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FROM THE EXPERIENCE TO ADAPT COMMUNICATIVE TECHNOLOGY OF TEACHING PHYSICS IN THE ENGLISH LANGUAGE IN A PEDAGOGICAL UNIVERSITY

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Abstract. The article describes experience of applying adapt a technology of communicative education for students studying Physics in the English language in a pedagogical institute. In the context of the modern paradigm of education and the strengthening of globalization processes, an important factor in the successful activity of a teacher, along with subject hard skills, soft skills have become in demand for effective intercultural communications. Concurrently, the issue of increasing language level and quality of mastering different special disciplines is becoming relevant. Along with that, according to our research, quality of basic disciplines and foreign languages taught is directly dependent on efficiency of applied technologies of education. In educational practice of teaching foreign languages technology of communicative education, developed by Ye.I.Passov, has proved itself as a sufficient one due to the activation of students' cognitive activity through the direct application of knowledge and skills in the communicative process in a collaborative environment. The aim of the research is to adapt Ye.I Passov's technology to teach Physics in English based on the construction of didactic content in Physics using tasks of a communicative-cognitive nature. The results of the research are as follows; adapted technology has contributed to increase efficiency of students' acquisition of studying Physics in English and enhanced the level of their competencies in mastering intercultural communications.

Experiment to apply the results of the research was held within the Educational Program «Physics» in Pavlodar Pedagogical University named after A.Margulan. The given approach to study Physics and developing linguistic competences on the basis of creating a collaborative environment on the lessons via communicative technology allows to increase efficiency of grasping knowledge in Physics in the English language and to improve the level of competence among students in order to master English. In the near term, these technologies can be applied in teaching other Physical disciplines in the English language.

Key words: methods of teaching Physics, didactic system of cognitive construction, technology of education, polylingual education, Ye.I Passov's technology of teaching disciplines, Physics in English, technology of communicative education, cognitive process, pedagogical university

Basic provisions

One of the challenges facing a teacher teaching physics in English is to find the most appropriate material and new teaching strategies that could improve the effectiveness of its use.

The study is aimed at investigating the use of the communicative method, which implies a greater activity of students, and the task of the teacher in this case is to involve everyone in the audience in the conversation. For better memorization and use of the language, it is necessary to use all channels of perception. Communication technologies are especially relevant in the context of the modern paradigm of education as a process of cooperation in a collaborative environment created by teachers.

To study general physics in English we selected, in our opinion, the principles of E. I. Passov's technology that are the most methodologically close in terms of didactic features: the speech orientation of the lesson (only lessons in the language, and not about the language, are legitimate); lexical functionality; situationality; novelty; collective interaction; modeling.

Introduction

Teaching Physics and other subjects in English is a modern trend in developing education, it contributes to creating professional competitive advantages for students that are relevant in the labor markets, including: developing intercultural communication skills, increasing general and specific language competence, developing communication skills, and also increases student motivation to lifelong education.

There are a number of proven methods and approaches to trilingual subject education: the strategy of integrated teaching of the subject and language (CLIL), team teaching and language immersion. But, unfortunately, applying the latter in the process of trilingual education does not solve the urgent problem of increasing the quality of studying physical and mathematical disciplines in English.

The problems of implementing trilingual education in the Pavlodar regional education system include: insufficient teaching second and English languages at school, as well as teachers' imperfect command of the English language; lack of authentic literature in English; the risk of insufficient acquirement of the discipline content taught in English. Though the methodology for studying disciplines in the native language is more studied, the methodological issues of studying disciplines in English need detailed study.

The relevance of the problem to adapt the technology of communicative teaching Physics in English is due to the following difficulties in practice:

1) In the process of teaching Physics in English, the language stands not only a subject of study, but a means of communication. Therefore, due to the students' different level of a foreign language knowledge, there are difficulties in mastering Physics [1].

2) Before studying a new topic, the teacher has to introduce new terminology, various specific, typical expressions and constructions of sentences relevant to this

topic.

3) The teacher of the discipline contributes to the study by introducing scientific terminology of the English language that has to be memorized. And it has to be done by taking time away from the subject itself, so the effectiveness of the methods used in teaching disciplines should be higher than when teaching in the native language, since in fact all the material needs to be presented in less time, moreover, in a foreign language.

4) When teaching in a foreign language, after the initial viewing, it might be efficient to first memorize terms unknown to the student, then typical constructions of the scientific style of speech, or memorize entire sentences from the text to ensure its reproduction at a sufficiently high level.

5) To ensure the same level of memorization efficiency as when teaching in the native language, several readings of the text are necessary, then switching to work on terminology and on the translation and memorization of separate sentences or paragraphs.

Thus, memorization is the basis of learning, and the effectiveness of memorization depends on the type of thinking. Thinking can be visual-effective, visual-figurative and abstract. Physical and technical specialists are characterized by visual-effective and partially abstract thinking. The need to substantiate is a consequence of the fact that in the psychological and pedagogical sciences and educational practice there is a contradiction between the public need to receive an international level education in English and the lack of effective methods of teaching Physics, Mathematics and other subjects in a foreign language to non-English-speaking students. In order to solve this contradiction, the *problem and goal* of our research have been formulated: it is necessary, based on the modern cognitive-constructivist didactic concept of J. Piaget [2,3], to create an effective technology of communicative teaching Physical disciplines in English, combined with the development of language competencies.

A review and analysis of scientific and methodological literature on the problems of using technologies of communicative teaching foreign languages indicates great interest and effectiveness in the application of this technology in the modern educational space of the CIS countries and far abroad [4-8].

Technologies of communicative learning are especially relevant in the modern paradigm of education, as a means of cooperation in a collaborative environment created by teachers [9, 10]. In a collaborative development environment, the main method is communication, understood as the interaction of two or more people, that includes exchanging information of a cognitive or affective-evaluative nature between them. At the same time, three components are distinguished in the structure of communication: cognitive (cognitive), affective (emotional), behavioral. The means of communication are communication, perception and interaction.

In clarifying the conceptual-functional relationship, we refer to the opinion of G.K. Selevko about the procedural-effective aspect of technology as an activity to implement a project of the educational process [2]. Educational technologies are a means of practical realization of a theoretically based lesson project, carried out in a

specific, time-relevant didactic system. In our study, it is a didactic system of cognitive constructivism by J. Piaget [3, 11]. Ye.I. Passov's technology is associative-reflexive, activity-based [12], referred to the laws of the cognitive process, in which cognitive schemes for studying the categories of science that form the basis of the discipline being studied (English language) have proven themselves well. The constructivist part of the researched, created adapted technology of communicative learning is determined by the use of cognitive schemes for studying scientific categories of Physics (concepts, processes, quantities... theories).

Materials and methods

The methodological basis of the study is a systematic analysis of the object (the process of studying Physics in English) and the subject of research - the specific characteristics of the technology of communicative interaction, as the interrelation of individuals based on conscious verbal perception, using "... a commonly understood language of communication" determined by the general culture of communications [13, p.11].

- to study, review and analyze the scientific and methodological literature on the problem of communication technologies in education;
- to study the features of the cognitive activity of students in the process of teaching Physics in the context of using communicative technology and identifying the peculiarities of teaching Physics in a foreign language compared to teaching in native language;
- to develop a methodology to apply communicative technology to teach Physics in English;
- to develop diagnostic methods to teach Physics. To develop didactic material to evaluate knowledge in Physics and English among students;
- to describe and analyze the results of knowledge evaluation and develop guidelines to study Physics in English.

The methodological basis of the study is system analysis, communication technologies.

A pedagogical experiment to test the research results was carried out on the basis of the educational program "Physics" of Pavlodar Pedagogical University named after A.Margulan. This approach to the study of physics and the development of language competencies based on the creation of a collaborative environment in the classroom through communication technologies made it possible to increase the efficiency of students' acquisition of physics knowledge in English and the level of students' competencies in mastering the English language. In the future, these technologies can be used in teaching other physical disciplines in English.

Results

In the frames of Educational Program (hereafter EP) of Physics in Pavlodar State Pedagogical University, trilingual education is carried out on the basis of Bachelor educational program 6B01520 - Physics. Distribution of disciplines according to languages taught is carried out in the following percentage: 40 % of

disciplines are delivered in the native language, 30 % in the second language (Kazakh or Russian) and 30 % in English. Disciplines of the basic and profile cycles are mostly taught in the second and English languages, not earlier than the second year of study. The study of languages is carried out according to the level methodology and also includes professionally oriented Kazakh (Russian) and English.

One of the tasks that an educator faces while teaching Physics in English is introducing a methodological system to teach Physics, taking into account the above features. The limited number of hours per discipline makes it necessary to search for the most appropriate material and new teaching strategies that could improve the effectiveness of its application. Teaching Physics in English should not lead students away from the physical content of the subject. Thus, the emphasis in this approach should be on the actual subject material.

One of the effective methods of studying is the communicative method, which implies a great activity of students, and the task of the teacher in this case is to involve everyone present into the conversation. It is necessary to use all channels of perception for better memorization and usage of the language.

To study general Physics in English, we selected, in our opinion, the most methodologically close principles in terms of didactic features (Table 1): the speech orientation of the lesson (only lessons in the language are legitimate, and not about the language,); lexical functionality; situationality; novelty; collective interaction; modeling. The mentioned above principles are so-called “Ye.I. Passov’s technology principles” [9].

Table 1 - Ye.I. Passov’s technological map referring the methodology of teaching Physics in English

Step 1: skills formation	*Step 2: skills improvement*	*Step 3: skills development*
1) Formation of empirical competencies to assimilate new physical knowledge (elements of physical science) 2) Formation of knowledge using the methodology to study the elements of physical science (concepts, quantities, laws, processes, etc.)	1) Improving the assimilation of the elements of physical science on the basis of generalization, systematization, concretization of knowledge based on analysis, synthesis, comparison, analogy.	1) development of practical skills to apply the knowledge in terms of solving quantitative and qualitative tasks 2) development of a dialogue speech on the basis of new content in Physics
The sub-steps may be either interchanged or one of the steps may be missing.	Prepared text on the topic being studied.	Fulfillment of practical tasks

Table 2 shows the structure of students' cognitive activity in studying Physics based on the so-called rules or schemes to study various categories of the science of Physics, for example, for a physical quantity it is as follows: 1) determination of the quantity; 2) the physical meaning of this quantity; 3) formula and designation; 4) types and methods of measurement; 5) units of quantity measurement; 6) boundaries of quantity application. In the cognitive approach, the category of the object being studied is determined at the beginning of the study and then scheme’s data are applied. Rules of study are necessary for perception, for students’ conscious

perception of each other while interacting, as a “commonly understood language of communication” according to Remezov [13].

Table 2 - Technological map of the cognitive-activity approach to the study of Physics

Formation of a need and motive	*Aim*	*Tasks*		
		What do you need to know?	What do you need to understand?	What to be able to do? What to learn? What competencies should be developed?
Diagnostics of the reference knowledge system	Learn the material	Empirical material	Methodological and theoretical material	Apply in practice
Perception	Awareness	Understanding	Application-reproduction	Creative application
Basic knowledge	Given didactic content for study	Didactic content of a methodological nature in the form of questions and assignments	Didactic content for practical use: a system of tasks	Didactic content for creative use
Reflection				
Monitoring and assessment of educational achievements				
New need				

In our study, we used check tasks at the beginning of the lesson and at the end of the lesson to record data and monitor students’ achievement. In these tests, terms in English were presented in one column and with a blank place for translation (from students) in another column (table). Before compiling tests, it is necessary to compose a text in English, where there will be an acceptable number of new terms. The number of terms is selected after determining the level of language proficiency of students.

The main principle is the principle of information operability and elements of speech. As is known, speech activity consists of lexical, grammatical, phonetic aspects. They are inextricably linked in the process of listening, speaking, reading and writing.

According to the principle of operability, words, new terms cannot be learned in isolation from their semantic meaning, forms of application in language and speech, and therefore without understanding the meaning.

The complex of language competencies acquired by the trainee consists of the following functions:

- to master interaction in the target language;
- to assimilate a foreign language culture, using the language as a tool for intercultural communication;
- to improve foreign language pronunciation;
- to learn the most common vocabulary, master the productive lexical minimum;
- to recognize and use the basic grammatical phenomena of the language being studied;

- to understand in general the statements of native speakers of the target language;

- to understand and highlight meaningful information in simple sounding texts;

- to conduct a dialogue, business conversation, discussion, etc.

- to create business messages, stories, reasoning in connection with the topics covered and the problems of the texts read, give definitions, compare, draw analogues.

- to read original texts from textbooks on various subjects.

The usage of new methods in teaching Physics along with traditional methods such as the jigso method, insert method, cluster method, fishbone, KWL table, group or pair work, mutual assessment and self-assessment, the use of appropriate audio and video materials from the Internet, can diversify learning and increase efficiency of assimilation.

Teaching physics in English should not lead students away from the physical content of the subject. Thus, the emphasis in such an approach should be on the subject material.

On Physics lessons, much attention was paid to teaching students to freely "communicate" with formulas and terms in the process of mastering the material in English. The most difficult thing for a teacher is to distinguish language parallels between understanding terms in the native language and their interpretation in English. At the same time, understanding depends on the level of the English language. A Physics teacher in English needs to convey all the meanings that words and terms carry as accurately as possible. At the beginning of each lesson or before presenting particularly complex material, attention was paid to terms and highly specific expressions. English-language Physics is much more focused on practical applications. English-language textbooks were used to teach students Physics in English.

Here are examples of classes using communicative technology

Example 1. The lesson’s topic is “Materials Used in Electronics”, the group is divided into 3 subgroups and discuss 3 questions:

1. Insulators.
2. Conductors.
3. Semiconductors.

After each group presents their topic, the differences between conductors, semiconductors, and dielectrics are discussed. Students answer questions:

1) What is the basic difference between conductors and insulators?
2) How do semiconductors differ from conductors and insulators?
3) How many valence electrons does a conductor such as copper have?
4) How many valence electrons does a semiconductor have?
5) Name three of the best conductive materials.
6) What is the most widely used semiconductive material?
7) Why does a semiconductor have fewer free electrons than a conductor?
8) How are covalent bonds formed?
9) What is meant by the term intrinsic?

10) What is a crystal?

Example 2. Here is an example of studying the topic "Electric charge" according to the textbook University Physics with Modern Physics (13th Edition) by Hugh D. Young, Roger A. Freedman, A. Lewis Ford [10, p. 688-691].

Students are divided into groups of 3-4 people. Each group is given the texts on the topic 1. Electric Charge, 2. Electric Charge and the Structure of Matter, 3. Electric Charge Is Conserved. When studying the topic, the Insert method was used.

Questionnaires. The technique to use questionnaires. Questionnaires are an effective way to stimulate students' oral expressions at all stages of learning. They are easily projected onto any topic being studied and meet almost all the principles of communicative learning: speech orientation, personal individualization, functionality, situationality, novelty. With their help, it is easy to provide any required grammatical orientation of oral statements.

Language analysis of the text.

In table 2, students fill in English words and terms:

• Check mark (V) – mark already known physical words and terms in the text;

• Plus sign (+) - mark new set expressions and grammatical forms found in the text;

• Minus sign (-) – previously unknown words and terms are marked;

• The question mark (?) – indicates what remains unclear and requires additional study and understanding, what you would like to learn more about.

Table 3 - Language analysis of the text

V *(already knew)*	- *(new words and terms)*	+ *(Interesting)*	*?* *(not clear, have questions)*

The communicative method implies a great activity of students. The activity of students in this case is manifested in purposeful work with the text of the textbook. Students analyzed the text in two aspects: 1 aspect is presented in Table 1. This is an analysis of the level of mastering the topic. 2 aspect is presented in table 2, which has the goal of improving English language proficiency.

The task of the teacher in this case will be to involve all the students present in an interactive conversation according to the given text.

Discussions

The experiment on testing the results of the study was carried out on the basis of the EP Physics of the Pavlodar Pedagogical University during the entire 2021-2023 academic years in natural conditions. When conducting the experiment, we adhered to the generally accepted guidelines in pedagogy that a pedagogical experiment is a scientifically based practical experience of transforming the educational process into precisely taken into account conditions, deliberate changes in the educational process, deep qualitative analysis and quantitative measurement of the results of changing the process.

It is known that there are two types of experiment: laboratory and natural. In our study, we conducted a natural experiment, which is carried out in the usual environment for students.

The pedagogical experiment was carried out in two stages: ascertaining and adapting.

The adaptive (transformative, educational) experiment aims to actively intervene in the educational process by introducing significant changes, in our case, a new communicative technology for studying Physics in English.

An adaptive experiment requires the following issue from the researcher: the development of theoretical ideas about the parameters of the formed didactic, psychological and pedagogical phenomena. Full consideration of various factors of real learning that affect the emergence of the studied mental phenomena.

An ascertaining experiment is an experiment that establishes the existence of some immutable fact or phenomenon. An experiment is considered ascertaining in case if the researcher sets the task of identifying the presence of a state and the level of formation of some studied parameter, in other words, the actual level of development of the studied property in the subject or group of subjects is determined.

One of the goals of the ascertaining experiment is to measure the current level of development, to obtain primary material for organizing a formative experiment.

The ascertaining stage was held in order to test the system, competencies in terms of the level of mastering the English language and the subject under study of the experimental and controlled group of students in the process of studying the subject "Electricity and Magnetism in English".

According to the results of the semester, the average group score was 85%, in 2021 the average group score was 79 %.

The proposed methodology includes: permanent monitoring of the level of knowledge achieved by students; identifying the most typical mistakes in understanding the material studied over the past period, and correcting knowledge; preparation to perceive a new material by studying the terminology and typical constructions of scientific speech on the topic presented in English; presentation of the basic provisions of the new topic through several reformulations; demonstration of the application of new material; constant monitoring of the correct understanding of the studied material; conducting such types of classes and tasks that would ensure the training of each basic skill and skill several times during the course of study; conducting examinations to check the level; ensuring the constant activity of students.

Conclusion

Based on the results of the work, the research hypothesis was confirmed: An integrated approach to the study of physics and the development of language competencies based on the creation of a collaborative environment in the classroom through communication technologies made it possible to increase the efficiency of students learning Physics in English and the level of students' competencies in mastering English.

In the future, these technologies can be applied in teaching other physical disciplines in English.

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ПЕДАГОГИКАЛЫҚ УНИВЕРСИТЕТТЕ СТУДЕНТТЕРДІ АҒЫЛШЫН ТІЛІНДЕ ФИЗИКАДАН КОММУНИКАТИВТІ ОҚЫТУ ТЕХНОЛОГИЯСЫНА БЕЙІМДЕУ ТӘЖІРИБЕСІНЕН

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Аңдатпа. Бұл мақалада педагогикалық университетте студенттерді физикадан ағылшын тілінде коммуникативті оқыту технологиясын қолдану тәжірибесі сипатталған. Білім берудің заманауи парадигмасы және жаһандану процестерінің күшеюі жағдайында мұғалімнің табысты жұмысының маңызды факторы, пәндік hard дағдыларымен қатар, тиімді мәдениет аралық коммуникацияларды жүзеге асыру үшін soft дағдылары сұранысқа ие болды. Осыған байланысты ағылшын тілінде әртүрлі арнайы пәндердің оқыту сапасы мен тілдік дайындығын арттыру мәселесі өзекті болып отыр. Сонымен қатар, біздің зерттеуіміз көрсеткендей, негізгі пәндер мен шет тілдерін оқыту сапасы қолданылатын оқыту технологияларының тиімділігіне тікелей байланысты. Шет тілдерін оқытудың білім беру тәжірибесінде Е.И. Пассовтың коммуникативті оқыту технологиясы өзін жақсы дәлелдеді, оның тиімділігі студенттердің танымдық іс-әрекетін бірлескен ортада коммуникативті үрдістерде білім мен дағдыларды тікелей қолдану арқылы белсенділікті арттыуға байланысты. Бұл зерттеудің мақсаты – Е.И. Пассов технологиясын коммуникативті-танымдық тапсырмаларды қолдана отырып, физикадан дидактикалық мазмұнды құру негізінде физиканы ағылшын тілінде оқуға бейімдеу. Зерттеу нәтижелері: бейімделген технология студенттердің ағылшын тілінде физикадан білімдерін меңгеру тиімділігін арттыруға ықпал етті және олардың мәдениет аралық коммуникацияларды меңгерудегі құзыреттілік деңгейін арттырды.

Зерттеу нәтижелерін тексеру эксперименті Ә. Марғұлан атындағы Павлодар педагогикалық университетінің «Физика» білім беру бағдарламасы негізінде жүргізілді. Физиканы оқытуға және коммуникативтік технологиялар арқылы сабақта ынтымақтастық орта құруға негізделген тілдік құзыреттіліктерді дамытудағы бұл тәсіл оқушылардың физика білімін ағылшын тілінде меңгеру тиімділігін және оқушылардың ағылшын тілі бойынша құзыреттілік деңгейін арттыруға мүмкіндік берді. Болашақта бұл технологияларды басқа да физикалық пәндерді ағылшын тілінде оқытуда қолдануға болады.

Тірек сөздер: **Тірек сөздер**: физиканы оқыту әдістемесі, когнитивті конструктивизмнің дидактикалық жүйесі, оқыту технологиясы, көптілді білім беру, пәндерді оқытудағы Е.И. Пассовтың технологиясы, ағылшын тіліндегі физика, коммуникативті оқыту технологиясы, танымдық үдеріс, педагогикалық университет

ИЗ ОПЫТА АДАПТАЦИИ ТЕХНОЛОГИИ КОММУНИКАТИВНОГО ОБУЧЕНИЯ СТУДЕНТОВ ФИЗИКЕ НА АНГЛИЙСКОМ ЯЗЫКЕ В ПЕДАГОГИЧЕСКОМ УНИВЕРСИТЕТЕ

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Аннотация. В данной статье описан опыт применения технологии коммуникативного обучения студентов физике на английском языке в педагогическом университете. В условиях современной парадигмы образования и усиления глобализационных процессов важным фактором успешной деятельности педагога, наряду с предметными hard навыками,стали востребованными soft навыки для осуществления эффективных межкультурных коммуникаций. В связи с этим актуальной становится проблема повышения языковой подготовки и качества изучения различных специальных дисциплин, на английском языке. При этом качество изучения базовых дисциплин и иностранных языков, как показывает наше исследование, находится в прямой зависимости от эффективности применяемых технологий обучения. В образовательной практике изучения иностранных языков хорошо зарекомендовала себя технология коммуникативного обучения Е.И. Пассова, эффективность которой обусловлена активизацией когнитивной деятельности студентов через непосредственное применение знаний и навыков в коммуникативном процессе в коллаборативной среде. Целью данного исследования является адаптация технологии Е.И. Пассова к изучению физики на английском языке на основе конструирования дидактическогоконтента по физике с помощью заданий коммуникативно-когнитивного характера.Результаты исследования: адаптированная технология способствовала повышению эффективности усвоения студентами знаний по физике на английском языке и повысила уровень их компетенций в овладении межкультурными коммуникациями.

Эксперимент по апробации результатов исследования проводился на базе образовательной программы «Физика» Павлодарского педагогического университета имени Ә.Марғұлан. Данный подход к изучению физики и развитию языковых компетенций на основе создания на занятиях коллаборативной среды посредством коммуникативных технологий позволил повысить эффективность усвоения студентами знаний по физике на английском языке и уровень компетенций студентов в овладении английским языком. В перспективе данные технологии могут быть применены и при преподавании других физических дисциплин на английском языке.

Ключевые слова: методика преподавания физики, дидактическая система когнитивного конструктивизма, технология обучения, полиязычное образование, технология преподавание дисциплин Е.И. Пассова, физика на английском, технология коммуникативного обучения, когнитивный процесс, педагогический университет

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