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FEATURES OF TEACHING HIGHER MATHEMATICS TO STUDENTS WHO ARE DOING THE COURSE IN A FOREIGN LANGUAGE

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Key words: *higher mathematics, foreign language, foreign language education, mathematical terms, communication, glossary.*

The article considers the features of teaching higher mathematics in a foreign language (non-native to students). The article notes that globalization in the field of international business and scientific cooperation, Ukrainian universities' integration into the international scientific and educational space result in training specialists to know the official languages of business and scientific communication, including English. Therefore, basic courses are taught in English at many universities. The authors cover issues related to teaching higher mathematics in English for Ukrainian-speaking students of engineering and technical specialities, as well as in Ukrainian for foreign students of medical and pharmacological specialities. The article highlights the main communicative problems of linguistics that arise when teaching students English: the correct perception of the form pronounced; translation of the form into its general meaning; use of terms-elements and narrowly specific expressions; formation of a lexical concept associated with a new lexeme. It also outlines the most common specific problems teachers of higher mathematics face when teaching English, such as students' low English language entry level, slow pace of teaching, lack of similar courses in a native language, differences in approaches to teaching higher mathematics in Ukraine and abroad, as well as possible ways to overcome these problems. The authors emphasize the urgency of appropriate methodological support for foreign language classes. Similar issues are covered for the case when the course of higher mathematics is taught in Ukrainian for foreign students. The authors, based on their personal experience, give recommendations for direct classes in higher mathematics in a foreign language. They show that these problems do not affect the quality of higher education provided the teacher has appropriate methodological qualifications. The article also draws attention to the benefits of learning English and the prospects that open up to students in this regard.

ОСОБЛИВОСТІ ВИКЛАДАННЯ ВИЩОЇ МАТЕМАТИКИ СТУДЕНТАМ, ЯКІ ОПАНОВУЮТЬ НАВЧАЛЬНУ ДИСЦИПЛІНУ ІНОЗЕМНОЮ МОВОЮ

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Ключові слова: *вища математика, іноземна мова, іншомовна освіта, математичні терміни, комунікація, глосарій.*

У статті розглянуто специфіку викладання вищої математики іноземною (не рідною для студентів) мовою. Зазначено, що глобалізація у сферах міжнародної ділової та наукової співпраці, інтегрування українських університетів в міжнародний науково-освітній простір призводять до необхідності підготовки фахівців, які володіють офіційною мовою спілкування в діловому та науковому світі, зокрема англійською. Із цією метою в багатьох університетах базові курси викладаються іноземною мовою. Автори висвітлюють питання, пов'язані з викладанням вищої математики англійською мовою для україномовних студентів інженерно-технічних спеціальностей, а також українською мовою для студентів – іноземних громадян медичних та фармацевтичних спеціальностей. Висвітлено основні комунікативні проблеми лінгвістики, які виникають під час навчання студентів англійською мовою: правильне сприйняття сказаної форми; переведення форми в загальне значення; застосування елементів-термінів та вузькоспецифічних виразів; формування лексичного поняття, асоційованого з новою лексемою. Сформульовано найпоширеніші конкретні проблеми, що постають перед викладачами курсу вищої математики під час викладання англійською, такі як низький вхідний рівень володіння англійською студентами, уповільнений темп викладання, відсутність аналогічного курсу рідною мовою, відмінності у підходах до викладання вищої математики в Україні та за кордоном, а також можливі шляхи подолання вказаних проблем. Підкреслено необхідність відповідного методичного забезпечення занять іноземною мовою. Аналогічні питання висвітлюються і для випадку, коли курс вищої математики викладається українською для іноземних студентів. Автори, спираючись на особистий досвід, дають рекомендації щодо безпосереднього проведення занять з вищої математики іноземною мовою. Показано, що зазначені проблеми не впливають на якість вищої освіти за умови належної методичної кваліфікації викладача. Звернено увагу на переваги навчання англійською та перспективи, які у зв'язку із цим відкриваються перед студентами.

Topicality. In the period of globalization growing and Ukrainian companies entering the world market, when English turns into the official language of business and scientific communication, English language teaching, in order to further integrate universities and their graduates into the international scientific and educational space, is becoming especially important. Engineering and medical fields are no exceptions. In this regard, it is important to train specialists who not only have modern knowledge (in engineering, medicine), but are also able to apply it in practical work in a globalized environment, including documentation and communication in English.

The **purpose** of this work is to highlight the features of teaching higher mathematics in English for Ukrainian-speaking students and in Ukrainian for foreign students, to formulate the most common, specific problems a teacher faces, as well as possible practical ways to overcome them.

In recent years, the National University "Zaporizhzhia Polytechnic" has been teaching a course of higher mathematics in English for Electrical Engineering students. At the same time, there is a need to solve communicative linguistic problems. It is a well-known fact that a necessary condition for any communicative act should be mutual understanding of the realities by interlocutors, those who speak and those who listen to, which is the basis of linguistic communication. This understanding is called background knowledge in linguistics. A word that reflects the object or a phenomenon (a reality) of a particular society, not only means it, but also creates some background associated with this word.

The experience of teaching mathematics in English shows that students, even at advanced stages of learning, make a significant number of mistakes, both when doing exercises and when using noun constructions in conversational practice. Improper use of constructions in a complex sentence leads to a violation of the logic of an expression and, as a consequence, failure to perform communication tasks. Another obstacle to solving the communicative linguistic problem is the correct perception of the spoken form (word, term, sentence, phrase, etc.), i. e. the perception of what is said by ear.

The next problem is to translate the form into a general meaning. It is important for a listener to know at least one, the most common, meaning of a word or a mathematical term that has been used by others. Therefore, when teaching the course in English (which is considered a means of studying mathematics as a science), it is important for a teacher to make it clear to students that they must perceive the mathematical context through the already acquired knowledge of mathematics in Ukrainian, as well as through the individual knowledge, skills, and abilities in English, and therefore, the teacher of mathematics has to convey as accurately as possible these or those meanings that a word or a term carries.

At the beginning of each lesson or before introducing a particularly complex material, we consider it important to pay more attention to the terms-elements, narrowly specific expressions. Terminological mathematical aspect is an integral part of math classes in English, as there is a growing need to pay special attention to the content of concepts and terms, the stage of acquired rules and formulas, in other words, to teach the essence of the phenomenon.

When studying mathematics in English, simultaneously with mastering each lexeme, students understand the lexical concept associated with it. Even if the lexeme is mastered and articulated correctly, it does not indicate that the formation of the lexical concept is completed. In the educational process, it should be borne in mind that the term is both a sign of reality and a unit of language. Therefore, non-equivalent and background vocabulary needs commenting, requires special attention of the teacher of mathematics. If we compare the two national cultures, we can conclude that they never coincide completely. This follows from the fact that each language consists of national and international elements, and for each culture, the number of these elements will be different. Since there is a parallel between language and culture, we should talk about national and international elements not only in cultures, but also in the languages that serve them. The teacher has to explain and clarify certain mathematical terms by switching to the Ukrainian language. In this regard, the teacher of mathematics must select language material that reflects the content of a new topic, definition or theorem.

One of the components of effective teaching is its connection with life, with other subjects. Mathematical problems with interdisciplinary content or of applied nature help to better reveal each topic. New teaching technologies promote involuntary memorization, develop interest not only in the subject, but also in the process of cognition, improve the quality of knowledge and the ability to acquire it. The connection between mathematics and English is obvious. Mathematical terms are precise and expressive, they most closely convey the meaning of what is said. One of the purposes of teaching mathematics in English is to increase interest in the origin of mathematical concepts, mathematics and other subjects, to demonstrate the connection of mathematics with life, with other subjects.

Thus, when teaching in English, the system of mastering mathematics involves using simultaneously mathematical terms in English, applying and manipulating them freely in the process of studying the subject. The teacher as

a methodologist must work constanty on testing students' mastery of mathematical terms in English and finding methods for learning English mathematics with its practical applications.

As for conducting classes in higher mathematics in a foreign language directly, its specificity in practice is as follows. First of all, such classes should be very dynamic, should be able to maintain the constant interest of the audience, which is much more difficult than when conducting similar classes in Ukrainian. Because English is not a native language for students, it is more difficult for them to focus on the material being taught.

The authors come to the conclusion that in practical classes all basic mathematical terms should be translated into Ukrainian. Thus, students learn mathematical terminology not only in English, but also in Ukrainian. At the beginning of each lesson, the topic is written on the board in English, and its interpretation into Ukrainian is given at once. Therefore, students immediately understand what material they have to learn in class. In order for students to better understand the material, the teacher has to write more on the board during the lesson, while in "Ukrainian-speaking" groups, it is enough to say most of the key phrases aloud. Students who are called to the board to solve problems have to speak English and do not switch to Ukrainian. The teacher, if necessary, corrects the student's mistake and repeats loudly the correct phrase for the audience. All tests, control works and exams in higher mathematics are performed by students only in writing and exclusively in English. Thus, in math classes, students have the opportunity to maintain and improve their level of English.

Below we will formulate the most common, specific problems teachers of higher mathematics face when teaching the course in English, as well as possible ways to overcome them.

The first problem is related to the students' English language entry level (because they are freshmen). From the very beginning, they start to listen to lectures in English, communicate in English in practical classes, use methodological recommendations written in English. This is a challenge for them due to the lack of similar learning experience in the past. This situation can force the teacher to simplify the explanation, to avoid considering some important, but difficult to understand details. And this can lead to insufficient and incomplete study of some aspects of the subject. This problem is solved by intensifying the study of English in the first year (students of "English" groups have additional hours of English compared to students of "regular" groups).

The second problem is that teaching a subject in a foreign language (as well as students' perception of the material) inevitably takes place at a slow pace. The teacher must speak clearly, not quickly; quite often it is necessary to repeat the phrase several times. Students' perception and comprehension of information is also slower. It takes some time and effort of students. As a result, within the planned classroom hours of higher mathematics, students of "English-speaking" groups have time to master a smaller amount of material than those who study in their native language. This situation can affect the implementation of the curriculum. And here the teacher's experience is of great importance, as it is experience that allows a critical approach to the information selection and the sequence of its processing. Thus, this problem is solved by the teacher's methodological qualification.

The third problem is related to the following fact: in contrast to those technical universities, where the English mathematics course is taught as an additional (optional) to the main course in the native language (in parallel), in "Zaporizhzhia Polytechnic" the English language course is the only higher mathematics course. As a result, the teacher is obliged to duplicate terminology in the native language. This is obviously necessary in order to have an adequate understanding of terminology and use it correctly in a professional context. Therefore, the teacher must give the exact equivalent for each term in the native language, explain the term in other words, give a definition or example, and compile a glossary for each topic.

Finally, another problem stems from differences in approaches to teaching higher mathematics to students in Ukraine and abroad. As you know, English-language mathematics is more focused on practical competencies and skills. There is a view that the main purpose of foreign mathematics education is to know how, and of domestic one – to know why. Therefore, Ukrainian pupils and students can easily operate with complex numbers, trigonometric and logarithmic transformations, solve non-trivial stereometric problems, systems of linear equations, but get lost when performing the simplest combinatorial, statistical, financial calculations, confused in graphical information, can not formalize the problem described in terms of a specific life situation. In foreign educational institutions, this is taught in secondary school, and in some places even in primary school. It should also be noted that in English-language mathematics tests, control works and exams are also presented in a slightly different way than our students are used to. All this does not allow using only English textbooks and manuals (foreign for our students), because they do not take into account our realities of learning. There is a need to create methodological support for the course, which would combine the principles of foreign mathematics education and the realities of our school education. Methodological manuals

in English (lecture notes, materials for independent work, examples of solving practical and situational tasks, calculation and control works with samples of performance) should contain a list of special terms in English and native language. Thus, we consider it expedient to use both the original English-language textbooks and manuals created especially for such courses by the university teaching staff in order to bridge this gap between English-language and domestic higher mathematics. In particular, in "Zaporizhzhia Polytechnic" in the educational process, together with the original English-language textbooks [6; 10; 12] we use textbooks in English by Ukrainian authors [5; 7; 8; 9] and manuals created by "Zaporizhzhia Polytechnic" instructors [13; 14; 15; 16].

Despite the above mentioned problems, teaching higher mathematics in English has obvious advantages. Among them:

– students maintain language skills acquired in high school;

– students improve their English by reading educational literature, doing written work, listening to teachers and classmates, speaking at the board, making reports and presentations during classes;

– students study well-designed and effective Western textbooks written by recognized experts in their field; such textbooks are usually well developed and have been reprinted at least 5–6 times;

– students master special vocabulary, not only engineering or medical, but also mathematical one. This not only gives them the opportunity to read articles and textbooks more confidently in English, but also prepares them for further study, such as in the double degree program, joint master's programs with partner universities, and during foreign business trips and internships in English;

– students can prepare much more effectively for exams and tests such as: IELTS (International English Language Testing System), TOEIC (Test of English for International Communication), TOEFL (Test of English as a Foreign Language), GRE (Graduate Record Examination – a test for applicants for the United States master's programs). These tests are usually a prerequisite for continuing one's studies or working abroad;

– students have the opportunity to freely deal with English-language periodicals and special literature, which is published much more in English than in Ukrainian.

It should be noted that almost everything of the above mentioned refers to the opposite situation as well, namely, to the case when foreign students study in Ukraine in groups with the Ukrainian language of instruction. In this case, learning and mastering the material is also in a non-native language, and there are problems similar to those described. We will illustrate the facts declared on the example of teaching foreign students in Ukrainian at the Bogomolets National Medical University.

The use of sophisticated equipment for functional diagnostics and therapy in modern medicine, mathematical methods of data analysis and modeling of processes that occur in the human body makes it necessary for students – future physicians to understand fundamental mathematical concepts and master methods of processing medical and biological information. First-year students, on the basis of the school curriculim, must be fluent enough in mathematical terms, know the basic functions, their properties, do fractions, radicals, factorize polynomials, be able to simplify mathematical expressions etc. However, for foreign students who have chosen to study in Ukrainian, the above-mentioned mathematical operations sometimes cause difficulties. There can be several reasons.

Not all first-year students studied at the preparatory department of the university. Therefore, the level of Ukrainian proficiency at the beginning of the first year is too low. Lectures and practical classes in the Ukrainian language take place in parallel with the course of higher mathematics.

Experience with medical students and pharmacologists shows that at the beginning of the course, one lesson, specially arranged to review the school curriculum, is not enough; the teacher has to pay much attention to elementary functions and basic mathematical skills throughout the course of "Higher Mathematics" [2; 4; 11]. Thus, the teacher faces a separate methodological challenge: to have not enough classroom hours in the course programs to revise basic mathematical actions.

Additional difficulties arise due to differences in some mathematical symbols and signs in domestic and foreign textbooks of the course. For example, some trigonometric functions in foreign textbooks, in contrast to Ukrainian-language textbooks, are not denoted by *tg x*, c*tg x*, but *tan(x)*, *cot(x)*. Exponential function in Ukrainian-language textbooks is shown as e^x, in foreign textbooks it looks like *exp(x)*. It may seem like a trifle, but students need time to get used to writing and perceiving [3]. In addition, the formulas for the square of the sum and difference are given in other countries in a slightly different sequence when opening the square; there are also different approaches to differentiation of functions, etc.

Thus, the teacher slows down the pace of teaching the material, and students from time to time turn to electronic translators. The Ukrainian-English and English-Ukrainian glossary has been compiled by the teaching staff to help students [1]. But what complicates the teacher's work with students is that English is not the native language of communication for all students (but Arabic, Persian, Uzbek, etc.).

The experience of teaching higher mathematics, both in English to Ukrainian students and in Ukrainian to foreign students, shows that successful results of tests and exams in higher mathematics does not depend on the student's basic language training (because lectures and practical classes in higher mathematics do not involve using complex grammatical constructions in a non-native language) and is largely due to the student's persistence and his good mathematical skills acquired in high school.

Conclusions and prospects for further development in this direction. Thus, the article describes the specifics of teaching higher mathematics in English for Ukrainian-speaking students and in Ukrainian – for foreign students, highlights both the advantages and the most common specific problems the teacher faces when teaching in a foreign language, and gives possible practical ways to overcome these problems. It shows that these challenges do not affect the quality of higher education provided the teacher has proper methodological qualification. The prospect of further research may lie in developing principles for a distance learning complex in higher mathematics in English for Ukrainian-speaking students, which will provide students with all the necessary educational materials for their independent work.

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