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Article

Key Aspects of Algorithmization of Collaborative Educational and Cognitive Activity of Students at a Technical University in the Conditions of Digitalization of Education

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Abstract: This article presents a quantitative assessment of pedagogical support aimed at improving collaborative education at a modern technical university. The article analyzes the structural composition of the universal communicative competence in a foreign language to identify the advantages of the proposed content detailization. An algorithm for constructing educational and speech actions of students with the use of collaborative digital technology, regarding the monitoring and control of tools, is developed and theoretically justified. Microsoft Teams is offered as a platform for implementing digital collaborative learning technology. The didactic possibilities and methodological functions of Microsoft Teams in foreign language teaching are revealed. The digital technology of the collaborative learning algorithm is relevant for building collaborative actions is relevant, since it contributes to the development of the ability to solve common professional tasks. The algorithm of the dialogic communication, including problem, contradiction, conflict, intellectual difficulty, having general professional context as a stimulus to enhance the interaction in pair work is proposed as pedagogical support. The analysis and quantitative assessment of students' oral responses showed that the dialogue in a foreign language, based on the algorithmic component, is more structured and stimulates students' communication on relevant professional-oriented topics.

Keywords: universal communicative competence; algorithm; digital technology of collaborative learning; technical university; Microsoft Teams

1. Introduction

Due to changes in society, the education system is being reformed, and there is a need to meet these changes. The modern man is in a single information space, in which data is continuously generated and transmitted. Special attention is paid to the use of digital technologies, which are a key factor of economic growth that improves the quality of the population's life and plays an important role in a wide variety of areas of modern life. They are rapidly penetrating all areas of activity: production, science, politics, commerce, everyday life, culture, and, in particular, education [1,2]. In this situation, it is essential to strengthen engineering practice to improve the quality of graduates' training with a focus on its practical implementation in everyday professional activities.

Global informatization and digitalization of public life, the rapid development of information and communication technologies have led to changes in the traditional paradigm of education, which is based on the idea of forming knowledge, skills, and abilities. The ideas of the competence approach in education meet the needs of modern society today [3]. Currently, the main task of the higher educational institution is to prepare a qualified graduate: competent, proactive, flexible, mobile, constructive, able to make free choices in standard and non-standard situations [4,5]. The university graduate should have a desire for self-education throughout life, practice new

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technologies, be aware of the possibilities of their use and adaptation to the professional sphere, resolve professional issues and work in a team.

Currently, the sign of the university graduate's high qualification is not only the possession of deep and solid knowledge, skills, and abilities, it is also necessary to be able to choose the most necessary data from a huge array, verify its validity and efficiency. Moreover, the ability to consciously and responsibly make informed decisions in non-standard life situations is essential. Significant amounts of open information related to all types of professional activities of future specialists, which appeared as the result of the rapid development of society and accelerated pace of its informatization, determine the need for students to be able to independently understand its abundance. The graduate should be able to extract the necessary information and evaluate it adequately, determining the scope of application, theoretical and practical significance for solving professional problems. Consequently, new requirements are imposed on future specialists' training, which indicates the need to introduce changes in goals, content, technologies, and approaches to higher education.

It is natural that the issue of the graduate competencies formation reveals the interest and requires a comprehensive solution due to globalization and the growing intensity of international interactions, when the issue of analyzing various types of information, its appropriate perception and interpretation becomes so important.

The competence approach involves a combination of disciplines defined by the university for the competence formation specified in the Federal state standard for the corresponding specialties of higher education. The competence approach is considered as a method of modeling learning outcomes and their representation as higher education quality standards [6]. Competence is a set of both knowledge, skills, and abilities that a student must have as a result of training and such personal qualities as the ability to apply knowledge and skills in practice. Knowledge is the basis of skills that represent a higher stage of their development brought to automatism. Universal competencies are components of the professional competence of students, that is, the readiness and ability of a professional to perform any activity or any action in their professional sphere. To form competencies, it is necessary to strengthen the initiative in all disciplines and organize creative independent work.

The competence approach assumes the presence of professional knowledge and skills, as well as the readiness of a person to apply this knowledge in practice, that is, directly in the professional sphere in various life situations. The competence approach makes us both master knowledge, skills, and abilities and gain experience in their application starting with the university training when performing practical tasks, that is, to be ready for productive activities in various socially significant situations. Practical orientation is the content basis of the competence approach, which also correlates with the personal-activity and interdisciplinary approaches to the design of the educational process in higher education [7]. The interdisciplinary essence of the competence approach, in our opinion, is clearly expressed, since the content of any competence, as a result of training, integrates the content aspects of several disciplines that are mastered in the computer learning environment of the modern university. When implementing a practice-oriented competence approach, the focus is not only on educational activities but also on the result of this activity, that is, the quality of competencies formed in the process of teaching a foreign language.

1.1. Research Questions

Despite the fact that the works devoted to the problems of communicative competence formation by means of Internet technologies occupy a significant volume in the scientific literature [8-13], we have to admit that there is a number of issues that require the attention of researchers and teachers-practitioners, namely, methodical aspects of students' oral and written speech skills development are not grounded and not completely revealed; the organizational conditions for the implementation of interactive learning technology in the educational process at technical university are not developed.

Based on our analysis of the existing literature on professional education [14-19], the following contradictions become obvious: between the large volume of methodological literature on the use of digital technologies and, in particular, Web 2.0 services for teaching a foreign language and the pure description of the didactic aspects that use Microsoft Teams, a unified communication and collaboration platform; between the need to form a foreign language communicative competence and the insufficient development of the communicative component in teaching students to speak on professional topics; between the requirement of the foreign language program to shift the focus from class with the predominance of reproductive and training tasks to independent search and cognitive activities with different degrees of educational autonomy and the underdevelopment of algorithms for performing independent work using digital technologies of collaborative education.

These contradictions determined the research problem, which is formulated as follows: how to organize independent work on the discipline "Foreign language" in the practice of technical university students' foreign language training effectively?

The purpose of the research is to develop, scientifically and theoretically substantiate and verify the effectiveness of collaborative students' training digital technology in the professionally-oriented foreign language using the algorithm developed by us with the use of the problem situation to intensify the learning process, aimed at the formation of students' communicative competence in the process of independent work.

2. Literature Review

The ideas of the competence approach in education, reflected in The Third Generation Federal State Educational Standards of Higher Education (FSES HE), meet the needs of modern society today, and universal competencies occupy the important place in all FSES HE. Universal competencies are defined as the key competencies that ensure the life of a person in society. These competencies are supra-professional and they are defined as knowledge management skills and abilities, or as social interaction and adaptation abilities.

2.1. The composition of the universal competence responsible for mastering a foreign language

In the master's degree standards for all areas of higher education at Peter the Great St. Petersburg Polytechnic University, the universal competence (UC-4) which is focused on the formation of the discipline Foreign Language is formulated as follows. It is the ability to "apply modern communication technologies even in the foreign language(s), for academic and professional interaction". In our opinion, it is necessary to provide a detailed representation of this universal competence composition to facilitate the methodological work of university teachers to assess its formation.

Table 1 shows the structural composition of the universal communicative competence "The ability to apply modern communication technologies even in the foreign language(s), for academic and professional interaction", implemented in classes on the discipline Foreign Language following three descriptors *to know*, *be able* and *possess*.

Table 1. Requirements for the results of mastering the discipline Foreign Language to masters in all non-linguistic areas.

Code	**The result of the graduate's training**	**Descriptors** ***(to know, be able, possess)***

	(competence): the competence indicator			
Universal competence UC-4	**The ability to apply modern communication technologies even in foreign language(s), for academic and professional interaction**			
Competence achievement indicator 1	The demonstration of the integrative skills necessary for writing, translating and editing various academic texts (essays, reviews, articles, etc.).	The knowledge of various information and communication technologies (ICTs) for communication and two-way translation.	The ability to apply the rules of writing, use of electronic resources to improve knowledge of a foreign language, various types of translation.	The ability to annotate, review and edit professionally-oriented text, basic translation skills.
Competence achievement indicator 2	The demonstration of academic and professional activities results at various scientific events, including international ones.	The knowledge of the foreign language basic grammatical norms necessary for oral and written communication in the process of professional-oriented communication.	The ability to present their point of view in a reasoned manner, independently engage in educational and cognitive activities within the specialty on the material of foreign-language sources and improve their level.	The possession of skills to make public speeches and presentations of scientific products in a foreign language.
Competence achievement indicator 3	The demonstration of the integrative skills necessary for effective participation in academic and professional discussions.	The knowledge of phonetic norms, general language vocabulary, neutral and scientific styles, terminology of the main specialty.	The ability to achieve communication goals, understand the content of texts on general and professionally-oriented topics graduate.	The possession of speaking, listening, reading and writing skills, the knowledge of rules of intercultural communication.

Table 1 shows that the detailed interpretation of the universal communicative competence developed at Peter the Great St. Petersburg Polytechnic University includes three indicators and three descriptors of its achievement. Although all knowledge, skills, and abilities are integrative, they can be considered differentially, which is convenient for building the learning process and evaluating the formation of individual competence components. It is supposed to master the skills of speaking, listening, reading, and writing at a level sufficient for effective participation of the student in academic and professional discussions. The emphasis is on students' knowledge of ICT and their ability to use it for communication and two-way translation of the professionally-oriented text. The skills of public speech and presentation of the scientific content in a foreign language in compliance with the rules of intercultural communication are also important for students.

The requirement to master a universal communicative competence, the formation of which is focused on the study of the discipline Foreign Language is designated, in general, as the ability to necessarily use a foreign language to perform professional tasks. It becomes obvious that the ability to use a foreign language in professional communication is the highest priority in the formation of this universal competence of masters. The development of professionally-oriented vocabulary will help graduates in solving communication problems related to further learning of their specialty.

Students should be able to use a foreign language in professional communication and interpersonal communication, conduct oral monological and dialogical speech on professional topics confidently, as well as to work with special literature in a foreign language independently to obtain professional information, to use electronic resources to improve their knowledge of a foreign language and work with professionally-oriented materials in a foreign language.

The universal communicative competence UC-4 can be generally defined as the ability to carry out speech activities, implementing communicative behavior based on phonological, lexical-grammatical, sociolinguistic, subject, and country-specific knowledge and skills. It is achieved by using various tasks and situations of communication within a particular subject area. The task of developing this universal competence in the process of implementing the proposed technology of interactive learning seems feasible to us in two interrelated aspects: algorithmized oral-speech activity and simultaneous written-speech representation of this activity.

2.2. The essence of interactive learning and computer-based tools of its organization

The term "interactivity" has an ambiguous interpretation. The word "inter" means collaborative, "act" - to do or perform. Therefore, the term “interactive” means the ability to collaborate or to be in dialogue with someone (a person) or something (a computer). Interaction is recognized as a special form of cognitive and communication activities organization, the most important feature of which is the ability of a person to interpret a situation and design his actions [20]. Thus, interactive learning is collaborative learning, in which the interaction between the teacher and the student is carried out, as well as between students both in the class and remotely.

Interactive forms of computer-based learning are designed to help train students in a practice-oriented competence approach. When teaching a foreign language, the use of interactive teaching methods, including the use of information and communication technologies, allows us to expand the range of professional communication based on specialized educational material.

Thus, the relevance of the research is determined by the social demand for training professional personnel who possess various competencies. The research meets the contemporary requirement to use the whole set of modern educational resources, including the potential capabilities of the Web 2.0 service for the formation of professionally significant competencies. The use of digital technologies for learning a foreign language does not cause difficulties for students, since they already have an instrumental competence, including the skills of using a computer and social services. Modern students are focused on the widespread use of computers in everyday life, so the introduction of electronic resources in teaching a professionally-oriented foreign language will help to increase the overall interest of students in the cognitive process.

Due to the rapid development of modern science and updating of terminological vocabulary in all areas of knowledge, when studying a foreign language at a university, it is necessary to use the best methods of its introduction and learning. Using the Web 2.0 service, which allows a person to implement mechanisms for independent work in an interactive mode, is a solution to one of the many existing problems of organizational and procedural nature associated with teaching a foreign language in a technical university.

Interactive learning technology is a process based on a system of rules for organizing interaction between students who communicate with each other and the teacher via a computer and provides students' oral and speech activities. The process of acquiring students' personal experience in the sphere of communication in a foreign language requires creating situations of foreign language practical use. The formation of a priority communicative competence listed in the sample program on English for non-linguistic specialties of higher education institutions is important for the use of the language as a communication tool.

Interactive computer learning (CSCL) can play a key role in shaping algorithmic thinking, developing action skills according to a given algorithm, and developing new algorithms [21-23]. Algorithms can be close to the concept of educational support scaffolding. The main characteristic of the scaffolding strategy is the gradual reduction of teacher assistance in the process of students' independent work. Pedagogical support for students at the beginning of training may be frequent and meaningful, while it is significantly or completely reduced by the end of the course [24,25]. Pedagogical support can be provided to the student in the performance of educational tasks that he cannot cope with at the moment; in the future, it will allow the student to complete such a volume or number of educational tasks that he can already cope with on his own.

CSCL provides students with the opportunity to collaborate using the developed algorithm, as well as using technological tools as a resource [26,27]. The issues of effective organization and high-quality methodological support for teaching students of technical universities using digital tools are one of the most relevant areas of research activities for teachers [28-30]. The choice of software should correspond to the goals of the discipline in which it is intended to be used. Moreover, a teacher should also take into account the algorithm for working with a specific software tool, which, in turn, can help open up new potential opportunities that were not previously available.

The use of digital technologies as a means of organizing and managing students' independent work leads to an increase in the efficiency of the educational process [31]. Automation of the knowledge control procedure provides more complete verification of students' learning levels. In the traditional organization, the knowledge control and self-control are episodic, a significant part of the

educational material is controlled fluently, or not controlled at all due to the lack of time. The use of interactive learning technology developed by us will help the teacher to solve the problems of forming strong communication skills and improving the lexical stock of students. Providing students with the opportunity to consolidate and activate the material explained by the teacher when performing algorithmized independent work in extracurricular time gives real prospects for improving the quality of training, especially for a weak contingent of students.

In our research, we are developing interactive learning technology, which is designed to solve several tasks such as learning your training direction through your self-educational activities, using the Microsoft Teams as an Internet resource. It seems to us that the preparation of homework using electronic resources and computer tools contributes to the strengthening of interest in the discipline, as well as the formation of universal foreign language competence. In the process of independent work, students perform tasks using a computer to work in the Microsoft Teams. As a control tool, we suggest sending audio records and screenshots of the dialogue to the teacher's page in Microsoft Teams. In the course of work in class, students demonstrate the completion of their homework.

Since the effectiveness of any training technology depends on the clarity of its structure and components, we will proceed to consider the algorithmization of educational activities as a preliminary stage of technology development. To ensure the effectiveness and reproducibility of any training technology, its developers need to think through the course of the training process, which should be divided into stages, which should consist of smaller procedural blocks or training steps. The entire process of preparing the technology for use can be considered an algorithmization of activities for the introduction of technology into the educational process.

2.3. Algorithmization of educational activities as a preliminary stage in the development of interactive learning technology

The term "algorithmization of educational and cognitive activity" denotes the introduction of technology in the learning process [32]. An algorithm is defined as an exact instruction to perform a sequence of actions aimed at achieving an objective for a certain type of task under certain conditions. Following the algorithm and taking into account the source data results in the desired effect. The idea of educational and cognitive activity algorithmization in education has recently attracted the attention of many researchers, especially in relation to training at a technical university. The study of algorithmization in the educational sphere is the objective of many authors' works [33,34], etc. In recent years, a number of works [35,36], and other authors have appeared, which consider the algorithm educational potential in relation to the learning process. The need to use algorithms in the educational process is justified in the works of foreign researchers [37,38], etc. Although the use of learning algorithms has become the subject of many researchers [39,40], etc., the analysis of scientific and methodological literature indicates the lack of theoretical and practical development of issues related to them in the light of modern requirements for digital technologies. The problem of algorithm effective use in the educational process remains open for theoretical understanding and experimental research.

The algorithmization of training involves the identification of algorithms for the activity of the teacher and students. The literature analysis shows that many authors [41-42], studying the problem of algorithm realization in teaching, expressed a similar opinion. They believe that in the algorithmic

processes, tools, and artists themselves are vital. They state that the interaction between teachers and students is more significant than agreeing on its modalities, that the willingness to changes to the algorithm is a priority to the original plan, and the performance is more important than the algorithmic requirements.

The algorithm for solving educational and cognitive tasks is understood as the structure of students' activities to find its solution in certain conditions. Consequently, it creates prerequisites for the assimilation of cognitive activity elements and ultimately leads to self-adaptation, self-regulation, self-organization. In the end, it can contribute to self-education.

Learning process algorithmization is widely used in the practice of teaching a foreign language [43-45]. The successful teaching of a foreign language is based on the management of actions, which are aimed at ordering the mental activity of students. Algorithmization helps to organize their mental activity following their language capabilities. All textbooks designed to prepare for such international exams as, for example, FCE (First Certificate of English), IELTS (International English Language Testing System), provide training algorithms for all aspects of these exams.

Based on the analysis of the main scientific developments, we have identified the main requirements that should be applied to the compilation and content of categorically different algorithms [46-48]: the conditionality of the algorithm choice in the current investigative situation; building a clear order of actions to achieve the final result; the uniqueness and simplicity of the algorithm, the possibility of its further transformation into a typical model of similar actions; mobility (dynamism), i.e., the possibility of significant changes in the transformation of the investigative situation, as well as the transformation of actions due to new and newly discovered circumstances.

The actual process of algorithm building should be done immediately after the system of elements it consists of is formed. In our opinion, such common elements can be the formulation of the task concerning the source data; the choice of methods, as well as ways to solve the tasks; the optimal sequence of educational and cognitive actions to solve the task; additional information that can help in solving the task, in particular, the circumstances that must be determined.

The review of the materials on the preparation for the well-known exams confirms the need for step-by-step development of the educational action sequence performed by students to achieve a guaranteed result, which is the main requirement of the technology. All the examples we have given are nothing but the means of pedagogical support for students, developed to meet the needs of teaching a foreign language solving one specific objective.

The pedagogical support offered by us is the introduction of a certain dialogic educational activity algorithm, which, as our testing shows, can be effectively used for teaching students of technical universities. The introduction of schematic supports can help the student to compensate for the missing abilities and will allow him to cope with tasks together with his group mates. Thus, both the introduction of algorithmization and schematic supports when creating a dialogue by communication participants contribute to the structuring of the dialogue and its relevance to the topic in an interactive mode.

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2.4. Implementation of interactive learning technology in Microsoft Teams

Many universities in the Russian Federation use Microsoft products as text data processing environments. Therefore, it is advisable to create a stable system for providing distance education using ready-made digital software solutions. The research methodology is based on the study of the distance learning technologies implementation for higher education programs using the electronic environment Office 365, distributed by the University's subscription to the software products Microsoft Office. The methodological base is determined by the capabilities of the Teams software environment modules, as well as by the theoretical analysis of other remote communication methods in the educational process. The practical value is determined by the vector of education development in the field of digitalization with the active use of ICT.

The use of the educational and cognitive activity algorithm in teaching disciplines of different cycles can be considered on the example of the well-known interactive educational systems that serve for training. Microsoft Teams is a designer of dialogue simulations. The choice of this service is justified by the fact that it has a well-thought-out functionality for the user's needs in comparison with other similar programs. Microsoft Teams is one of the most popular educational platforms. Due to our intention to use it in our research, it is necessary to clearly present its advantages. The choice of Microsoft Teams as unified communication and collaboration platform can be explained by a number of serious advantages over other platforms. The big advantage of it is that the use of the resource is in the public domain. Convenient mass mailing services will help teachers quickly share educational materials with students, as well as remind students of an important event or deadline. An equally important advantage is the available user interface.

Let's consider the didactic advantages of using Microsoft Teams to deal with the objectives of professional education in foreign language discipline. When using Microsoft Teams as a platform for teaching a foreign language, it is important to have constant interaction between the teacher and students, which ensures the continuity of the educational process and deeper planning of students' independent activities. Microsoft Teams creates conditions for organizing synchronous communication between Internet users. The teacher can, for example, invite students to create their dialogue and submit a written version and audio file, which can be used for didactic purposes. Thus, Microsoft Teams can become a means of organizing and conducting specially organized educational activities for students, where the main aim of students is to achieve educational objectives in communication, both in their native and foreign languages.

A characteristic feature of educational work in Microsoft Teams is productivity, that is, the result of activity on this communication and collaboration platform is a certain product such as messages, dialogues, etc. In teaching a foreign language, Microsoft Teams can be effectively used as an information resource for enriching students' language practice and developing their reading skills.

The study of research on the use of the second generation Internet technologies such as Web 2.0 in teaching a foreign language and developing speech skills [49-57], allowed us to identify and justify some methodological conditions that must be taken into account for the effectiveness of the elaborated algorithm for the speech skills development of technical university students based on Microsoft Teams. These methodological conditions include the following: the formation of students' ICT competence, the motivation of students to participate in network interaction, the ability to work

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in Microsoft Teams, and the presence of a structured learning algorithm. Table 2 shows the didactic features and methodological functions of the Microsoft Teams platform.

Table 2. Didactic features and methodological functions of Microsoft Teams.

Microsoft Teams didactic opportunities	**Microsoft Teams methodological functions for developing students' speech skills**
The ability to leave video and audio messages in online and offline modes.	Each student creates a video or audio record and sends it to another student.
The ability to leave messages in real-time and offline chat.	Using this platform students can communicate with each other, developing dialogic skills.
The ability to share the screen to demonstrate the work.	Students can demonstrate the project they are working on.

Table 2 shows that one of the didactic features of Microsoft Teams is the file-sharing option, the presence of voice and audio communication modules in chat in online and offline modes. Each student creates a video or audio record and sends it to another student. After viewing the record of a particular student, the teacher can post their comments in the chat. Thus, when preparing an audio or video message and discussing it further, students can develop all types of speech skills. Depending on the tasks set, after viewing or listening to the message in their comments, the teacher can express agreement or disagreement with the message author' opinion, highlight positive and negative points in the message content, and point out the message language (language correctness, the active vocabulary used, etc.). The teacher determines the algorithm for organizing the discussion.

One of the main criteria for choosing this software product is the ability to store a digital educational trace: the capabilities of the mail service as a tool for participants' remote interaction in the educational process by exchanging electronic messages; files created by students in formats .doc or .pdf (test papers, answers to final control questions) can remain in the system; stable operation on common hardware platforms (computer, smartphone); the friendly interface of the electronic educational environment that does not cause difficulties when working; minimal hardware support. Based on this platform, students can communicate with each other, developing dialogic skills. The thematic content of dialogues is determined by the foreign language training programs for students of non-linguistic specialties. It should be noted that this table includes another didactic feature of Microsoft Teams - the option to demonstrate the work by sharing the screen. Students can show the work they are doing (writing), or share educational information (pictures, texts, audio, video, etc.) that they are interested in, which can become material for discussion later.

The educational process is administered as follows. The student registers in the app, having previously received a personal username and password to log in to the program. After the completion of these actions, the teachers assigned by the educational institution to the students provide all possible assistance to them. By clicking on the Commands tab, the student gets access to the list of academic disciplines. Integrated voice and video communication tools are used for group or two-way communication. Notification of the class time with a notification of the user is

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implemented using the Meeting tab. This tool allows you to create an electronic schedule. During the lesson, all users are online, which Microsoft Teams notifies by an indication.

Having analyzed the technical capabilities of Microsoft Teams, you can identify many advantages that determine the use of this system in the remote educational process, such as unified formats for working with files for all participants in the educational process; the ability to control digital traces during the learning process; a student's work is performed in electronic form - this makes it possible to systematize the material further; multiple individual video viewing; link with the teacher; the ability to visually identify participants in the educational process; control of online presence in the system or visiting time; the possibility of complex dialogue (with file exchange and audio-visual communication). The disadvantages of working in the system are the relative requirement to the hardware capacity (a computer or smartphone must have more than two gigabytes of RAM for good performance).

3. Materials and Methods

To enhance the interactivity of dialogical speech, we suggest the algorithm developed by us for creating a dialogue between students using conflict, problem, or contradiction as an incentive to intensify the process of speaking to exchange evaluation information. The student is offered a certain problem and several solutions. The task of the student is to discuss the proposed solutions to the problem with the teacher and find the optimal solution.

3.1. The essence of the students' dialogic speech algorithm implemented in Microsoft Teams

The oral speech activity of the student is in creative reproduction and partial reconstruction of the problematic information content. This implies the need to analyze the problem and look for various possible ways to solve it. That is why, in our research, we decided to use the problem, contradiction, or conflict as the content core of dialogical speech.

The dialogue preparation algorithm can be divided into 1) using politeness formulae, 2) giving a generalized statement of the problem: keywords, 3) giving argumentation of the first participant's opinion, 4) giving argumentation of the second participant's opinion, 5) expressing disagreement, unwillingness to solve the problem, explaining the reason for disagreement 6) providing a solution to the problem (compromise), and 7) using politeness formulae.

At the preliminary stage, the student should carefully read the training task, paying attention to the selected content components and constraints (points in the plan) and the size of the monologue (its duration). In the first stage, the speaker uses politeness formulae and demonstrates the ability to initiate a conversation. The second stage is to request information and explain its necessity to the interlocutor. The third and fourth stages are two detailed answers to two questions of the interlocutor, observing the order when exchanging remarks. The fifth stage includes the speaker's polite decline of the other person's offer with an indication of the reasons. The sixth one is for requesting information from the interlocutor. In this task, it is necessary to demonstrate the compliance of the used lexical units and grammatical structures with the proposed communicative task and the correctness of lexical combinations and grammatical structures use. When completing the task, you must demonstrate the ability to start, maintain, and end a conversation, ask questions, and provide the requested information.

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This algorithm demonstrates step-by-step development of the activity sequence aimed at the achievement of the guaranteed result, which is the main requirement of the technology, which, in turn, is a means of clearly expressed pedagogical support for students on the way to the set objective. The support we offer is the introduction of a certain educational and cognitive activity algorithm, which, as our testing shows, can be effectively used for training students of technical universities. The introduction of schematic supports can help the trainee compensate for the missing abilities. The introduction of algorithmization and schematic supports when performing a training task can contribute to the systematic implementation of the task in an interactive mode.

In our study, we decided to use a problem, contradiction, conflict, or intellectual difficulty with a general context where the simplified interpretation of life situations are prevalent. The learners perceive these situations as their own issues and they stimulate the intensification of the learning process (table 3). Solving professionally-oriented problems allows you to synthesize various aspects of the disciplines studied by students.

Table 3. Educational actions algorithm of students in interactive mode.

	Participants	
Statements	First participant	Second participant
1	Politeness formulae	Politeness formulae
2	Generalized statement of a problem or conflict situation: keywords	The clarification with the repetition of keywords and emotion expressions
3	The first solution to the problem / conflict interpretation	Expressions for disagreeing / unwillingness to solve the problem, explanation of the reason for disagreement
4	The second solution to the problem / conflict interpretation	Expressions for disagreeing / unwillingness to solve the problem, explanation of the reason for disagreement
5	The third solution to the problem / conflict interpretation	Expressions for disagreeing / unwillingness to solve the problem, explanation of the reason for disagreement
6	The final solution to the problem / conflict interpretation (compromise)	Expressions for agreeing, explanation of the reason for agreement, creating an emotional background (assurance, joy, etc.)
7	Clarification of the second participant's opinion	Additional assurances that the opinion is final
8	Politeness formulae	Politeness formulae

This algorithm shows that students had to discuss three options for solving the problem or resolving the conflict before making a compromise. Here is an example of two completed task

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variants that are almost identical in content. Both conventional and algorithmized formats are based on the task of the textbook. It is formulated as follows: "A customer orders an item at an online marine shop Neptun. An item should be delivered within seven days. One month passed. The item arrived yesterday and an item doesn't work properly. The customer (C) phones the manager (M) of the marine company to complain" (Table 4).

Table 4. Dialogue 1.

	Participants	
Statements	Manager	Customer
1	Good Afternoon! Can I help you?	I have problems with my item.
2	What are the problems exactly?	My item is broken.
3	I'm afraid it isn't our policy to change items, sir.	I bought this item in your shop and it costs me a fortune.
4	I'm sorry about the problem, but I can't help you.	My item is broken and I should work on it. You should repair it.
5	I'm afraid you are mistaken.	Call me your chief.
6	He is out of the office …	

The typical student's dialogue 1 indicates that the objective of communication is not achieved by students. The topic was not fully disclosed, and the students demonstrated a limited vocabulary. The possession of lexical and grammatical skills is insufficient to solve the given communicative task. The dialogue is constructed illogically and incoherently, without adequate use of linkers.

Here is an example of an algorithmized dialogue 2 (Table 5) based on the same task from the student's book.

Table 5. Dialogue 2.

	Participants	
Statements	Manager	Customer
1	Good Afternoon! It's Marine Shop "Neptun". Can I help you?	I hope so. I am here to express my dissatisfaction with my recently purchase from your website. I have recently purchased a wallet and bag from your website, my order number is #1787654328. My parcel is arrived this morning, unfortunately there is some issue with my parcel. I'm going to complain about the item that was delivered by your courier yesterday.
2	We are sorry to hear that you didn't enjoy your experience at Neptun. Customer happiness is important to us and we're happy to review your	Firstly, the color I order was white but the delivered item is black. Secondly, the brand that I was order was Dior but my item is unknown brand.

	request to receive for service. What the problem exactly?	Finally, I saw some scratch on item and also one of item's rip does not work.
3	Well, this is not our problem, I'm afraid. You'd better contact our supplier…	The material quality is just awful. Besides the size is wrong. I ordered XL size… There is a hole in it. Moreover, it sticks.
4	The manager that is in answer for this aspect is on vacation at the moment, se we can't change it real fast. Anything else?	There's a gift that I did not choose. Could you just replace it? I think this matter deserve your urgent attention. I would like you to respond quickly by either giving my full refund or by sending again my item as I order.
5	I'm afraid it isn't our policy to change gifts, sir.	What? Are you joking? This item costs a fortune! It took me three years to save money on it and your service is out of this world!
6	I'm sorry about the problems, of course. Could you please leave it here until tomorrow when our specialists can examine it. Is it OK?	Great! Thank you for your time and consideration. I look forward to your services. Let's hope they will find the solution.

In the conventional version of the task, the objective was not achieved. The topic is not fully disclosed. The statement is constructed illogically, incoherently and it doesn't contain the adequate number of linkers. Despite some artificiality of its content, in an algorithmized version the task was completed, the result becomes more detailed and productive in comparison with the dialogue without algorithmized support and artificial complexity. Pedagogical support of students' educational and cognitive activities is especially relevant for weak students since this contingent experiences the greatest difficulties in communicating. Pedagogical support in the form of providing students with a specific and understandable learning algorithm contributes to increasing the degree of interactivity of dialogical speech.

The analysis of the algorithmized dialogue 2 (Table 5) presents three client problems, followed by the manager's indifferent remarks, and then demonstrates a compromise solution. In dialogue 2, which has a greater degree of interactivity than dialogue 1, students make more use of linkers and grammatical material from the student's book.

We consider it important to note that creating an algorithmized task requires more time, which is not always enough in class, especially in groups with a weak contingent of students. In this regard, it is recommended to transfer the preparation of this task to the students' independent work. As many students actively use Microsoft Teams, which makes it possible to communicate in synchronous mode, you can give a task using an algorithmic instruction. As our experience of testing this task shows, students willingly perform it and hand in a printed screenshot of the completed task, which can be presented in class.

We regard this mode of self-training as quite effective since it takes little time - about 17-30 minutes and does not distract students from other tasks. This allows you to save your time in class and use it more effectively. The completed task based on the algorithm can be monitored and tracked, which is especially important when working in large groups typical of technical universities. It is interesting to note that the extracurricular format of performing educational tasks was attractive for those students who are very reluctant to participate in class communication due to laziness, their nature, or lack of knowledge on the academic discipline.

Like any project activity, the method of developing students' foreign language speech based on the Microsoft Teams platform requires a clear sequence of stages and steps. We offer one of the possible algorithms for organizing students' activities aimed at developing their speech skills (table 6).

Table 6. Students' universal communicative competence development algorithm on the Microsoft Teams platform.

	Preparation stage	
№	Teacher's actions	Student's actions
Step 1	Introducing students to working in Microsoft Teams in class; introducing to the lesson topic, explaning the material.	Listening to the task, asking organizational questions
Step 2	Conducting instruction on registering training activities in Microsoft Teams	Learning how to work in Microsoft Teams
	Procedural stage	
	Teacher's actions	Student's actions
Step 1	Selecting a problem task and creating a dialogue (in the class and remotely); monitoring the work of students	Choosing the problem task, working on the dialogue
Step 2	Organizing the students' independent work in Microsoft Teams; monitoring students' independent work	Uploading the dialogue on the platform
Step 3	Organizing classroom activities, presentation of a collaborative document in the class; monitoring the presentation of students' dialogues, finding out problematic points and directing the students' activities	Presenting dialogues and taking part in their revision
	Final stage	
	Teacher's actions	Student's actions
Final step	Teacher's evaluation	Getting a mark for the dialogues

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Table 6 shows that at the preparatory stage, the teacher explains to students the essence of their activities in Microsoft Teams. Students listen to the teacher's instructions and ask organizational questions. At the procedural stage, the selection of a problem task and the preparation of dialogue are implemented. Students are introduced to the algorithm for creating a dialogue, distribute roles among themselves, and make up their dialogues, upload the screenshot of the document, and a record in Microsoft Teams. At this stage, they present the dialogue and find out the problem points. The teacher directs the students' activities. At the final stage, the teacher evaluates the students' work according to pre-defined criteria.

4. Discussion and Results

The research was conducted in several steps during 2019 - 2020 at Peter the Great St. Petersburg Polytechnic University. In total, the experiment was attended by 39 students from technical faculties such as the Institute of industrial management, economics, and trade. Twenty of them are in a control group and 19 are in an experimental one. The experiment included a statement, training, and control stages and was held in the framework of the discipline Foreign Language on the material of the English language.

4.1. Progress of the experiment to test the effectiveness of interactive foreign language teaching technology

The purpose of our experiment was to develop and test the effectiveness of digital technology using an algorithm developed by us based on a problem situation. It was used to intensify the learning process. Two groups were created from the participants of the experiment: a control group and an experimental group. The pedagogical experiment was conducted in three stages: initial, search, and control.

At the initial stage, the study of modern educational realities, search, collection, and analysis of facts, as well as the construction of a preliminary hypothesis of the study was carried out. At the search stage, experimental training was conducted based on the technology developed by us. At the third control stage, the experimental data were analyzed to confirm or change the previously put forward hypothesis.

In the control and experimental groups, the teacher asked to perform two exercises that ensure the oral practice of language material. In the experimental group, a brainstorming session was conducted, the problem task was selected, the algorithm of speech actions was introduced, and the dialogue was made up. In the control group, a dialogue was made upon the topic of the program student’s book, but without an algorithmic component. The texts for reading in the training session were the same in all groups, but the exercises were different.

In the course of the experiment, an audience assessment was conducted to determine the problem, highlight arguments regarding the question, express a reasoned point of view, request and exchange information, and clarify information.

The student had to complete four tasks for each topic, upload three screenshots, and one audio record onto the Microsoft Teams platform. The task was to solve a problem situation. The discussion took the form of a brainstorming session. Students exchanged views on the proposed topic. Any disagreements were recorded by the teacher on the blackboard. After the discussion, students

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express their opinions on the solution to the problem situation, and the teacher makes records of them in detail on the blackboard. The teacher's task is to write down all possible solutions to the problem. After all the solutions are written down, the teacher asks students to select those that they consider most important in terms of the problem situation or discussed topic.

The proposed solutions to the problem are discussed, the most successful ones are selected, and the reasons why these solutions are successful are discussed. The teacher can offer to classify statements, combine them into different groups, naming the basis of classification, that is, structure the statements independently. The teacher does not give answers to the problem situation. Students are also given keywords that they should use to create their dialogue. Students are introduced to the algorithm of educational and speech actions in interactive mode and an example of the algorithm.

The teacher conducted monitoring by tracking the list of screenshots in interactive mode on the Microsoft Teams platform. The student was given one point for each task completed on time. One point is also given for meeting deadlines. The maximum number of points that a student can get is 5 points. In case of failure to complete the task, the student loses 1 point.

The teacher uses screenshots and audio records obtained as a result of monitoring as a means of individual control of students' independent training. During the classes, the teacher selectively interviews several pairs of students, primarily those with a low level of training in a foreign language. If students do not attend classes and do not send completed tasks at the required time, the teacher has accurate information about what topics the student must answer to get credit. Monitoring allows the teacher to track a weak contingent of students and makes it clear what mistakes the student makes in the tasks.

We noted that the task on dialogue algorithmization, as well as the task on the creation of the record, was not uploaded on time. It made us improve technology: the teacher had to give a detailed explanation of the relevant tasks in the class. The monitoring results showed that starting with the third practice, the results of all students improved and stabilized. The interactive teaching technology of a foreign language, created by us, is an example of pedagogical support for students, carried out by structuring the students' independent work and its algorithmization.

Completing the tasks, the teacher evaluated the dialogue following a 10-point scale (Table 7). For evaluation, the following criteria were used: content based on the correct algorithm and the completeness of the answer (3 points), interaction with the interlocutor (2 points), lexical and grammatical components (2 points), and pronunciation (1 point).

Table 7. Students' answers evaluation table.

	English language skills	
Evaluation criteria	Competences	Points
Comunication task solving process (content)	C1	3
Interaction with the interlocutor	C2	2
Lexical aspect of the speech	C3	2
Grammatical aspect of the speech	C4	2
Pronunciation	C5	1

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For the evaluation of the students' oral speech, the following criteria were used: communication task solving process (content) criterion (C1); the criterion of collaboration with the interlocutor (C2), i.e. the ability of students to start a conversation, to support it, following the sequence of replicas, the ability to recover the conversation in the event of a failure to complete intercourse; the lexical criterion (C3), i.e. the vocabulary relevance to the topic, a wide range of lexical units, and the ability to develop the conversation; grammatical criterion (C4), i.e. grammatical relevance to a given situation, the variety and complexity of grammatical structures a person uses; the pronunciation criterion (C5), i.e. the articulation of sounds, stress, rhythm, and intonation. Criteria C1-C4 were evaluated on a scale from 0 to 3 points, the criterion C5 – on a scale 0-2. A clear correlation of universal communicative competence indicators in the control and experimental groups within the framework of the experiment final testing can be seen in Figure 1.

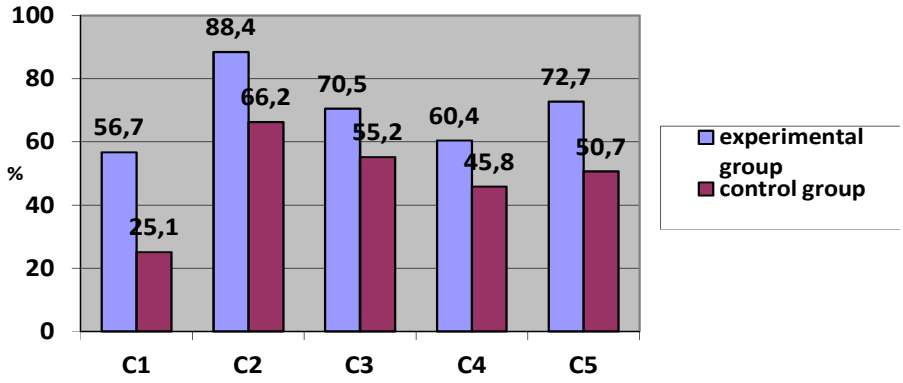

Figure 1. Increasing indicators of universal competence during the experiment in the experimental and control groups.

The analysis of universal communicative competence indicators showed that at this stage of training after the end of the experiment, the level of proficiency in the experimental group is 20.3% higher than in the control group in all its components. The highest average indicator is for the competence component - the collaboration with the interlocutor in the experimental group. The lowest level of ability to solve a communication task registered in the control group.

To determine the arithmetic exponents on two selections, we used to formulae. The maximum number of points that a student could get was m = 10. The average number of points $\overline{x_i}$ in the selection i is calculated by dividing the total number of all students' points in the selection x_{ik} by all students in the selection n_i:

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$$\overline{x_i} = \frac{\sum_{k=1}^{n} x_{ik}}{n}$$

Average percentage value $\overline{x_i^{\text{пр}}}$ of the selection i is calculated by multiplying the average number of points by one hundred percent and dividing the result by m = 10 (the maximum number of points taken as 100%):

$$\overline{x_i^{\text{пр}}} = \frac{100\% \times \overline{x_i}}{m}$$

The results of the evaluation in class, obtained during the technology testing show a preponderance in favor of the experimental group. To get the final charts and graphs, we summarized the percentages of class learning in the experimental group and the control group. After two semesters of training, the average result in the experimental group was 94.5%, and in the control group – 73.3%. This is the total result of the universal communicative competence formation.

The chart below clearly illustrates the percentage difference in the results of the class dialogue between the experimental group and the control group. It was determined that the average value in the experimental group was 94.5% and in the control group 73.3%. Therefore, the experimental group exceeds the control group by 21.2% (Figure 2) in the ability to solve a communicative task, lexically formalize speech, and interact with the interlocutor.

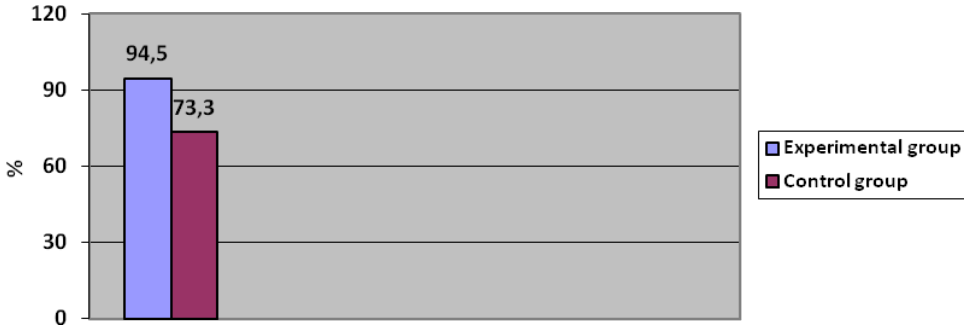

Figure 2. The results of the universal communicative competence formation.

The interactive learning technology implemented in our study guarantees a fairly high level of learning quality. According to the results of the pedagogical experiment and testing of interactive technology in practice, the experimental groups that used this technology showed much higher results than the control groups in which training was conducted according to the traditional scheme. This indicates a higher level of foreign-language universal communicative competence formation in the case with those students who studied using the technology we offer.

5. Conclusions

In conclusion, it should be emphasized that special importance in teaching a foreign language in the master's program of a technical university is connected with the use of interactive learning methods in the educational process. A foreign language teacher needs to improve the conditions for organizing independent work of students, namely, the forms of students' class and extracurricular work, and this primarily concerns the organization of structured extracurricular independent work, to increase the level of students' learning.

We have considered the competence model of technology implementation, which will ensure the students' universal communicative competence formation. The communicative aspect of the technology is implemented in an interactive learning environment on the Microsoft Teams platform and is successfully refracted in the main format of algorithmized dialogue. Universal communicative competence is formed in the oral speech by algorithmization of students' collaboration in the study of technical issues with the maintenance of dialogues written records and podcasts in a self-paced work. Structuring students' independent work in an interactive mode seems to us an important didactic resource for improving the quality of language training in a technical university. Interactive learning using ICT creates conditions for educational dialogue and reflects the form of collaboration between the teacher and students, and students among themselves.

Wider implementation of algorithmization in the educational process at a technical university, especially in conditions of training time deficit, will make it possible to optimize the learning process itself and choose the most rational and optimal ways to ensure it; avoid mistakes in solving tasks; increase the speed of making procedural and tactical decisions; anticipate the possible consequences of their adoption and the likely outcome of tactical risk situations; fully use significant information. The algorithm we created for constructing educational and speech actions of students using digital technology of co-education, taking into account monitoring and control tools, is a modern means of masters' universal communicative competence formation. The widespread use of interactive learning technology can be extrapolated to other humanities disciplines of higher professional education.

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