of linguistically qualified teachers and little or no EMI content in initial teacher education (teacher preparation) programmes and in-service courses. On the other hand, teaching subject in a foreign language can become a serious handicap for students, if they have a low level of English, which is often a case in many non-speaking English countries including Russia. In some countries (for example, Turkey) there is an intermediate year of English (between secondary and tertiary education) aimed at preparing students to learn their academic subjects through EMI. The question is how effective this year in preparing students and how to make English programmes effective in enhancing student performance in EMI content learning. Nevertheless, it is one of the possible solutions and measures are being undertaken. In other countries (for example, Russia) there are no preparatory classes for students and this creates significant difficulties for the students with low level of English since they are not able to perceive the information, make notes and/or respond in English even though they reveal strong knowledge of the subject in their native language. In such cases all what we can do is to provide the students intensive support and adopt the programmes so to help our students feel comfortable and avoid stress while overcoming difficulties with the foreign language.

1.2. Benefits of CLIL

In its turn it means we are crying for a new teaching technology, implementation of which would guaranty the success. Here we come to CLIL. CLIL stands for Content and Language Integrated Learning where curriculum subject is taught in non-native language, often English, with the emphasis depending on a situation (Coyle et al., 2010). CLIL requires the teacher not let the language teaching take over, but to use effective teaching practice together with introduction of key language items at relevant moments. It emerged from curriculum innovations in Finland in the mid-1990s and it has been adopted in many countries mostly in secondary school education.

However, teaching in this way is challenging (in terms of planning and preparation, class monitoring, etc.) and requires highly professional staff. It becomes even more complicated if we deal with tertiary education in non-speaking English countries especially in such fields as physics or mathematics or any other branch of science. At the same time the advantages of CLIL implementation in a classroom are obvious: integration of learning and thinking skills gives learners absolutely different experience in comparison with traditional ways of teaching English.

1.3. Constructing an ESP course

Taking all of the aforesaid into account we developed a course of English for Specific Purposes (ESP) for mathematicians “English Journey to the World of Maths. Calculus” (Vavelyuk, 2015). We based on elements of an adjunct CLIL model (Coyle et al., 2010) where language teaching runs parallel to content teaching with a specific focus on developing knowledge and skills to use the language so as to achieve higher-order thinking. Our model,
however, implies that the English course compliments stage-by-stage main higher education curriculum and can be performed by language teachers without their embedding into mathematical departments (as it is always the case with CLIL).

The main objectives of the course development were: to prepare our students for further studies, for internationalization, especially EU integration; to enhance the university profile; to improve overall and specific language competence; to develop multilingual interests and attitudes; to introduce our students to a wider cultural context.

The task required target situation and curriculum analyses, detail description of student needs, materials selection and syllabus design and resulted in ESP course with a specific focus on calculus.

2. Integrating subject content into English classroom

2.1. Content-obligatory language

In CLIL approach teachers as well as their learners require knowledge of the content-obligatory language. The term includes the subject specific vocabulary, grammatical structures and functional expressions needed for gaining knowledge of a curricular subject and communicating ideas (Bentley, 2010). Proper defined content-obligatory language helps develop linguistic abilities of students. To build up a corpus for mathematicians we had to analyse written and oral texts drawn from real lectures and seminars on calculus and to record language of interaction in native-language classes on the subject. We also interviewed lecturers in maths department.

Developing language through use is challenging: functional and notional levels of difficulty should prevail over grammatical levels of difficulty. For example, to operate successfully a science student should be able to describe a laboratory experiment or write a report (Vavelyuk, 2012). It may require learning of past tenses before present tenses. Conditionals are often the case in description of mathematical statements. There are also cases when specific grammar is required, therefore, teachers should be ready to change the traditional approach towards content demands. Thus, we based in the developing of course on the premise that the aim of learning language can be achieved through using necessary for the future carrier material rather than having to learn paradigms of verbs conjugated in the tense needed.

2.2. Content-based language activities

The course consists of 17 units; each of the units includes 7 parts aimed at development of all four language skills: reading, speaking, listening and writing. The content of the course exactly corresponds to the structure of the course of calculus: it starts with the short history of maths and birth of calculus; then, it describes the differentiation and integration notions; introduces limits and complex numbers; deals with multivariable calculus; pays attention on differential equations and, finally, discusses the applications of calculus in real life. Such order of the material is familiar to the students and it makes them feel free, comfortable and experience no stress being accustomed to the topics of the course book.

Each unit begins with an epigraph related to the topic. For example, the very first unit opens with a quotation of mathematician Ian Stewart: “Numbers seem very simple and straightforward, but appearances are deceptive” (Stewart, 2008). It is an open exercise: the students are welcome to express their own opinion about the phrase, agree or disagree with it or just explain what the author meant to say. This kind of activity depends on the initial level of the group, their openness and allows the teacher to tune the group for further work.

The first thing a teacher should do at the beginning of a class is a warm-up activity aimed at finding out what learners already know about the topic and what they know about the language of the topic (Dale & Tanner, 2012). For instance, the warming-up can be as follows. A teacher asks the students:
- Think of a number from 1 to 9.
- Multiply it by 9.
- If you have a two-digit number, add the digits together.
- Take away 5.
- Multiply the number by itself.
- The answer is 16.
Can you explain how it works?

Since we deal with mathematically minded students, even if their level of English is not too high, they are eager to demonstrate that they are good at maths, they know the answer and they try to explain the puzzle. They correct themselves and their classmates while giving explanation and try to make it as clear as they can. Mind maps, asking questions using visuals and demonstration of experiments which the students are supposed to explain are good instruments for triggering students’ activity at the very start.

To help learners remember a new vocabulary we developed learning activities that also proliferate teachers’ ideas. For example, we asked our students to give a definition of calculus with filling in gaps exercise, the words were given:

The ______ of calculus was one of the great turning______ in the history of mathematics. It ______ problems that had taxed mathematicians for 2,000 years and opened______ that no one even knew existed before.

Calculus ______ a way of measuring ______ of change and the effect of change. (‘Calculus’ is the ______ name for a small stone used for _______.) It is ______ two parts which are the inverse of each other: differentiation and _______. The fundamental ______ of calculus is that applying ______ to an integral returns the original expression, and vice versa.

Both are essentially methods of ______, but aim to use _____ that make the error involved (the inaccuracy of the approximation) tend towards zero.

To improve speaking skills of students we tried to make tasks very clear and easy to understand, encourage students to speak and to reward them for their attempts to speak English. We widely used activities on information gaps that make students to communicate, pair and group work. Fig.1 demonstrates an example of communication activity with the focus on subject content.

![Fig. 1. An example of communicative activity with a focus on subject content.](image)

For reading tasks we tried to use visuals: tables, pictures, charts. It is a great way to bring a dense mathematical text alive and stimulate students to participate actively in the class. We prefer texts that are clearly organized and well illustrated; it is also important to have texts that repeat the same information in different ways. All the texts in the course book are authentic and are extracts from the original textbooks on calculus. This fact also motivates students and challenges them giving the opportunity to compare their knowledge on subject with that of native speaker counterparts.

The techniques used for texts were quite standard: pre, while and post task activities. For example, to take key dates from the text on history of calculus and put them on a time line, to complete a table, to read the text and give a title to
each paragraph, to complete the text with the sentences given or summarize the content of the text. Fig.2 shows the example of comprehensive task after reading the text “Machines for maths”.

![Fig.2. An example of post reading activity.](image)

As we have mentioned, the activities of the course book include exercises aimed at developing all four skills. For listening activities we used actively BBC podcasts, Coursera lectures on calculus, video, songs and poems. Listening activities of the course also include pre-listening, while listening and post-listening activities.

Writing activities always included a real purpose: to write a letter to a friend summarizing your knowledge on history on mathematics, to give an opinion whether it is really important to be first in science, or to describe a biography of a mathematician you like most and so on. This work also gives an idea of different genres (Swales, 1990).

The course book also includes activities on translation since we consider them to be vital for the ESP studies. Unfortunately, this part of ELT is often neglected in favour of “nativeness”. However, we should not forget that we live in our native language environment, we think in our native language and, thus, we have to be able to make connections between our native language and English. Duff states: “Translation happens everywhere, all the time, why not in the classroom” (Duff, 1989, p.6). Indeed it can be considered as a kind of a communicative act between languages and cultures. Properly designed translation activities can enhance both productive and receptive skills, develop accuracy, clarity and flexibility (Duff, 1989). This topic is of great importance and certainly deserves a separate discussion.

3. Conclusions

In the modern world the factors that define real knowledge of English language are certainly not certificate availability that you passed a test or completed an English course. We have to admit that present situation led to the fact that English for most people is just a skill to fulfill different purposes. The most important of that is how successful a professional is at solving his/her professional tasks. Nowadays it is just an instrument, especially if we speak about English for specific purposes. Therefore, the teacher’s mission is to help their students to acquire the skill, to manage with the instrument as efficient as they can.

In Russian universities we often deal with a situation when a cognitive level of science students is far in advance of their linguistic level even in their mother tongue. Besides, even if these students strongly believe that learning English is important for their future, their present priorities and their time are mostly devoted to focusing their intellectual efforts on science, not on language. This situation is challenging for English teachers who sometimes find difficult to develop, create and adapt appropriate learning materials for teaching such students. Thus, the way of teaching ESP courses which would reflect real knowledge in their native language would be very much of help: a level of talks, meaningful interaction, and positive attitudes of learners show undeniable advantages of such an approach.

References

Bentley, K. (2010). *The TKT course: CLIL module*. Cambridge: Cambridge University Press.
Coyle, D., Hood, P., & Marsh, D. (2010). *Content and language integrated learning*. Cambridge: Cambridge University Press.
Olga Vavelyuk / Procedia - Social and Behavioral Sciences 199 (2015) 44 – 49

Dale, L. & Tanner, R. (2012). *CLIL activities: a resource for subject and language teachers*. Cambridge: Cambridge University Press.

Dearden, J. (2014). *English as a medium of instruction – a growing global phenomenon (Interim Report)*. The British Council.

Duff, A. (1989). *Translation*. Oxford: Oxford University Press.

Stewart, J. (2008). *The story of mathematics from babylonian numerals to chaos theory*. London: Quercus.

Swales, J. (1990). *Genre analysis: English in academic and research settings*. Cambridge: Cambridge University Press.

Vavelyuk, O. (2012). "CLIL: Content-obligatory language for students of physics." *SPELTA Newsletter, 42*, 6.

Vavelyuk, O. (2014). "Implementing CLIL models into a classroom: Teaching English to students of physics." *Journal of Professional and Academic English, 43*, 18-24.

Vavelyuk, O. (2015). *English journey to the world of maths: Calculus*. Saint-Petersburg: Polytechnic University Press.