YouTube English video lectures as a basis of CLIL classes for students of mathematics

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Abstract. The nowadays educational system has to adapt to the ever-changing society demands to provide it with graduates possessing high level of general knowledge, analytical thinking and creativity as well as specialized competences. With strict time limits set for academic courses, an apparent way to a more compact material presentation and practicing lies in the transdisciplinary approach. As far as a foreign language at a technical university is concerned, it can be effectively studied within an integrated course, combined with one of the core subjects in the form of CLIL classes, which would be beneficial for both disciplines. This paper presents the results of experimental teaching English to students of applied mathematics based on authentic YouTube video lectures in mathematics, demonstrating the rich potential of CLIL format for tertiary courses.

1. Introduction
Technical universities have traditionally been considered generators of innovations in science and technology. Their graduate, a contemporary engineer, must be able to demonstrate competences in a wide scope of professional issues, to create and develop complex products, methods and techniques, to swiftly adapt to a fast-changing information environment giving intelligent attention to the whole range of data, to find effective solutions to various problems – in other words to be competitive within the international scientific and business community. In the present-day society, where most of routine work has already been automated, the greatest demand that is placed on a person is one for creativity, non-standard thinking and ability to find new approaches to problems. With more and more equipment in all areas of the economy, the value of the machine-made product is constantly decreasing, thus increasing the value of the intellectual product. The central role in this process belongs to an engineer, who combines such qualities as high intelligence, analytical capabilities, well-developed abstract thinking, good memory and concentration.

Designing new products quickly and efficiently presupposes the practical skills of obtaining data from the whole scientific community. Since at present, English is the language of most academic conferences and papers, mastering it has become an important part of the professional training of the engineer and researcher, as a means of not only exchanging information, but of professional development and future career. What is more, participating in numerous international projects also requires good knowledge of English and communicative skills.

However, the traditional Russian educational system for teaching foreign languages to would-be-engineers has lately proved unable to meet those challenges, which necessitates its adaptation and
improvement. It is also worth mentioning that the ever-growing amount of information that students have to be given during their professional training comes into conflict with the time allocated for it. This brings forward the idea of combining different areas of knowledge within the framework of one academic course. As the borders between disciplines are becoming more and more vague, transdisciplinary approach at schools and universities naturally suggests itself. In a technical university, it seems that its most natural application is to weave a language study into the set of major courses, shifting from the aim of acquiring primarily language to that of simultaneous professional development.

2. Methods

While ESP (English for Specific Purposes) courses have been taught for centuries, one of their principal features is that they do not imply novelty of professional content. Yet the communicative approach to language teaching and learning requires focusing on the message and making the foreign language a vehicle for getting that message across rather than the aim of studying, which brings forward CLIL as the most adequate and efficient technology to meet the present-day demands. CLIL is an acronym for Content and Language Integrated Learning. It is an approach to teaching the content of curricular subjects through the medium of a non-native language. In a CLIL course, learners gain knowledge and understanding of the curricular subject while simultaneously learning and using the target language [1]. CLIL is known as an umbrella term for a large scope of methodologies directed at learning a subject content via the means of a foreign language. Within this frame, there is a shift from the language acquisition to cognitive and communicative skills. Most researchers believe it to be based on the 4Cs, which are understood as ‘Content, Cognition, Communication, Culture’ [2]. There is, however, a different list, comprising ‘Creativity, Critical Thinking, Communication, Collaboration’, which are considered key competences for 21-st century learners [3]. This makes CLIL especially favourable, as it enables the teacher to compose their own set of objectives depending on both the subject and class. As for learners, they are also enthused by the experience of using English for real professional needs and better motivated for making academic progress.

Originally, this approach was employed in Europe in teaching secondary school students. In Russia, however, school curricula do not usually leave room for combining a foreign language study with any other subject as students are taught general English with the focus on everyday topics, and CLIL has found its wider application at the tertiary level, mostly in teaching students of law and economics [4]. There was a certain period when a similar methodology, applied in the form of binary classes with two different subject teachers collaborating, was quite popular at Russian educational institutions [5]. As it is now, there are some stimulating and well-balanced CLIL courses developed by particular teachers and departments, but they belong to the area of teaching experiments and can hardly be taken up by the teaching community at large [6].

This situation may be explained by a number of reasons. While most subject teachers do not feel confident about their English language level, most language teachers do not know how to explain scientific concepts and are not prepared to answer questions about them. As a result, CLIL courses require considerable organizational support from the college or university governmental body [7], which is unfortunately not often found; for teachers they are very time-consuming at the stage of preparing materials; close collaboration between departments becomes absolutely necessary. Therefore, an ideal situation for employing CLIL is where a teacher is an expert in both the subject-matter and language areas, but this, of course, is an extremely rare case [8].

At the same time, the course may present certain challenges for learners as well, since they may take longer to understand subject concepts and communicate ideas about them in a foreign language. It should be mentioned that in most technical universities a foreign language course is taught in the first and second year with a very limited number of classroom hours, while in September of their first year, students do not often demonstrate a level of language knowledge higher than A2, which is obviously inadequate for a professional language course. Moreover, compared to secondary school courses, the university courses, in mathematics in particular, demand a much higher level of abstract thinking and this often leads to students experiencing problems with understanding subject concepts and
communicating ideas about them even in their mother tongue, let alone in a foreign language [9]. Therefore while a CLIL course may be really helpful in developing students’ specialized competences, they obviously need essential scaffolding to achieve good results and make progress. So, the objectives of finding out, understanding, analyzing and classifying students’ difficulties become of primary importance, which inspired our experimental teaching.

3. Results
The CLIL experimental teaching was organized by the Department of Foreign Languages of St. Petersburg State Marine Technical University, Russia. Traditionally with us, the course of English begins with general language topics, such as the structure and history of the university and Russian higher education as a whole, then switching into the students’ professional area. As the language course at our university is, unfortunately, rather short (2 terms of 72 classroom hours each), a decision was made to start introducing professionally-oriented materials as early as may be. Therefore we needed to find out how well the students were prepared for them and estimate their potential difficulties. The chosen group numbered 23 first-year students majoring in applied mathematics and the experimental teaching period lasted 24 classroom hours. In our case, the Department member who conducted the classes holds a degree in both English and mathematics. The teaching was based on the authentic video series *Introduction to Higher Mathematics* [10]. Each class started with some preliminary vocabulary work to improve the comprehension of the coming video lecture. The video material was presented to the students in sections (approximately 5-7 minutes each) followed by different types of tasks, the choice of which depended on the scientific complexity of the content. The final task for the students was to act the role of a teacher and give the same lecture at the board.

On completing the course the students were invited to share their feelings about the choice of material and their achievements. The questions and summary of the students’ answers are presented below.

Table 1. The Questionnaire.

1. Did the course seem to you easier or harder than working with traditional general English material?

|          |            |
|----------|------------|
| harder   | 35%        |
| easier   | 4%         |
| the same level of difficulty | 61%        |

2. What challenges did you have to meet while listening to the video lectures?

|                     |        |
|---------------------|--------|
| high speaking rate  | 39%    |
| too much unknown vocabulary | 57%    |
| the complexity of the material content | 9%     |
| the speaker’s articulation | 17%    |
| the excessive length of some parts presented | 26%    |

3. Was the *Pre-viewing* vocabulary practice useful? Did you recognize these words when watching?

|      |    |
|------|----|
| yes  | 74%|
| not much | 17%|
| no   | 4% |

4. Did you watch the video lectures on your own? If so, how many times?

|      |    |
|------|----|
| once | 57%|
| twice | 22%|
| thrice | 4%  |
| no   | 17%|

5. What caused difficulties when making an oral presentation of the material?
The figures listed above suggest that most students are quite comfortable with professional topics in English (question 1); however, it is necessary to devote much attention to preliminary vocabulary practice as this area turns out to really hinder comprehension as well as giving one’s own talk (questions 2 and 3). The students were enthused enough to watch the videos on their own thus aiming to improve their academic skills (question 4). In addition to vocabulary problems, the most serious problem proved to be that of the material logical structure for organizing one’s own talk (question 5), which along with the vocabulary practice should become a matter of special concern when preparing and conducting CLIL classes.

4. Discussions
The students’ difficulties and problems which were highlighted by the questionnaire are serious enough to need close attention on the part of the teacher at all stages of the work starting with the choice of material and strategy of presenting it in the classroom. Since our lucky situation of having a mathematics and English teacher in one person is a rare case, and generally CLIL classes can only be organized by two teachers working in close cooperation, it becomes necessary to set clear objectives for each of them. This is an approximate pattern that we suggest.

The mathematics teacher’s priorities would be to:

- make a decision about using a particular video for working with a particular group (according to the level of mathematical difficulty);
- analyse possible links to other topics and check to what extent the students are familiar with them;
- break the video into segments (as a rule, the videos found on YouTube last about 15-20 minutes, which is obviously too much for one language class);
- develop questions for the pre-viewing stage, so that the students could share their ideas on the topic;
- develop questions for checking understanding at the viewing stage;
- help the students to see the connections between the theoretical part and the examples, to transfer what has been learned from the examples onto the general case.

The language teacher’s priorities would be to:

- elicit the lexical units which may hinder understanding and introduce them at the pre-viewing stage (this has to be discussed with the mathematics teacher as he knows better what the topic will require);
- introduce the necessary grammar (it is unlikely that much work will be needed in this respect as most of the mathematical text is in the Present Simple Active or Passive with occasional additions of high grammar level structures, such as the Complex Subject);
- develop language exercises for each stage: pre-viewing, while-viewing, post-viewing (they may include key words, completing or restructuring paragraphs, making plans and diagrams of the material studied, etc.;
• finally comes speaking skills development as students take turns playing the lecturer either using freeze-frames from the video or just a marker and a whiteboard).

These results of the first step of our planned series of experimental teaching periods lead us to believe that this research can make the basis for designing a well-thought-out CLIL course for students of mathematics which could become available for wider educational applications.

5. Conclusion
The experimental teaching conducted has demonstrated that despite considerable difficulties presented by authentic video materials, even first-year students are able to effectively work with them when offered necessary support. They provide an educational medium different from conventional classes and additional motivation as students are naturally interested in their future work area and feel that CLIL classes give them a better understanding of it.

Thus we can conclude that employing video lectures in mathematics from YouTube opens new possibilities for widening the scope of instruction within the frame of would-be-mathematicians’ professional training. Firstly, there are plenty of them to choose from and most areas of mathematics can be introduced helping the students master their terminology in context. Secondly, they afford opportunities for analyzing the professional text structure (both in perceiving and reproducing it). Thirdly, they let the students realize differences in cultural conventions related to the subject-matter. Moreover, like all video materials in the target language, they offer extensive listening practice. Finally, they are of great use for preparing and giving a talk on a professional topic, which contributes to developing high-level academic skills.

References
[1] Teaching Science through English – a CLIL Approach. Cambridge English Language Assessment https://www.geo-clil.ugent.be/wp-content/uploads/2016/03/Teaching-Science-through-English-A-CLIL-Approach.pdf, last accessed 2020/10/12
[2] Coyle D, Hood Ph and Marsh D 2010 CLIL: Content and Language Integrated Learning (Cambridge, UK: Cambridge University Press) p 173
[3] The 4Cs: Creativity, Critical Thinking, Communication and Collaboration in Schools https://www.teacheracademy.eu/course/the-four-cs, last accessed 2020/10/12
[4] Ivanova T N 2017 Innovative ideas and approaches to integrating teaching of foreign languages and professionally-oriented subjects in high education Proc. Int. Methodological Training Conf. (St.Petersburg, Russia Polytechnic University Publishing) p 136-8
[5] Grigoryeva-Golubeva V A 2001 Humanistic values in education and the development of the teacher’s linguistic personality (St. Petersburg: State Marine Technical University Publishing)
[6] Popova N V, Kogan M S and Vdovina E K 2018 Content and Language Integrated Learning (CLIL) as actualization methodology of interdisciplinary links in technical university Tambov University Review. Series: Humanities 23(173) 29-42
[7] Khalyapina L P 2017 Interdisciplinary coordination in the system of professionally oriented foreign language teaching in higher education PNRPU Linguistics and Pedagogy Bulletin 2 149-57
[8] Krylov E G 2015 Bilingual Education in Engineering Disciplines and a Foreign Language at the University (Moscow, Izhevsk, Russia: Computer Sciences Institute Publ.)
[9] Silina E K and Surinova E A 2017 Integrated linguistic and professional training in view of the new knowledge paradigm Teaching methodology in Higher Education 6(20) 10-8
[10] Introduction to Higher Mathematics – Lecture 2: Introduction to Proofs https://www.youtube.com/watch?v=_x65OJU8Uq4, last accessed 2020/10/12