UDC 811.111'276.6:004.738.5

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PROCEDURE FOR COOPERATIVE PROFESSIONALLY ORIENTED WRITTEN COMMUNICATION OF PROSPECTIVE PROGRAMMERS

Abstract. In the age of information and communication technologies the English language plays a significant role both in oral and written communication. The successful performance of computer programming specialists largely depends on their level of lexical competence, so a university course of English for specific purposes (ESP) focused on its development, can be exceedingly useful in the professional training of prospective programmers. This study aims at investigating the effectiveness of the collaborative professional written communication in ESP classrooms to enhance future programmers' writing skills as well as improve their English lexical competence. To validate the efficiency of the algorithm, the author conducted experimental teaching of the 5th-year students of the Faculty of Applied Mathematics and Informatics at Ivan Franko Lviv National University in 2017–2018 academic year. The stages of the algorithm implemented in order to advance the level of English lexical competence were elaborated. Efficiency of the algorithm has been proved on the basis of the results obtained from pre- and post- experimental assessment of students from experimental and control groups. On a practical level, the participants' writing skills were examined through an English written test prior to and after cooperative learning activities were provided. Growth rate in students from experimental group significantly exceeded the students' results in the control group. Thus, the efficacy of the suggested algorithm used for developing lexical competence in computer programming students has been proved. In light of the findings, the researcher indicates that teachers can benefit from applying the proposed methodology for collaborative professional writing in English classes, which may in turn develop students' writing skills and improve their English lexical competence.

Keywords: cooperative learning; ESP; lexical competence; written communication; professionally oriented; group work; programmers.

1. INTRODUCTION

Problem statement. Globalization and integration economic possesses, requirements of the modern labour market to future programmers determine the need to be fluent in foreign languages, particularly English for specific purposes (ESP). Peculiar features of programmers' work presuppose maintaining correspondence in English since customers of Ukrainian IT companies are mostly foreign clients. Such written communication, including documents, must be lexically, grammatically and stylistically correct. As a result, demands to foreign language teaching of would-be programmers in higher educational institutions are rising. The level of English language lexical competence in professionally oriented written communication has become one of the priorities in ESP teaching. Moreover, the author completely agrees with the scholars Mykytenko, Rozhak and Semeriak [1] who state that the successful functioning of IT specialists significantly depends on their level of foreign communicative competence, which we consider to be one of the fundamental conditions for a prosperous career of university graduates.

Analysis of recent research and publications. Vocabulary knowledge is of great significance for language proficiency as it pervades all languages skills [2]. Foreign language acquisition researchers indicate that vocabulary learning is an indispensable part of second

language learning and constitutes a substantial base in perceiving a language [3]. Taking into account this essential role of vocabulary, the issue of forming foreign language communicative competence has been researched by such scholars as Nation [2], Hymes [4], Richards [5], Whyte [6], Bigych [7], Nikolaeva [8], Zadorozhna [9], etc. The improvement of foreign language professional vocabulary is based on the development of conceptual and categorical system while creating a network of major terms of a specific sphere [10]. As stated by Yufrizal [11], concerning communicative competence, students of English as a foreign language clearly understand the main purpose of learning it, namely, development of their ability to communicate in the target language. In the context of teaching ESP writing, the concept of communicative strategies is of paramount importance. These strategies are supposed to be targeted at students' ability to implement step-by-step writing activities in professionally oriented communication aimed at presenting participants' behaviour so as to reach a certain communicative aim [1].

During the recent decades different aspects of forming foreign language lexical competence have been studied by Caro and Mendinueta [12], Skliarenko [13], Laufer [14], Tereshchuk [15]. A comprehensive definition of lexical competence has been provided by Caro and Mendinueta [12] who view it as a cluster of knowledge (form, meaning and use of a lexical item), abilities and skills, which a person develops and deploys in various contexts of communication. Defining the process of developing foreign language competence, Laufer [14] determined it to be a learner's process along the interlanguage continuum from a non-existent knowledge towards native-like competence.

Distinguishing features of implementing diverse approaches and principles to teaching foreign languages have been discussed in research papers by the following scholars: Harmer [16], Mukalel [17], Dalton-Puffer, Nikula and Smit [18], Jacobs and Hall [19], Pidkasystyi [20] etc. In particular, Richards [5] was investigating how varied concepts of teaching historically led to various understandings of the essential skills of teachers and to different approaches to teacher training and teacher development. The effectiveness of the teacher's work in the classroom and the overall fruits they will reap will depend on the effectiveness of their approach [17, p. 43]. Jacobs and Hall [19] stress the importance of cooperative learning principles and techniques since these tools help teachers to encourage mutual helpfulness in the groups and active participation of all members.

Theoretical and methodological basis for teaching foreign languages for specific purposes has been researched by Dudley-Evans [21], Hutchinson and Waters [22], Morska, Skibska, Sulym and Masztalir [23], Semeriak [24], Kornieva [25] etc. As indicated by Dudley-Evans [21], teaching ESP has developed its own methodology and its research clearly draws on research from various disciplines in addition to applied linguistics. Moreover, this openness to the insights of other disciplines is a key distinguishing feature of ESP. The author is of the same opinion with those researchers [26] who identify professionally oriented foreign language communicative competence as integrative individual peculiarities of specialists reflecting their willingness and capacity to participate in professionally oriented intercultural and interpersonal foreign language communication based on subject and linguistic knowledge, skills and competences accompanied by future professional activeness which help students to resolve professionally essential problems. Scholars [23] also stress the importance of implementing an integrated approach to professionally oriented foreign language teaching of future programmers. The primary idea of this approach lies in considering all aspects and parts of educational integration in order to make syllabi more efficient and mark incorporative elements which may foster the learning process.

Specific features of communication with the help of information and communication technologies have been analysed by such scholars as Romashenko [27], Morska [28], Tynkaliuk & Semeriak [29]. According to Ipek and Ziatdinov [30], educational technology

facilitates cognitive and constructive learning theories so as to attain connection between guidance and studying. Hence, educational technologies promote learning by designing learning environment, adjusting resources and catering for educational tools. Moreover, the Internet provides means to construct alternative and comparatively secure environment where an individual is deprived of discouraging aspects. Modern information and communication technologies enable teachers to organize real-time interaction with students [31]. According to the research on mastering subject-specific vocabulary [32], e-learning stimulates teamwork, boosts interpersonal skills development, enhances students' motivation to memorize professional vocabulary.

The purpose of the article is to test the hypothesis concerning the effectiveness of the algorithm for cooperative professionally oriented written communication aimed at improving English lexical competence in professional writing of prospective programmers.

It presumes to solve the following **objectives**:

1) conduct pre-experimental evaluation of the level of English lexical competence in professionally oriented written communication of participants of the experiment in order to divide them into Experimental Group (EG) and Control Group (CG);

2) implement the algorithm for cooperative professionally oriented written communication while teaching the Experimental Group;

3) conduct post-experimental evaluation of the level of English lexical competence in professionally oriented written communication of students from both EG and CG in order to interpret obtained data and prove the hypothesis.

The **hypothesis** states that advanced level of English lexical competence in professionally oriented written communication of would-be programmers within Master's programme can be achieved by implementing the experimental methodology, namely, the algorithm for cooperative professionally oriented written communication.

2. THE THEORETICAL BACKGROUNDS

The concept of the algorithm for cooperative professionally oriented written communication presupposes students' collaborative writing of drafts and their individual writing of final versions of professionally oriented letters by implementing a corresponding procedure and techniques and using appropriate methods of solving problems at practical ESP classes at university as well as a part of self-guided work at home.

In the present research **cooperative professionally oriented written communication** is considered to be a form of joint interaction between the participants of professional activity aimed at implementing professional responsibilities, roles and functions, exchange of information in a written form to meet professional communication needs. Consequently, English language cooperative professionally oriented written communication of future IT specialists is regarded as a process of creating English written messages of professionally oriented content which belong to a certain genre and are characterised by appropriate grammatical structures, stylistic and lexical features and include professional vocabulary, in particular IT terms, performed in groups.

The **algorithm for cooperative professionally oriented written communication** (see Table 1) is understood as a sequence of actions which effectively combines forms of learning organisation (practical classes and self-guided work), teaching methods (problem-solving methods), appropriate procedures and techniques, involves the use of modern information and communication technologies, attracts corresponding levels of students' autonomy and ways to manage students' learning activities during their self-guided work. The proposed algorithm corresponds to defined stages (receptive, receptive-reproductive, reproductive) of formation

of English lexical competence in professionally oriented written communication of IT specialists in-the-making.

In order to implement the algorithm for cooperative professionally oriented written communication students were supposed to make use of **collective writing method**, which we define as a method of group work which takes place in the classroom as well as at home aimed at planning, drafting and producing a joint written work. This method is characterised by the following features:

– interaction between participants throughout the entire writing process whether it is brainstorming, writing a draft or reviewing a final version;

– shared responsibilities among participants: everyone involved into the collective writing process has the power to make decisions and possesses equal responsibilities for the final version;

– collaborative production of one single and specific text of a certain genre and style.

As far as the present experiment was dedicated to English lexical competence in professionally oriented written communication, the author's choice of the type of self-guided work was based on Rapoport and Turiy's [33] classification performed according to types of speech activity and aspects of language. The mentioned classification indicates self-guided work in such activities as reading, listening, speaking, writing as well as learning lexical, grammatical and phonetic material. Besides, in order for students to promote the mechanism of self-guided foreign language learning it is significant to allocate them in the position of the teacher [34].

Based on Pidkasystyi's research [20, p. 108], we consider self-guided work to be a system consisting of the following components:

– conceptual;

– operational, which involves diverse actions, operating skills and abilities, pedagogical methods and techniques;

– rewarding, which includes new knowledge, methods of solving problems; new experience, ideas, views and traits.

During students' self-guided work diverse levels of students' autonomy with corresponding teacher's manner to manage students' self-guided work are triggered, namely:

– rigid managerial manner with partial autonomy;

– relatively rigid managerial manner with semi-autonomy;

– relatively flexible managerial manner with partially dependent autonomy;

– flexible managerial manner with full autonomy [35, p. 15].

The choice of managerial manner depends on various factors, mainly: educational aim and objectives; level of formation of students' competence and its components; students' motivation to self-guided work; skills of self-education; experience of self-guided work; content of self-guided work; validity of selecting educational material for self-guided work [9, p. 21]. Thus, from the first steps of improving English lexical competence in professionally oriented written communication of prospective programmers rigid managerial manner can be combined with relatively rigid or even flexible one according to the abovementioned factors. In the process of mastering students' writing skills and abilities teacher's managerial manner of controlling students' self-guided work can be changed: rigid control is changed into relatively rigid, relatively flexible and later into flexible [9, p. 21].

Table 1

The algorithm for cooperative professionally oriented written communication of prospective programmers
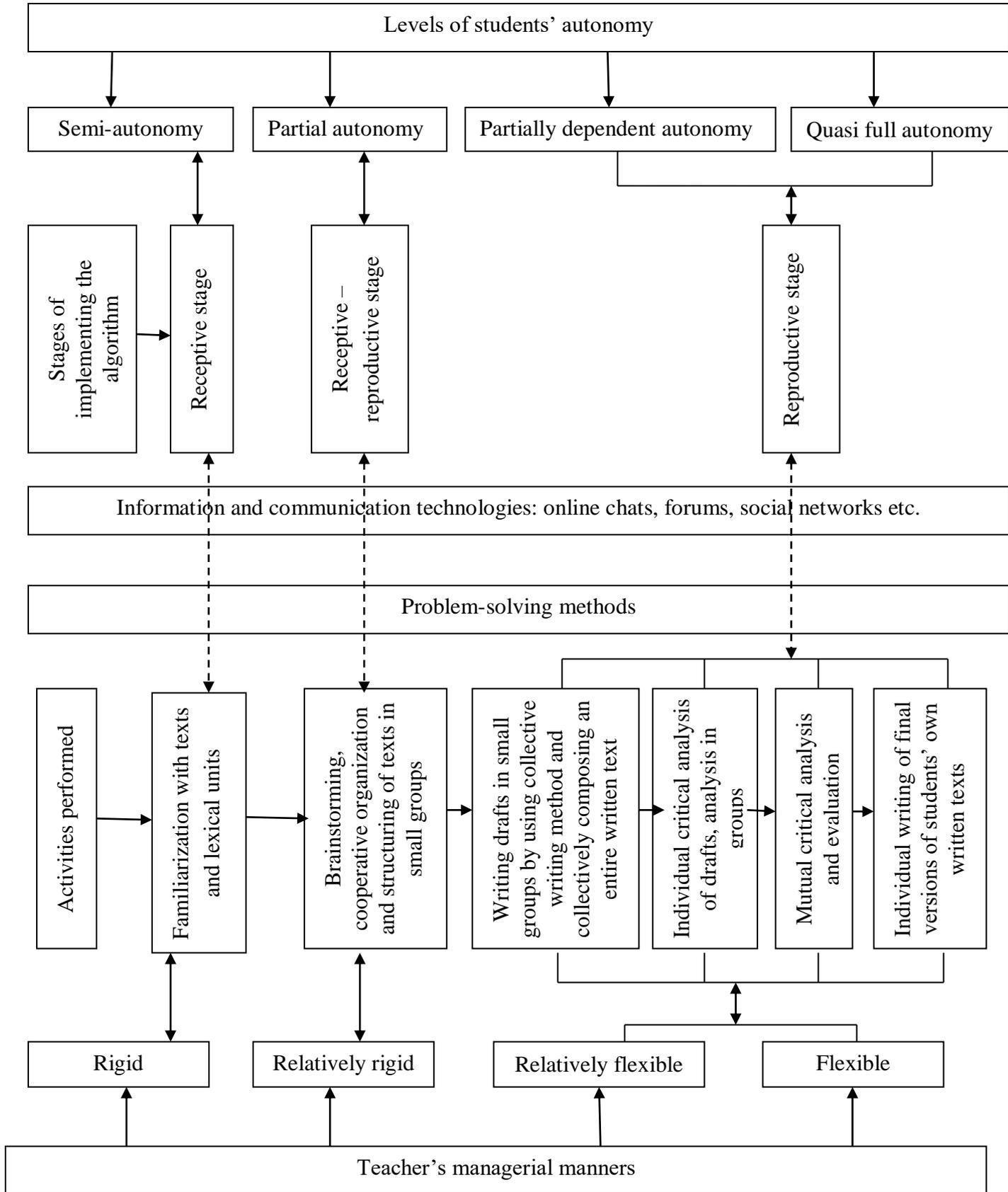
3. RESEARCH METHODS

The present methodological experiment was organized in order to solve a certain methodological problem by implementing a particular educational process which included cooperation of the researcher and participants of the experiment [36].

The main characteristics of the methodological experiment include [36, p. 39-40]:

1) time limit;
2) hypothesis;
3) clear plan;
4) structure of the experiment based on the hypothesis;
5) creation of favourable conditions;
6) measurement of relevant knowledge, skills and competence on the basis of pre-experimental and post-experimental evaluation.

3.1. Participants

The effectiveness of the algorithm for cooperative professionally oriented written communication was researched while conducting the methodological experiment at the Department of Foreign Languages for Sciences of Ivan Franko Lviv National University (Ukraine) during 2017-2018 academic year. A total of 96 future masters of Applied Mathematics and Informatics Faculty constituted the sample for this study. The participants were of similar age, ranging from 21 to 23 years at the time of conducting the study. Of the sample, 60 (62,5%) were male and 36 (37,5%) female, reflecting a preponderance of males in IT specialties in most Ukrainian universities. In order to prove the efficacy of the algorithm for cooperative professionally oriented written communication, students were subdivided into two groups: Experimental Group (EG) and Control Group (CG), 48 participants each, which formed the experimental pair. In the Experimental Group students were divided into 12 small groups and they were asked to undertake written tasks cooperatively as well as individually. In order to accomplish a group assignment, groupmates had to agree beforehand when to meet and which information and communication technologies to use.

3.2. Research design

The study was a naturalistic, basic, vertical-horizontal experiment.

Dependent variables included the essence of forming English lexical competence in professionally oriented written communication, selected material and methods of solving the problems.

Independent variables were as follows: duration of the experiment, equal number of participants, types of tasks for pre-experimental and post-experimental evaluation, criteria and indicators of the level of English lexical competence in professionally oriented written communication.

3.3. Procedure

The author distinguished between three stages of the present experiment, namely:
− preparatory, where the material was selected, the algorithm for cooperative professionally oriented written communication was presented, a test was conducted in order to determine the level of English lexical competence in professionally oriented written communication, discussions with ESP lecturers were organized;

- experimental, which involved the conduction of experimental education in EG, purposeful observation of participants' cooperative professionally oriented written communication during classes and self-guided work;
- post-experimental, which included testing of participants in order to determine their level of English lexical competence in professionally oriented written communication after the experimental education, interpretation of experiment data using mathematical statistics, proving the hypothesis.

The level of formation of English lexical competence in professionally oriented writing of future programmers can be measured by the number of correctly completed tasks which corresponds to certain quantitative indicators of criteria for assessing target competence as well as the amount of time spent on these tasks. Based on the analysis of the content of Common European Recommendations and a number of works dedicated to the assessment of English professionally oriented communicative competence and derived language and speech competencies, we have developed descriptors of the formation of English lexical competence in professionally oriented written communicative of would-be IT specialists at the autonomous level C1, represented by a system of criteria of knowledge, skills, and abilities that are components of English lexical competence in professionally oriented written communication (see Table 2).

Table 2

Descriptors of the formation of English lexical competence in professionally oriented written communication of prospective IT specialists at the autonomous level C1

Criteria for the level of formation of English lexical competence in professionally oriented written communication of prospective IT specialists	Descriptors of criteria for the level of formation of English lexical competence in professionally oriented written communication of prospective IT specialists
– correct general lexical formation of a written statement: correct use of lexical units in writing, mastery of terminological units in the field of specialization, demonstration of sufficient vocabulary to achieve a communicative goal in a situation of professionally oriented written communication in accordance with the chosen style and genre;	– a student completes written exercises and tasks of high level of complexity, reflecting lexical material to certain topics, problems and situations of professionally oriented written communication of IT specialists, while demonstrating the correct lexical formation of a written statement, which is the correct use of lexical units, including terms, appropriate use of key phrases for the implementation of appropriate communication strategies, demonstration of sufficient vocabulary to achieve a communicative goal in a situation of professionally oriented written communication in accordance with the chosen style and genre;
– demonstration of correct grammatical use of lexical units, except for a few minor mistakes that do not affect the understanding of the content of a written statement; – ensuring a correct lexical arrangement of compositional correctness of the text according to the style and genre, demonstration of logics and	– a student uses grammatically correct lexical units, makes his/her own statements within specific topics, problems and situations of professionally oriented written communication of IT specialists; – a student easily creates multi-genre written discourses in the process of writing written works of different formats, demonstrating the correctness of compositional structure of the text

sequence of presenting a statement, integrity, coherence, completeness, addressability and compliance of selected lexical units to the characteristics of professional discourse of IT specialists, presence of connecting elements between parts of the text at the level of sentences in paragraphs and semantic paragraphs: linking words, conjunctions of concordance and subordination, insert words, etc; – correspondence of vocabulary to the style and genre of written statements as well as the communicative goal and situation of professionally oriented written communication; – demonstration of compensatory skills of using lexical units in the process of information transfer using paraphrasing techniques, formulation of complex statements with the help of simpler language means.	and its lexical arrangement according to the style and genre with a high degree of integration of lexical and stylistic correctness with logics and sequence of presenting a statement, integrity, coherence, completeness, addressability and compliance of selected lexical units to the characteristics of professional discourse of IT specialists, presence of connecting elements between parts of the text at the level of sentences in paragraphs and semantic paragraphs: linking words, conjunctions of concordance and subordination, insert words, etc; – a student easily creates written statements of a certain style and genre using functionally appropriate vocabulary in accordance with a given communicative goal and the situation of professionally oriented written communication; – a student demonstrates free mastery of compensatory skills of using lexical units in the process of information transfer using paraphrasing techniques, formulation of complex statements with the help of simpler language means.

These criteria and descriptors were used in the present pedagogical experiment in assessing the level of formation of English lexical competence in professionally oriented writing of future programmers in the process of designing the developed methodology for the formation of this competence in first-year master's students majoring in applied mathematics and informatics at Ivan Franko National University of Lviv. Thereby, justified criteria and descriptors were used within pre- and post-experimental assessment of the level of formation of English lexical competence in professionally oriented written communication of future IT specialists.

The tests, offered to students for pre-experimental and post-experimental evaluation, aimed at demonstrating students' mastery of lexical skills and abilities in writing which are components of English lexical competence in professionally oriented written communication. The tests consisted of multiple choice tasks, tasks of matching terms with their definitions, filling in the gaps with a correct form of terminological verbs and writing an e-mail of certain style and genre which correspond to the communicative goal and situation of professionally oriented written communication. The evaluation of students' performance was carried out on the basis of the above criteria, their indicators and descriptors using a100-point scale (see Table 3).

100 points were distributed among five tasks of the test and were calculated according to the correctness of conducting the tasks.

According to the results of assessing the level of formation of English lexical competence in professionally oriented written communication, the participants of the experiment were divided into EG and CG 48 students in each group who formed an experimental pair.

At the experimental stage students of EG were given sufficient amount of time to participate in chat and forum discussions, write their drafts and final versions of professional letters, implementing the algorithm for cooperative professionally oriented written communication. Students of CG were taught according to the general methodology accepted at Ivan Franko Lviv National University.

Table 3

Scale evaluating the level of English lexical competence in professionally oriented written communication of prospective programmers

Amount of points	Indicator of the level of English lexical competence in professionally oriented written communication
90-100	English lexical competence in professionally oriented written communication is at C2 level
80-89	English lexical competence in professionally oriented written communication is at C1 level
70-79	English lexical competence in professionally oriented written communication is at B2 level
60-69	English lexical competence in professionally oriented written communication is at B1 level
50-59	English lexical competence in professionally oriented written communication is at A2 level
40-49	English lexical competence in professionally oriented written communication is at A1 level
0-39	English lexical competence in professionally oriented written communication is not formed

3.4. Stages of implementing the algorithm for cooperative professionally oriented written communication

At the **receptive stage** of implementing the algorithm for cooperative professionally oriented written communication, students perused texts – model samples of a certain genre and examined corresponding lexical and terminological units. The process of selecting educational material was aimed at students' acquisition of lexical knowledge, lexical skills, knowledge of writing, writing abilities and skills. In the process of selecting educational material the author took into consideration students' educational needs, dominant genres and situations of professionally oriented communication of future programmers.

In the present pedagogical experiment carefully selected educational material provided students with language and speech samples which developed perception and understanding of a foreign language. The usage of representative samples of texts in various genres illustrated specifics of using lexical units, speech models and grammatical structures in situations of programmers' professionally oriented written communication. Educational material assisted the formation of database of lexical knowledge and knowledge of writing.

Texts of dominant genres in programmers' professionally oriented written communication (private and business e-mails, chats, forums, posts on electronic message boards, memo, and reports) and lexical units were considered to be units of selecting educational material in the present experimental research. The selection of lexical units was conducted within thematic fields taking into account professional needs of prospective specialists who studied a foreign language on the basis of oral and written foreign authentic

texts. The written texts were selected from among English authentic texts dominant in programmers' written professionally oriented communication.

The lexical units were opted according to the following criteria: semantic value as the ability to express concepts significant for programmers' professional writing, stylistic correspondence to certain dominant genres of programmers' professionally oriented written communication, connectivity as the ability of lexical units to combine with other lexical units in programmers' professional writing, frequency of usage in samples of programmers' professionally oriented written communication.

The texts were selected according to such criteria as: authenticity, structural and stylistic templates, correspondence to dominant genres of communicative situations in programmers' professionally oriented written communication; concordance with genres of programmers' professional writing, authority of sources of selection.

At the **receptive-reproductive stage** of implementing the algorithm for cooperative professionally oriented written communication, the brainstorm method was used in order to create favourable atmosphere, select a moderator who generated his/her own ideas and took notes of participants' ideas. Then in small groups (4 students) participants discussed their ways of solving a particular problem, executed creative analysis of indicated ideas in order to arrive at a result-oriented solution and perform a communicative task. On the basis of brainstorm results, the planning, collaborate organization and structuring of written letters were performed in small groups. At this stage the motivation-stimulating environment was created in order to maintain incorporation of the participants into the professionally oriented collaboration intended to improve the communication in professional settings [37].

At the **reproductive stage** of implementing the algorithm for cooperative professionally oriented written communication, students were preparing their drafts in small groups using collective writing method, according to which each student of a group was responsible for writing a certain part of a common written task within communicative situations of programmers' professionally oriented written communication. Later all group members were collectively composing an entire written letter. The students were informed about such notions as communicative situations and communication strategies. Otherwise, their unawareness would have led to communication breakdown [38].

Practical training in composing drafts and final versions of their own written texts enabled students to expand their lexical capabilities and writing skills, namely:

- determine the purpose, main idea of the message, coherence and cohesion between the expressed opinions;
- use correctly lexical units, particularly terminological ones;
- acknowledge the role of lexical and stylistic means of the English language in the effectiveness of message transmission;
- select verbal means in order to reach a communicative goal.

The aim of this stage was to develop lexical skills in the correct usage of lexical units in texts of various genres of programmers' professionally oriented written communication considering stylistic relevance and connectivity; develop students' skills to prepare texts of certain genres of programmers' professionally oriented written communication; develop lexical awareness.

At first students performed critical analysis of drafts individually, using a list of teacher's evaluation criteria. The list of evaluation criteria used during the pedagogical experiment had been deduced from a number of research works of national and foreign scholars and included:

- logics and sequence of layout;
- usage of linking elements within the text as well as paragraphs and sentences;
- division into contextually meaningful paragraphs with the help of linking words, subordinate connectors, parenthesis etc;

– correspondence of the style of writing to the communicative goal, communicative situation and selected genre;
– correct lexical design of a written text: proper usage of lexical and terminological units, demonstration of sufficient vocabulary obligatory to reach a communicative goal in a certain communicative situation according to a particular genre;
– correct usage of grammatical structures except a few mistakes which did not hamper the understanding of a written text.

Participants of the experimental research performed critical analysis of the drafts at first individually and later in small groups implementing a list of evaluation criteria introduced by the teacher. Thereafter participants exchanged their drafts within groups and critically analysed them. In the process of groupwork mutual checking, students were proofreading, analysing and evaluating other group works, applying the same list of evaluation criteria. At this point the benefits of cooperative writing were clearly visible. Firstly, cooperative writing helped a group of students to apply their potential power in order to perform the task. Secondly, it helped group members to get accustomed to peer-review while completing their writing. Besides, cooperative writing motivated the participants to take into account their audience [39, p. 338-339].

Later at this reproductive stage of implementing the algorithm for cooperative professionally oriented written communication after self-evaluation and mutual evaluation, the participants individually wrote their texts according to the same communicative task. Considering critical remarks, possessing a complex of acquired abilities, skills and knowledge, the students individually created final versions of their letters evaluated by the teacher.

In the process of implementing the algorithm for cooperative professionally oriented written communication it is advisable to consider the fact that teaching writing also involves mastering students' ability to recognize and qualify speech and language errors. During the research students were supposed to demonstrate their ability to exploit diverse editing techniques. The correction process took place under conditions of self- or mutual control aimed at evaluating the progress of developing English lexical competence in professionally oriented written communication [40, p. 310]. Prompt evaluation of students' written letters helped to identify gaps in the content and organization of the process to improve prospective programmers' English lexical competence in professionally oriented written communication and provided for their correction.

The level of students' autonomy (from semi-autonomy to quasi full autonomy [9, p. 24]) and teacher's managerial manners (from relatively rigid to flexible) at this stage highly depends on students' level of English lexical competence in professionally oriented communication and the nature of interaction between participants of the educational process: subject-object, subject-subject, object-subject or completely subjective.

In the present experiment the author used the term "quasi full autonomy" introduced by Ukrainian scholar Zadorozhna [9]. At higher educational institutions (universities, colleges) full autonomy is performed only during students' self-education, when students individually determine educational goals, ways of reaching them, methods and techniques of education, select educational material, construct their individual learning trajectory and set its pace, perform self-control, self-correction and self-evaluation.

Since autonomy within university study includes not only the above-mentioned components but also self-determination of learning goals taking into account requirements of the curriculum and syllabi, students' educational needs and interests, possibility to consult with a teacher, we can apply only quasi full autonomy [9, p. 23-24] within students' self-guided work while implementing the algorithm for cooperative professionally oriented written communication.

3.5. Application of information and communication technologies while implementing the algorithm for cooperative professionally oriented written communication

The process of compiling drafts and final versions of students' written texts was performed at the reproductive stage of implementing the algorithm for cooperative professionally oriented written communication so as to boost students' English lexical competence in professional writing. In order to save limited classroom teaching time devoted to studying ESP, the abovementioned groupwork task was completed by the participants remotely with the help of computers and information technologies (in particular, online chats, forums, social networks, social educational platforms etc.).

Application of computers and ICT allowed the author to implement a specific principle of immersion into a communicative situation of professionally oriented written communication.

As stated by Tarnapolskyi and Vyselko [41], the term immersion in scientific and pedagogical works can be used as:

- educational method of studying a foreign language by teaching one or several non-philological subjects using this particular language;
- specific type of integrated foreign language teaching aimed at mastering a foreign language for specific purposes.

Within the present pedagogical research, immersion into situations of professionally oriented communication was regarded to be a specific type of integrated teaching performed applying special means of a foreign language [42]. Immersion promoted a distinctive organization of teaching process with the implementation of the algorithm for cooperative professionally oriented written communication. ICT used in the experimental research, namely multimedia computers, local and global information networks (online chats, forums) enabled the participants to obtain access to, save, transmit, create and change information.

Ukrainian researcher Bykonia [43, p. 114] indicates that one of the major tasks of computer linguodidactics is determination of information and communication technologies which facilitate improvement of English writing competence, increase autonomy, productivity and creativity during self-guided work. In this perspective, ICT intensify and modernize the training system as well as improve education quality [44].

In the process of using the abovementioned means of information and communication technologies and specially created virtual environment, the following principles were actualized: interactivity, mobility, creativity, stimulation, self-education [45]. Interactivity ensured active participation and cooperation between students and the teacher. Students as well as the teacher were considered to be parties in the education process with equal rights. Creating comfortable conditions for interactive learning provided students with the feeling of their success and intellectual ability Moreover, by creating a favourable virtual teaching and learning environment, the author designed a system which ensured effective training, keeping in mind participants' individual educational needs and encouraging supportive cooperation [29].

Application of modern information and communication technologies enabled participants of the learning process to engage in educational interaction, asynchronous and synchronous in time, place and pace [46]. Modern means of information and communication technologies facilitated prompt subject-subject and subject-object feedback from the teacher and other students by electronic exchange of educational material [45, p. 86]. Educational and developmental influences between the subjects of interaction (teacher-student, student-student, group of students) occurred due to a rapid response in information and learning environment.

Social networks proved to be an ideal virtual teaching and learning environment for groupwork. Discussions and debates, which started during class sessions, were continued in social networks. Consequently, educational material was understood, grasped and learnt much more diligently [46, p. 145].

Networking means of information and communication technologies (online chats, forums) as well as multimedia computers fostered the development of students' creative and critical thinking. Unlike educational material on paper, the quality of students' perception of information in the virtual learning environment was much higher. Content features, design of the virtual environment, possibility of intensive written communication created opportunities for students to develop creativity, analytical attitude to objects during professionally oriented written communication. Therefore, networking means of ICT were an effective virtual environment for students' immersion into communicative situations of professionally oriented written communication, using such teaching methods as problem solving, brainstorming, analogy, division and victory etc. It should be indicated that performance of tasks, working in groups, discussions by means of e-mails, online chats, forums stimulated prospective programmers to active participation in educational and cognitive activity of creating their own professionally oriented texts.

4. THE RESULTS AND DISCUSSION

Interpretation of results of the methodological experiment based on implementing the algorithm for cooperative professionally oriented written communication was completed with the help of mathematical statistics at two levels:

1. Checking the normality of data distribution. In order to check the normality of data distribution, the author used frequency histogram of the data distribution with a theoretically normal Gaussian curve (see Figure 1) and Kolmogorov-Smirnov test (distribution is normal at $p > 0,2$).

2. Calculation of statistical criteria selected on the basis of results of data validation. The reliability and objectivity of empirical data were tested by means of Mann-Whitney U-test. All calculations were carried out using statistical software Statistica.
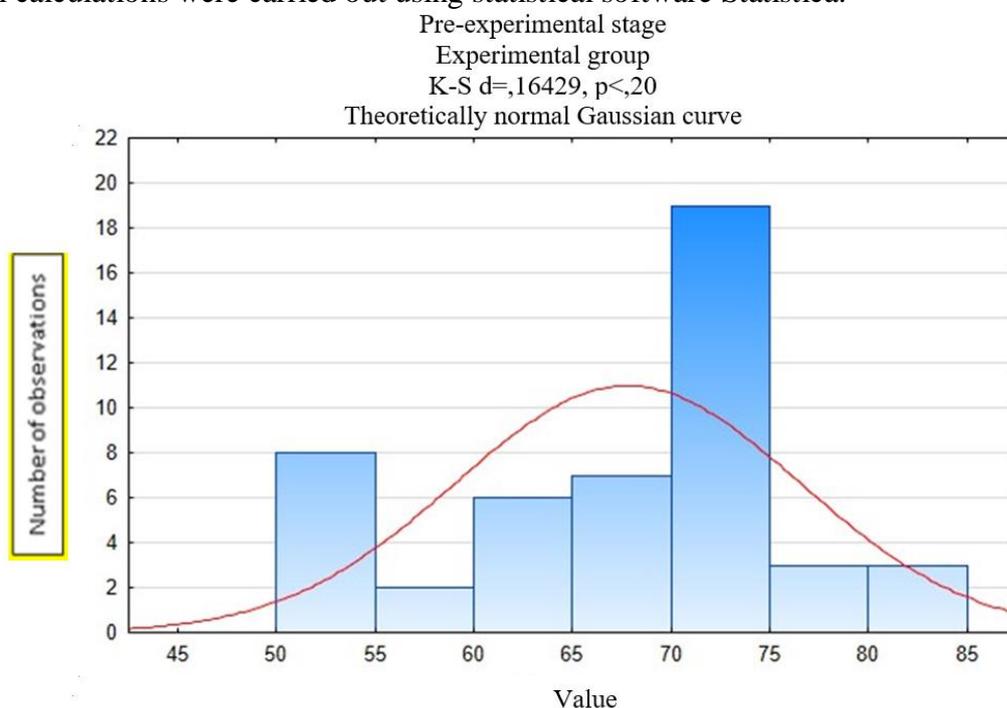
Fig. 1. Frequency histogram of the distribution of quantitative indicators of the level of formation of English lexical competence in professionally oriented written communication in EG at the stage of pre-experimental evaluation within a theoretically normal Gaussian curve and data from the calculation of Kolmogorov-Smirnov test
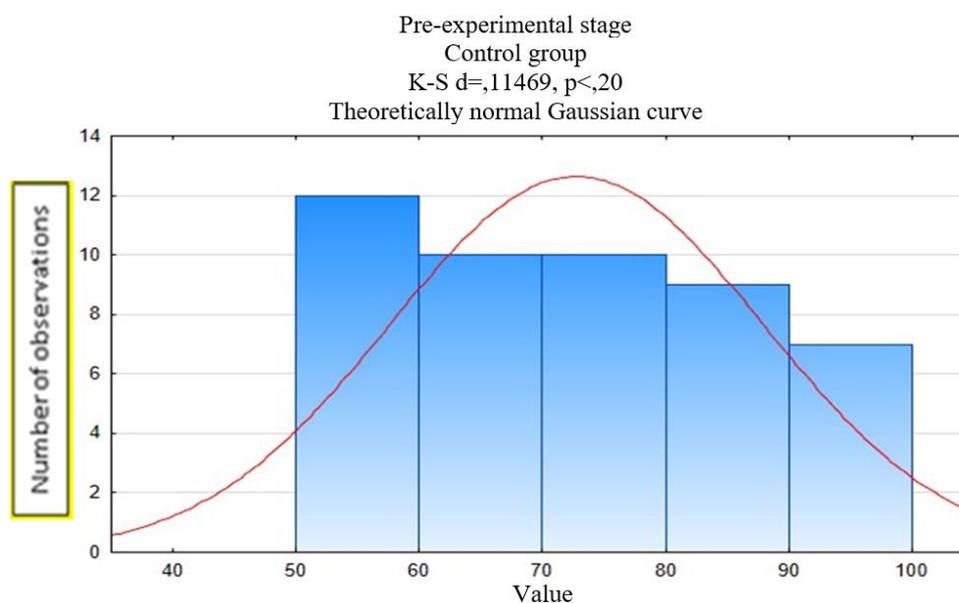
At the first level of interpretation of experimental research data, first of all, the distribution of data on quantitative indicators of levels of formation English lexical competence in professionally oriented written communication in EG and CG at the stages of pre- and post-experimental evaluation was checked. In figure 1 we can observe that the histogram does not correspond to the theoretically normal Gaussian curve. There is a strong right-sided asymmetry and excess which may indicate an abnormal distribution of quantitative indicators of the levels of developing English lexical competence in professionally oriented written communication. Mathematical expectation according to Kolmogorov-Smirnov criterion also indicates an abnormal distribution. Therefore, we can conclude that the distribution in the EG at the stage of pre-experimental assessment is abnormal.

The next step in interpreting data at the first level was to check the distribution of data on quantitative indicators of levels of forming English lexical competence in professionally oriented written communication in EG at the stage of post- experimental evaluation (see Fig. 2). Here we can observe that the histogram does not correspond to the theoretically normal Gaussian curve. There is a strong right-sided asymmetry and excess which may indicate an abnormal distribution. Mathematical expectation according to Kolmogorov-Smirnov criterion also indicates an abnormal distribution. Therefore, we can conclude that the distribution in the EG at the stage of post-experimental assessment is abnormal.
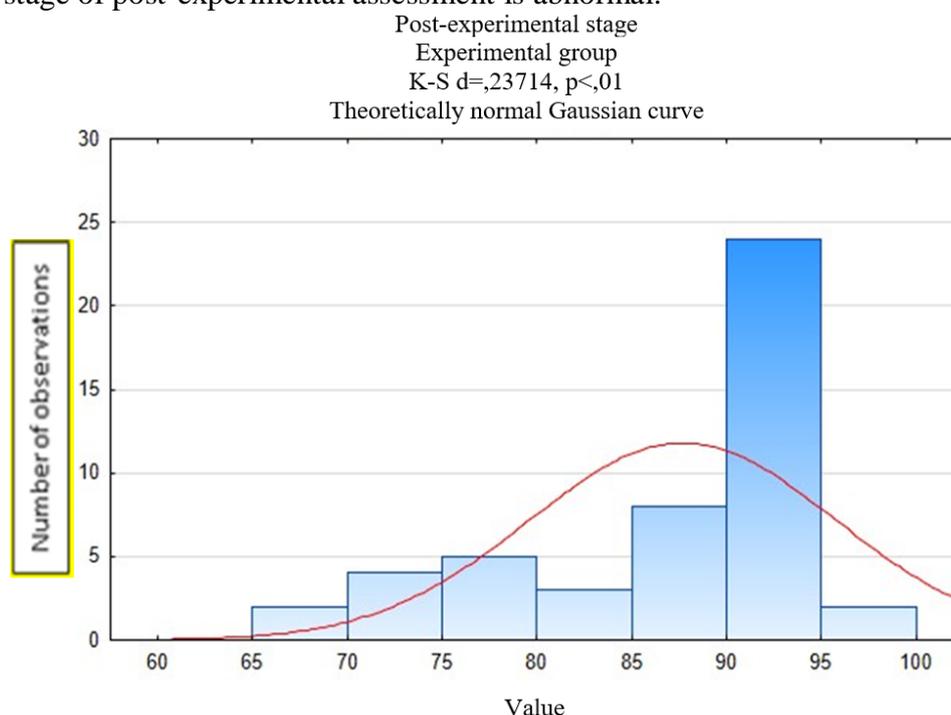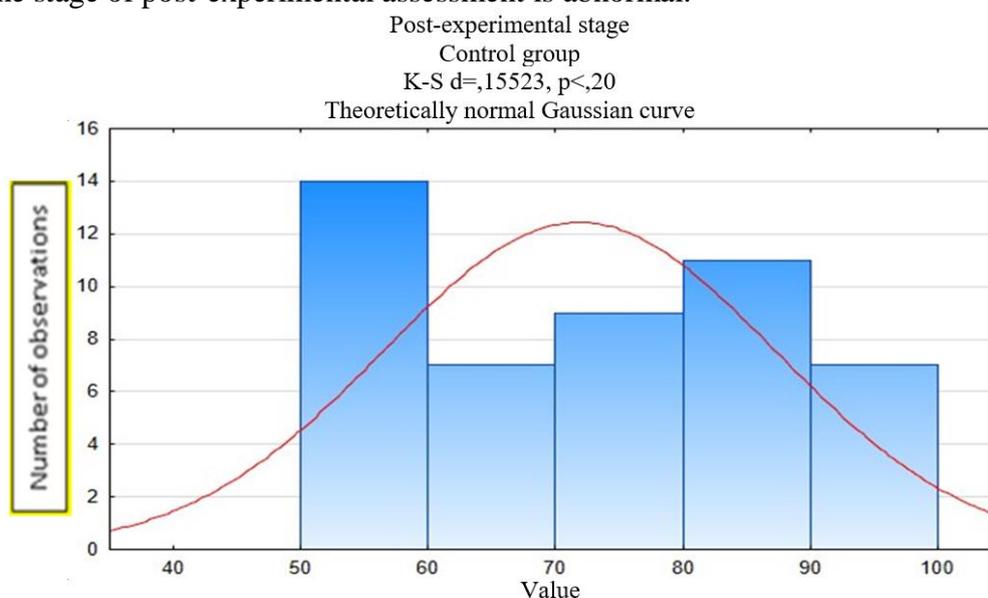

Fig. 2. Frequency histogram of the distribution of quantitative indicators of the level of formation of English lexical competence in professionally oriented written communication in EG at the stage of post-experimental evaluation within a theoretically normal Gaussian curve and data from the calculation of Kolmogorov-Smirnov test

Identical calculations were performed for samples of CG data. In figure 3 we can observe that the histogram generally corresponds to the theoretically normal Gaussian curve. Severe asymmetry and excess, which indicate abnormal distribution, is not observed. Mathematical expectation according to Kolmogorov-Smirnov criterion also indicates the normality of distribution. As a result, we may state that the distribution of data in CG is normal at the stage of pre-experimental evaluation.

Fig. 3. Frequency histogram of the distribution of quantitative indicators of the level of formation of English lexical competence in professionally oriented written communication in CG at the stage of pre-experimental evaluation within a theoretically normal Gaussian curve and data from the calculation of Kolmogorov-Smirnov test

Accordingly, the next step in calculating the data was to check the normality of distribution of data on quantitative indicators of levels of developing English lexical competence in professionally oriented written communication in CG at the stage of post-experimental evaluation (see Fig. 4). We can notice that the histogram does not correspond to the theoretically normal Gaussian curve. There is left asymmetry which may indicate an abnormal distribution. Mathematical expectation according to Kolmogorov-Smirnov criterion also indicates an abnormal distribution. Therefore, we can conclude that the distribution in the CG at the stage of post-experimental assessment is abnormal.

Fig. 4. Frequency histogram of the distribution of quantitative indicators of the level of formation of English lexical competence in professionally oriented written communication in CG at the stage of post-experimental evaluation within a theoretically normal Gaussian curve and data from the calculation of Kolmogorov-Smirnov test

At the second level of the interpretation of results of the methodological experiment the reliability and objectivity of empirical data were tested by means of Mann-Whitney U-test and Wilkikson's criterion.

In most cases the distribution of quantitative indicators of levels of developing English lexical competence in professionally oriented writing based on pre- and post-experimental evaluation of EG and CG was abnormal. In addition, since there were less than 100 observations of samples of these quantitative indicators, it was decided to calculate non-parametric statistical criteria. To test the statistical significance between two independent samples of these quantitative indicators of levels of developing English lexical competence in professionally oriented writing of EG and CG, Mann-Whitney U-test was calculated (non-parametric criterion that checks the statistical significance of the difference between two independent samples). To test the statistical significance between two dependent samples of these quantitative indicators in EG and CG, Wilkikson's criterion (non-parametric criterion which checks statistical significance of the difference between two dependences) was calculated.

In order to determine whether there was a difference between the levels of English lexical competence in professionally oriented written communication in EG and CG at the stage of pre-experimental evaluation, Mann-Whitney U-test was calculated for the difference between EG and CG medians. The data of this calculation are presented in table 4.

Table 4

Mann-Whitney U-test data for the difference between the medians of EG and CG at the stage of pre-experimental evaluation

Mathematical expectation according to Mann-Whitney U-test	
Stage of pre-experimental evaluation	0,144786867

At pre-experimental evaluation stage the difference between indicators of the level of English lexical competence in professionally oriented written communication in two independent samplings EG and CG was statistically insignificant since the mathematical expectation is greater than 0,05. This indicator shows a similar level of English lexical competence in professionally oriented writing possessed by students of EG and CG at the stage of pre-experimental assessment.

In order to determine whether there was a difference between the levels of English lexical competence in professionally oriented written communication in EG and CG at the stage of post-experimental evaluation, Mann-Whitney U-test was calculated for the difference between EG and CG medians (see Table 5). Based on the data presented in table 5, we can observe the statistical significance of the difference between the medians of EG and CG at the stage of post-experimental evaluation since the mathematical expectation is lower than 0,05. This indicates a significantly different level of formation of English lexical competence in professionally oriented written communication in two independent samplings EG and CG.

Table 5

Mann-Whitney U-test data for the difference between the medians of EG and CG at the stage of post-experimental evaluation

Mathematical expectation according to Mann-Whitney U-test	
Stage of post-experimental evaluation	0,000000269113236

At the next step statistical significance of the difference in the median EG and CG was calculated from the data of pre- and post-experimental stages in order to access the statistical

significance of the growth of level of English lexical competence in professionally oriented written communication in students of EG and CG during the period of experimental learning. The obtained results are illustrated in Tables 6 and 7.

Table 6

Calculation of statistical significance of the difference of median EG according to pre- and post-experimental sections

Mathematical expectation by Wilkikson's criterion	
EG (according to pre- and post-experimental evaluation)	0,00000000163278814

Based on data of the calculation presented in table 6 we can state that there is a statistical significance in the medians of EG at the stages of pre- and post-experimental evaluation since mathematical expectation is less than 0,05. The obtained indicator shows a radically different level of formation of English lexical competence in students of EG in professionally oriented written communication before and after the experimental learning, i.e. a crucial increase in the level of the competence under analysis during the experimental period.

The statistical significance of the difference in the medians of CG according to the data of pre- and post-experiential sections was calculated (see Table 7). Based on the data presented in the table we can state that there is a statistical insignificance of the difference in the medians of CG according to pre- and post-experimental evaluation since mathematical expectation is greater than 0,05. This indicates a great similarity of the quantitative indicator of the level of formation of English lexical competence in students of CG in professionally oriented written communication both the stages of pre- and post-experimental assessment. Thus, we can state that there is a slight increase in the level of the competence under the analysis among students of CG while studying ESP during one academic year.

Table 7

Calculation of statistical significance of the difference of median CG according to pre- and post-experimental sections

Mathematical expectation by Wilkikson's criterion	
CG (according to pre- and post-experimental evaluation)	0,698126732

The difference between indicators of the level of English lexical competence in professionally oriented written communication in two dependent samplings based on pre-experimental and post-experimental evaluation in CG was statistically insignificant, whereas in EG – statistically significant. This data indicate a significant increase in the level of formation of EG students of English lexical competence in professionally oriented written communication while implementing the algorithm under study.

The obtained data showed that at pre-experimental evaluation stage an average indicator of the level of English lexical competence in professionally oriented written communication of EG and CG students was identical. However, at post-experimental evaluation stage an increase in the level of English lexical competence in professionally oriented written communication of EG students was statistically significant, an average indicator of the level of English lexical competence in professionally oriented written communication increased to C1 level which was the aim of the experimental study. In CG an increase in the level of English lexical competence

was statistically insignificant and an average indicator of the level of English lexical competence in professionally oriented written communication remained the same.

Graphs in Figures 5 and 6 demonstrate trajectory and dynamics of the increase in the level of English lexical competence in professionally oriented written communication of EG and CG students when implementing (EG) and not implementing (CG) the algorithm for cooperative professionally oriented written communication.
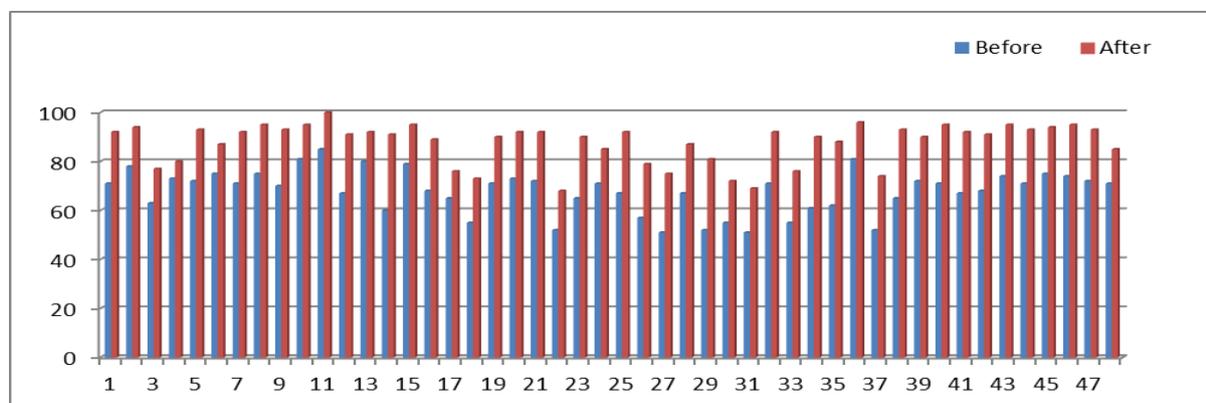
Figure 5. Dynamics of the increase in the level of English lexical competence in professionally oriented written communication of EG before and after implementing the algorithm for cooperative professionally oriented written communication
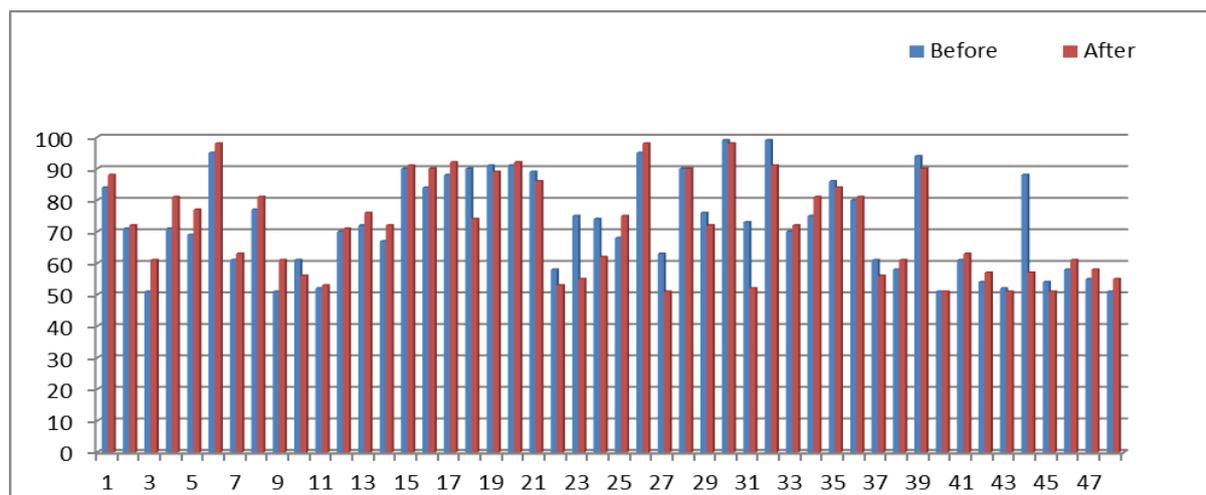
Figure 6. Dynamics of the increase in the level of English lexical competence in professionally oriented written communication of CG before and after the experiment without implementing the algorithm for cooperative professionally oriented written communication

Judging from the present academic research and pedagogical experience, implementing the proposed algorithm for cooperative professionally oriented written communication into the ESP teaching training brought clear benefits to the process of mastering a foreign language, specifically, it enhanced students' individual level of English lexical competence in professionally oriented written communication through groupwork writing and provided a technological basis for the process of training, involving modern ICT.

Interpretation of the results before and after the experiment allowed us to prove the validity of the hypothesis of the experimental research.

5. CONCLUSIONS AND PROSPECTS FOR FURTHER RESEARCH

The analysis of the results of the present study allowed us to single out some arguments which, in the author's opinion, can show the effectiveness of the developed algorithm for cooperative professionally oriented written communication implemented to improve prospective programmers' English lexical competence. Moreover, the results of the experiment clearly demonstrate numerous implications for ESP educators, researchers and teachers.

Firstly, the hypothesis which indicated that advanced level of English lexical competence in professionally oriented written communication of future programmers can be achieved by implementing the experimental methodology, mainly the algorithm for cooperative professionally oriented written communication, has been confirmed.

Secondly, a gradual implementation of the developed algorithm at all stages (receptive, receptive-reproductive and reproductive) has proved to be efficient and beneficial to prospective programmers in terms of enhancing their level of English for Specific Purposes to advanced one.

Thirdly, the findings of this study can be regarded as a contribution to the language curriculum. The maximum benefit from the pedagogical method is expected when introducing a separate course on professionally oriented writing.

Theoretically, the findings are conducive to enriching the theory of ESP teaching, especially as regards improving writing skills. Furthermore, the author is convinced that the findings have pedagogical implications that are relevant to teaching English for Specific Purposes. Methodologically speaking, this study has investigated groupwork via cooperative professionally oriented written communication. To the best of our knowledge, this approach represents the first attempt to measure the effectiveness of collaborative writing in the context of asynchronous work (i.e. online). At the practical level, the study has contributed to the long-standing debate over the possibility to apply information and communication technologies to teaching professionally oriented written communication. Moreover, the findings contribute to the role of using technology in developing writing skills. Accordingly, the research supports the role of the Internet, multimedia and social networks in boosting ESP learning.

The study is not without its limitations though. The fact that the experiment involved only graduates of the faculty of Applied Mathematics and Informatics limited generalizability to the study. Moreover, more reliable results could be achieved with a greater number of participants and even gender distribution. Future studies may benefit from a larger sample size with a higher percentage of female respondents.

Surely, the present study is not exhaustive as far as all of the aspects of the research problem in question are concerned. Particulars pertaining to the outlining of an oral professionally oriented communication of future programmers and development of corresponding methodological guidelines for specialists may be the object of future academic studies into adjacent segments of research in the same area. Future research should also replicate the same study of teaching English professionally oriented written communication to students of other majors (i.e. economics, biology, physics etc.).

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Text of the article was accepted by Editorial Team 02.07.2020

ПРОЦЕДУРА КОЛЕКТИВНОГО ПРОФЕСІЙНО ОРІЄНТОВАНОГО ПИСЕМНОГО СПІЛКУВАННЯ МАЙБУТНІХ ПРОГРАМІСТІВ

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Анотація. В епоху інформаційно-комунікаційних технологій англійська мова відіграє вагому роль як в усному, так і писемному спілкуванні. Успішна робота фахівців з комп'ютерного програмування значною мірою залежить від рівня їх лексичної компетентності, тому університетський курс англійської мови для спеціальних цілей, орієнтований на її розвиток, може бути надзвичайно корисним у професійній підготовці майбутніх програмістів. Дане дослідження мало на меті вивчити ефективність колективного професійно орієнтованого писемного спілкування на заняттях з англійської мови для спеціальних цілей з метою підвищення майстерності письма майбутніх українських програмістів, а також удосконалити їх англомовну лексичну компетентність. Для перевірки ефективності алгоритму автор провів експериментальне навчання студентів 5 курсу факультету прикладної математики та інформатики Львівського національного університету імені Івана Франка у 2017-2018 навчальному році. Розроблено етапи імплементації алгоритму задля підвищення рівня англомовної лексичної компетентності. Ефективність алгоритму доведена на основі результатів, отриманих під час до- та післяекспериментального оцінювання студентів контрольної та експериментальної груп. З практичної точки зору, навички письма учасників експерименту були перевірені за допомогою письмового тесту з англійської мови, який проводився до та після колективного навчання. Темпи покращення навичок письма у студентів з експериментальної групи значно перевищили показники студентів з контрольної групи. Отже, доведено ефективність запропонованого алгоритму, що використовується для розвитку лексичної компетентності у студентів з комп'ютерного програмування. У світлі отриманих результатів автор зазначає, що викладачі отримають користь від застосування вивченої методики колективного професійного письма на заняттях з англійської мови, що, своєю чергою, сприятиме розвитку навичок письма студентів та удосконаленню їх англомовної лексичної компетентності.

Ключові слова: колективне навчання; англійська мова для спеціальних цілей; лексична компетентність; писемне спілкування; професійно орієнтований; групова робота; програмісти.

ПРОЦЕДУРА КОЛЛЕКТИВНОГО ПРОФЕССИОНАЛЬНО ОРИЕНТИРОВАННОГО ПИСЬМЕННОГО ОБЩЕНИЯ БУДУЩИХ ПРОГРАММИСТОВ

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Аннотация. В эпоху информационно-коммуникационных технологий английский язык играет важную роль как в устном, так и письменном общении. Успешная работа специалистов по компьютерному программированию в значительной степени зависит от уровня их лексической компетентности, поэтому университетский курс английского языка для специальных целей, ориентированный на ее развитие, может быть чрезвычайно полезным в профессиональной подготовке будущих программистов. Данное исследование имело целью изучить эффективность коллективного профессионально ориентированного письменного общения на занятиях по английскому языку для специальных целей для

повышения мастерства письма будущих украинских программистов, а также усовершенствовать их англоязычную лексическую компетентность. Для проверки эффективности алгоритма автор провел экспериментальное обучение студентов 5 курса факультета прикладной математики и информатики Львовского национального университета имени Ивана Франко в 2017-2018 учебном году. Разработаны этапы имплементации алгоритма для повышения уровня англоязычной лексической компетентности. Эффективность алгоритма доказана на основе результатов, полученных при до- и послеэкспериментальном оценивании студентов контрольной и экспериментальной групп. С практической точки зрения навыки письма участников эксперимента были проверены с помощью письменного теста по английскому языку, который проводился до и после коллективного обучения. Темпы улучшения навыков письма у студентов из экспериментальной группы значительно превысили показатели студентов из контрольной группы. Таким образом, доказана эффективность предложенного алгоритма, используемого для развития лексической компетентности студентов-программистов. В свете полученных результатов автор считает, что преподаватели получат пользу от применения изученной методики коллективного профессионального письма на занятиях по английскому языку, что, в свою очередь, будет способствовать развитию навыков письма студентов и совершенствованию их англоязычной лексической компетентности.

Ключевые слова: коллективное обучение; английский язык для специальных целей; лексическая компетентность; письменное общение; профессионально ориентированный; групповая работа; программисты.