INNOVATION OF 'ENGLISH FOR MATHEMATICIANS' COURSES – CHALLENGES OF A SUBJECT-SPECIFIC APPROACH

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Abstract

This paper focuses on the creation and innovation of the course "English for Mathematicians". When processing teaching materials and introducing innovations, several problems emerge. The first is topic selection. Natural sciences comprise extensive knowledge; it is difficult to choose topics relating to the specialisms or interests of all students. Secondly, various levels of professional and language competence of individuals in class must also be taken into consideration. Thirdly, it is vital to assess the degree of authenticity of materials, and the possibility or necessity of their adjustment by language teachers. Students usually appreciate video lectures and conference papers for their expertise. However, these sources are not always suitable and applicable in language learning. Last but not least, a combination of skills-based and topic-based approaches, as well as problem-solving tasks, can keep students interested and motivated.

Introduction

A good characterization of an ESP teacher is given in the classic book by Tom Hutchinson and Allan Waters: "ESP teachers are all too often reluctant dwellers in a strange and uncharted land" [3, p. 158]). In my paper I would like to discuss the reasons for these feelings of alienation many of my colleagues and I experience when trying to design and teach ESP courses. As a result of many discussions we have had at our department of the Language Centre of Masaryk University at the Faculty of Science, sometimes we are not quite sure whether we are teaching, let us say, English for Biology, or Biology in English. Even if most of us would, hopefully, opt for the first possibility, the distinction is not quite clear in all cases. Since the purpose of an ESP course is to prepare students for their professional life, i.e. to develop their use of English in a specialized field of science, and enable them to use English as the main means of communication and cooperation with partners in their expert fields, the need for subject-specific materials reflecting study programs becomes self-evident. At our department, we cater for the needs of a wide range of students of scientific subjects – biology, geology, geography, chemistry, mathematics, and physics. As our teachers prepare courses for two different levels, and sometimes even for two different subjects, the difficulties of the task are clearly manifest.

1 Difficulties ESP teachers face

1.1 Lack of expertise

The main obstacle for teachers is insufficient expertise in a specialist field. Even if some teachers are exceptions, having studied language and a scientific subject at college, the majority of them are still linguistics majors combined with a humanities discipline. Hutchinson and Waters claim that ESP teachers do not need to master specialist subject knowledge. In their opinion only three things are required: 1) a positive attitude towards the ESP content, 2) a knowledge of the fundamental principles of the subject area, and 3) an awareness of how much they probably already know. They conclude that "the ESP teacher

should not become a teacher of the subject matter, but rather an interested student of the subject matter" [3, p. 163].

However, other sources mention additional requirements for teachers, such as "the need to feel confident about subject knowledge and subject skills related to that subject", and "be prepared to answer learner's questions about subject material which may be unfamiliar to them" [1, p. 6].

I believe that a positive attitude and enthusiasm are necessary, but teachers may still need to overcome their natural fears related to the complexity of scientific disciplines. Moreover, for highly abstract disciplines like mathematics and physics, fundamental principles alone would not suffice, as they require a deeper understanding of their methodology as well. To complicate matters even more, as I discovered during my ESP lessons and when evaluating the course questionnaires, specialist knowledge is what students expect. Of course, I always state openly at the beginning of our course that I am not a specialist and would need and appreciate their help and understanding. Still, many of them think that language teachers should be experts in a scientific subject as well. To illustrate this point I quote two reactions from students gathered in an anonymous survey conducted by Masaryk University evaluating individual teachers and courses – these reactions concern only courses I taught and prepared – see Table 1.

Tab. 1: *Answers of students in a survey evaluating individual teachers and courses*

	Autumn term 2012 course English for Mathematicians JAM01	**Spring term 2010 course English for Mathematicians JAM03**
Original version in Czech	Angličtinu pro matematiky by měl učit někdo, kdo dané problematice rozumí. Nepochybuji o jazykových schopnostech Mgr. Čoupkové, ale sama přiznala, že té matematické části plně nerozumí.	Bylo by vhodné, aby tento předmět učil někdo, kdo něco ví o matematice (alespoň základy), popřípadě matematická témata měla být vybrána tak, aby jim rozuměli všichni.
My translation into English	English for Mathematicians should be taught by someone who understands the subject and its problems. I do not doubt the language abilities of Mgr. Čoupková, but she herself admitted she did not fully understand the mathematical part of the course.	This course should be taught by someone who knows something about mathematics (at least the basics), and the mathematical topics should be chosen so that everybody in the group is able to understand them.

Source: Information System of Masaryk University

It is true that as teachers prepare and adapt materials related to the specific scientific disciplines, they learn along the way and may become learned practitioners in the field. However, this knowledge is still quite limited and not sufficient to protect the teacher from being seen by students as unprepared and incompetent, and sometimes even ridiculous. So, where can ESP teachers look for help?

One obvious answer would be cooperation with a teacher of the subject [2, p. 4]. Developing a project based on collaboration of the language teacher and the subject teacher would have its merits, but there are also obstacles to overcome. The main one is, at least at our university, a lack of funding and interest on the part of subject teachers. Even if the faculty policy requires subject-specific content of language seminars, there is no subject-specific support for ESP teachers.

We tried to solve this problem by creating a course combining both subject and language. So far we have discovered that it may be quite challenging to find a common point of reference between a subject teacher and a language teacher. We started a collaborative project at our department aimed at addressing one scientific topic from different angles – as scientists (specialists) in their fields – and language teachers. Even if we are still at the beginning, the grounds for disputes are quite obvious: for specialists, the content of the learning process is of the prime importance, and they are sometimes unwilling to include communicative and language aspects as well. Language teachers, on the other hand, lack adequate knowledge of the content, and concentrate instead on grammar structures or syntax, which some of the specialists may find insubstantial.

Some of my colleagues try to bridge this gap by engaging in life-long learning programs provided by individual departments, or they even become full-time students of the specialist subject. Others, like me, rely on the help of friends and family members, my husband being a mathematician willing to give me advice. Still, I find this quite demanding – even if life-long learning is an essential component of the professional development and dedication of any university teacher, trying to master a subject completely different from their own is perhaps too much to expect.

Many writers dealing with ESP recommend taking a learner-centred approach which relies on students' knowledge of their disciplines and leaves a large amount of expertise to them [4, pp. 63-101].

Even if we are trying in our country to adopt this learner-oriented approach in our whole education system, I believe that most students are still used to seeing their teachers as the main source of information; they do not question their competence. Moreover, our undergraduate ESP courses are mainly designed for the first and second year students whose familiarity with their subject may still be insufficient. On the other hand, this can be seen as an advantage as well, because if students can learn something new about their subject in a language course, they will feel motivated and be more interested.

1.2 Selecting course topics

As the number of textbooks and resource books is quite limited, especially those dealing with scientific disciplines, ESP teachers will need to design and develop their own materials for the course. The first challenge facing them is what to include or concentrate on.

A much recommended beginning is the needs analysis. But if you ask students at the beginning of the first term - before they start their B1 level course, i.e. immediately after they have completed their secondary education - what they would like to do, most of them say practice grammar or discuss general topics, since that is what they have done so far. They have generally a very vague idea of what they need in so far as their professional English and university environment are concerned. The situation is much better with the advanced students attending a B2 level course because they are normally undergraduate students who have spent two to three years at university, possibly participated in some Erasmus programmes, and understand their needs much better. Then it is useful to ask them, through a questionnaire or other means, what their interests are and what they would like to do.

However, the teacher remains the person responsible for designing learning activities and materials.

When thinking about what specialist knowledge students need and appreciate, it is important to consider what they already know. To discover this, we might go through their subject syllabus and see the topics they deal with. The main problem here is that, in our courses, we have students from different study groups and levels. So, in one of my mathematical groups, there can be the first, second or even third year students, and students of pure mathematics, applied mathematics, financial mathematics, statistics, mathematical modelling or teachers of mathematics. These students have different background knowledge and different needs, yet they all attend the same class. It may happen that students learning ESP in their first semester do not have adequate specialist knowledge, since the topics discussed in their ESP classes precede the topics they consider in their specific fields. On the other hand, students of more advanced levels find some materials too easy, insubstantial, or difficult to recall from their previous studies. Sometimes, more advanced students may be willing to help the teacher and younger students to explain advanced problems, which can improve the learning process. However, in cases different from these ideal ones, advanced students can be just bored and feel they are learning very little. That is why choosing specialist topics which everybody in the group understands and is interested in, as the second respondent in the survey above demanded, is a very complex task.

I tried to address this issue by introducing problems that are, in my view, not too narrowly specialized and understandable for all students. Generally, I try to cover all branches of the field, i.e. for mathematicians I include several topics in algebra, geometry, applied mathematics, statistics and so on, so that hopefully there is at least some material each student can enjoy. What I find useful is to ask students during their first lessons what they like about their specialist field, and what their favourite topics are. For advanced students, I often use problems they discuss in their presentations, both in class and exams, since these are by definition more general and supposed to be clear to most of them. What is always beneficial is to follow recent developments in their disciplines and try to include some of the latest discoveries – in mathematics it can be new proofs of theorems, etc. I also recommend that more advanced students attend advanced courses and skip the initial ones, which is also an option since our courses are voluntary and do not have to be taken in a specific order.

1.3 Designing course materials – reading and listening

This area comprises a concrete text selection and the decision on its adaptation and the creation of learning activities. Here it is possible to refer back to the lack of expertise as being the first difficulty mentioned, since for ESP teachers who are not specialists in the professional fields it can be difficult to decide how to abridge or adapt texts without altering their meaning or omitting substantial information or terminology. Similarly, as Jurate Helsvig points out, if they are not able to understand the content of the text, it is impossible for them to design meaningful activities [2, p. 1].

To provide materials for the first language competence - reading - a decision must be made about the texts. Generally, if they are too difficult, the students may lack sufficient professional knowledge to deal with them and they feel embarrassed; on the other hand, if they are too simple or too popular, students tend to disregard their content as well as language.

So I believe the text should pose questions and involve the professional knowledge of students, but it should not intimidate them. If they feel professionally motivated, they are also ready to concentrate on the language aspects of the texts. Moreover, both teachers and

students should bear in mind that "in the real world people learn language and content simultaneously" [2, p. 3], so there is no need to separate the two areas in an ESP classroom. Where to look for suitable texts? It is possible to use specialized mathematical websites or subject-specific textbooks, while for the discussion and definition of mathematical terms various dictionaries of mathematics can help.

For listening exercises, teachers can use video lectures, for example those offered by MIT, which provide excellent and authentic learning materials – they are also supplemented by a transcript. These are very motivating for the students since they resemble their learning experienced in their lectures delivered in Czech. However, it is not always easy to adapt them, as they are full-fledged lectures given by experts in their fields. Difficulties for the language teacher stem from the form itself. Since most of the lectures are approximately 1 hour long, and it is feasible to use only 5 – 10-minute sections in a language lesson, choosing just one short part of a lecture containing sufficient and meaningful information is far from straightforward. Moreover, lecturers often refer to previously discussed problems and employ specific terms, or sometimes only their abbreviations, which may be difficult to understand even for experts who are familiar with English field-specific terminology. Also, even if the mathematical language is universal, there may be some national conceptual differences. Some terms are used only in English and have no Czech equivalents, e.g. "jointly proportional" or "joint variation". Jarmila Novotná and Marie Hofmannová, on the other hand, mention examples of Czech terms which are not used in English, e.g. "central symmetry" [5, p. 228]. That is why term and concept analysis is necessary when preparing materials in the specific mathematical area. Last but not least, since these are lectures, to use them in every lesson may become boring and repetitive. That is why it is advisable to prepare, at least sometimes, less professional but more amusing materials – a good choice would be, for example, the excellent popular BBC Four series entitled *The Story of Maths*, which outlines aspects of the history of mathematics, and discusses why mathematics is important at present; or the YouTube site *Numberphile*, which explores various mathematical topics in a humorous and interesting way.

1.4 Deciding on learning processes and activities – speaking

There are several activities I go through when discussing specialist topics in my courses. The first step is to find out what the students already know. To do this, I include pre-reading or pre-listening exercises to warm up the students and direct their attention to the problem we are about to deal with. These tasks may be just answering questions about the problem, suggesting keywords, predicting concepts discussed in the text, or trying to outline language structures present in the text. Alternately, they can try to explain the meaning of the terms used in the material. They work in pairs or groups so that they can develop their communication skills in the area of professional English.

Then I continue with listening or reading activities. Students start with listening or reading for general information, looking for the main idea of the text, or answering general questions. After that they concentrate on more specific information or data, such as interpreting graphs, describing processes, explaining results or comparing methods.

Students of scientific subjects generally like problem-solving tasks since this type of activity is professionally oriented and similar to what they normally do in their specialist courses. Hence, if the topic permits it, I often think of real problems related to it, like making a similar computation using slightly different input, creating a new graph which interprets the given data in another way, solving puzzles, etc. What is important from the language perspective is to ask students to explain their methods or steps in English because in that way they can practice and use new vocabulary and phrases related to the topic.

I conclude with a final discussion in which I ask students whether they have learned something new in terms of the specialist field itself or its terminology, or whether their pre-conceptions concerning the topic have changed. A good speaking task is to try to explain the problem to a non-specialist, which shows students how to simplify the matter and concentrate on the most important aspects, or, in a broader sense, how to popularise science for the general public.

Conclusion

In conclusion I would like to summarize the most important points.

1) The ESP teacher does not have to be a specialist in the field, but sufficient knowledge of the topic is essential. It is advisable to ask students what their interests in their fields are, and ask them for help where appropriate, but the person responsible for designing materials and teaching is the ESP teacher. Moreover, the subject learning and language learning are intertwined; it is impossible to separate them.
2) When selecting topics for an ESP course, it is convenient to try to consider the knowledge of students, their professional interests and needs, and relevance for their future careers. In mixed classes the topics should cover all fields or branches, and also include current developments in the field.
3) Texts for reading, as well as listening materials, should be interesting, authentic, and professionally motivating. However, it is not always possible to change or adapt all of them to suit the needs of the language classroom.
4) It is advisable to use a mixture of skills-based and topic-based approaches that may activate students' professional knowledge, and enhance their language competence. Problem-solving tasks are especially important, since they enable students to use their specialist and communication skills in English.

Literature

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INOVACE PŘEDMĚTŮ ‚ANGLIČTINA PRO MATEMATIKY'

Příspěvek se zabývá vytvářením a inovací kurzu Angličtina pro matematiky JAM03-04. Při tvorbě výukových materiálů i jejich inovací se setkáváme s několika problémy. Prvním je výběr témat ve vztahu k odborné specializaci studentů. Přírodovědné obory jsou velmi rozsáhlé, je proto obtížné vybrat témata, která by se týkala studijního zaměření a zájmů všech studentů. Dále je třeba vzít v úvahu rozdílné znalosti studentů, týkající se jak jejich odbornosti, tak i jazykových kompetencí. Ve stávajících podmínkách není bohužel možné utvořit homogenní studijní skupiny, které by byly odborně i jazykově rovnocenné. V neposlední řadě je třeba posoudit míru autenticity používaných materiálů a nutnost nebo možnost zásahů a úprav na straně učitele jazyka. Studenti obvykle oceňují zařazení video přednášek a konferenčních článků pro jejich vysokou odbornost. Na druhé straně však nejsou tyto zdroje vždy vhodné a uplatnitelné v jazykové výuce.

INNOVATION DES KURSES ‚ENGLISCH FÜR MATHEMATIKER'

Dieser Beitrag beschäftigt sich mit der Planung und Innovation des Kurses Englisch für Mathematiker JAM03-04. Bei der Erstellung der Lehrmaterialien und der Einführung von Innovationen entstehen die einige Probleme. Das erste besteht in der Auswahl der Themen. Die Naturwissenschaften setzen große Kenntnisse voraus. Es ist daher schwierig, Themen zu wählen, welche die speziellen Interessen aller Studenten befriedigen. Außerdem muss man auch unterschiedliche Niveaus von Fach- und Sprachkompetenz in Betracht ziehen. Unter den gegebenen Umständen ist es unmöglich, homogene Studiengruppen zusammenzustellen, in denen alle Studenten über den gleichen oder zumindest einen ähnlichen Kenntnisstand verfügen. Schließlich und endlich ist es ebenfalls vonnöten, das Maß der Authentizität der verwendeten Materialien und die Notwendigkeit bzw. Möglichkeit eines Eingriffs von Seiten des Dozenten zu beurteilen. Die Studenten begrüßen in der Regel die Verwendung von Videos und Konferenzartikeln wegen deren hoher Fachlichkeit. Auf der anderen Seite erweisen sich diese Quellen nicht immer als geeignet und anwendbar für den Sprachunterricht.

INNOWACYJNOŚĆ PRZEDMIOTÓW 'ANGIELSKI DLA MATEMATYKÓW'

Niniejszy artykuł poświęcony jest tworzeniu i wprowadzaniu innowacji do kursu pn. Angielski dla matematyków JAM 03-04. W procesie opracowywania materiałów dydaktycznych i wprowadzania do nich elementów innowacyjnych napotykamy na kilka problemów. Pierwszym jest dobór tematów odnoszących się do specjalizacji merytorycznej studentów. Kierunki przyrodnicze są bardzo obszerne, dlatego trudno jest wybrać tematy, które wpisywałyby się w kierunek studiów i zainteresowania wszystkich studentów. Ponadto należy uwzględnić różny poziom wiedzy studentów, w zakresie zarówno ich umiejętności, jak i kompetencji językowych. Niestety w obecnych warunkach nie jest możliwe stworzenie homogenicznych grup studiujących, które byłyby równowartościowe pod względem merytorycznym i językowym. Ponadto należy ocenić stopień autentyczności stosowanych materiałów oraz konieczność lub możliwość ingerencji lub zmian wprowadzanych przez nauczyciela języka. Studenci zazwyczaj doceniają wprowadzenie wykładów wideo oraz artykułów konferencyjnych ze względu na ich wysoki poziom merytoryczny. Z drugiej strony jednak, takie źródła nie są w każdym przypadku właściwe i możliwe do wykorzystywania w nauczaniu języka.