Methodology for formation of professional communicative competence of future IT specialists

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Abstract. At present, due to significant attention of the employers in the IT sphere to key competencies of University graduates the system of professional communicative competence formation is required. This paper presents an overall design and implementation scheme of the course “Translation in the Field of Professional Communication” as an integral part of the cycle of disciplines in the area of “Infocommunication Technologies and Communication Systems”. The foreign language intersubject status is strengthened by the developed course. The paper focuses on basic components of this course providing integrity of educational process. Based on theoretical and practical approaches: study of psychological and pedagogical literature; analysis and synthesis of theoretical generalization of research results, comparison and interpretation of new facts and specific manifestations of the research subject, abstracting, questioning, testing, observation, pedagogic experiment and statistical data processing methods the efficiency of a proposed experimental training system was confirmed. Its positive influence on the level of acquisition of knowledge in the English language discipline and, correspondingly, on formation of the professional communicative competence of a software engineer and on development of positive motivation for professional activity was analysed. Besides, the development of positive motivation for the self-development of the personality and for the growth of interest in communication was described.

Keywords: future IT specialists, foreign language teaching, professional communicative competence, computer-aided learning, students’ motivation

1. Introduction
Nowadays various studies focusing on the correspondence of the bachelor and master level of competence to the increasing public and individual needs for qualified specialists with the higher professional education are being conducted [1,2,3,4,5]. The main requirements to the graduates are in most cases the requirements to their professional competence, therefore optimal organizational and pedagogic conditions contributing to the efficient formation of the professional competence of a university graduate must be identified [6,7]. A graduate must have professional competences corresponding to the type of professional activity [8,9]. Moreover, the graduates shall determine their professional significance in the labour market, be able to combine knowledge gained at the university with the practice, to communicate in a group [10,11]. In order to form their professional competence they are to become available for continuous education, independence, motivation to cognition. Due to global accumulation of new information
and communication products future specialists are motivated to be knowledgeable, broad-minded, flexible, and capable of adopting high-tech products to achieve their life goals [12,13]. Therefore productive educational forms, methods, tools and technologies developing students’ skills of working independently and creatively with large flows of information should be modified [14].

A high level of the society informatization is primarily conditioned by introduction of infocommunication technologies in the production that requires the corresponding professional training of graduates working in the field of IT technologies. In the educational system for IT specialists, who are competitive in the labour market, a foreign language is getting more and more important and its expert use becomes an integral part of the professional competence of the specialists in this area. Linguistic and grammatical structures of the English language underlie the memorization and interpretation of machine language structures, reaction of communication with the operating system, software debugging, etc.

In this regard, the place and role of a foreign language and communicative competence in the system of professional training of staff in the field of programming and infocommunication technologies is changing considerably. The paramount importance is given not only to the language skills assuming the knowledge of oral and written business language, the ability to use language in the professional activities, but to the maturity of the communicative competence. The term “Communicative Competence” has been developed for many years. Hymes stated that communicative communicate is the ability to use language or interpreted language correctly in the process of interaction with the social environment such as the use of language in the proper regulation of social practices [15]. Moreover, Canale and Swain also support Hymes’ idea that communicative competence is the ability to use language correctly, appropriate to situations and express suitable behaviour in cultural context of communication [16].

Therefore, communicative competence in this present study refers to the ability to use English language in situations connected with the professional activity.

The analysis of both the labour market in the field of utilization of the applied information technologies and results of training of IT specialists proves that many graduates may actually read the specialized literature using a dictionary or work with a text using electronic translators. However, they have difficulties with expressing their ideas in a foreign language in the field of professional knowledge. Unfortunately, they cannot participate in the communication process, have problems with oral and visual perception of foreign speech, cannot quickly transform the translated message, actualize and adapt the same for the feedback. All this is the result of poor elaboration of the problem of foreign language training in professional educational institutions in the context of the profession obtained. It should be noted that profession-oriented foreign language included in the education plan for “Information Technologies and Communication Systems” program is loosely connected with professional training of bachelors. Insufficient language skills of the university graduates do not meet the current requirements of IT services market.

All above-mentioned set the main goal of the paper – to form professional communicative competence of IT-students. To achieve this goal we set the following objectives: to define the structure of the professional communicative competence reflecting the key areas of professional activity; to introduce the system of professional communicative competence of future IT specialists; to trace the dynamics of formation of the professional communicative competence.

2. Methods
The research methods are based on theoretical and practical approaches: study of philosophic, psychological and pedagogical literature; analysis and synthesis of theoretical generalization of research results, didactic theory modelling, comparison and interpretation of new facts and specific manifestations of the research subject, abstracting and statistical data processing methods. To our mind, one of the most significant methods for the paper was empirical method: questioning, testing, observation and pedagogic experiment.

An experiment was conducted for 60 students studying IT at Peter the Great Saint Petersburg Polytechnic University, Russia. All students volunteered to take part in the experiment; they were informed about its objective. Among the participants, 67% were male, and the other 33% were
female. The forming experiment included the experimental (EG) and control (CG) groups characterized by uniformity of quantitative and qualitative composition: the comparative analysis showed that there were no significant differences in the level of academic progress of EG and CG students before the start of the pedagogic experiment.

The control group studied under the traditional system. In the experimental group, the study was based on the “Foreign Language” discipline according to the specially developed program designed to teach a future specialist to read the specialized literature and to form the skills required for the professional communicative activity. The comparison of the control points at different stages of the experiment in the control and experimental groups allows tracing of the dynamics of formation of the professional communicative competence. For this purpose, the level of maturity of the communicative competence was controlled as per each aspect based on the integrated test performed by the students in the control and experimental groups. Upon execution of the task to determine the level of maturity of the professional communicative skills, the students were divided into four conventional groups: with heuristic, high, medium and low level of maturity of the above skills.

3. Results and Discussion

The analysis of results showed that during study of the discipline blocks and transition to more complicated cycles in the experimental group there were positive changes in execution of tests at more complicated level. Where the tests in two discipline blocks of low level of complexity were passed on average by 34% of the students, the tests in 5-6 blocks were passed by about 22% of the students and only 11% of the students passed the tests in the last discipline blocks. At the same time, the number of the students, who fulfilled the high-complexity tasks, increased from 15% for the firsts discipline blocks to 30% for the last discipline blocks. Sample value of the Student's test $t=2.53$ significantly exceeds the critical $t_{\alpha/2} =2.01$. Consequently, to a high degree of accuracy it may be concluded that there is a substantial difference between the mean grade for execution of the final task by the students in experimental and control groups.

Having analysed the distribution of grades for the performed tasks and structure of errors made in the course of the web-site development, we may say that the students in the experimental group were more successful not only at the search and analytical stages of the web-site development but in ensuring the information safety and software product certification as well.

In order to obtain more reliable and authentic results we checked the normality of grade distribution in each aspect.

As the sample Pearson’s value in CG and EG is less than critical one = 3.84, the hypothesis of normal distribution in the interactive, perceptive and cognitive aspects is confirmed.

As the sample value $t_s = 2.19$ exceeds the critical $t_{cr} =2.01$, it can be said that there are differences between the mean grades in the control and experimental groups for each aspect of the communicative competence.

It should be noted that the most remarkable excess of the percentage of the students with high level as compared to low level was observed in the perceptive aspect of the communicative competence. In our opinion, this is the most complicated aspect, because here creative activity prevails over the technical one. The perceptive aspect of the communicative competence of an IT specialist presumes the knowledge of regulatory and technical peculiarities of man and machine interaction.

Thus, we may note that while completing the professional tasks being a part of the perceptive communicative competence the importance of the English language is more evident. Consequently, we can observe the positive dynamics in perceptive skills that becomes obvious due to integration of continuous English language learning in the educational process. According to the conducted studies, it may be concluded that the proposed course is one of the main tools in formation of the communicative competence of a software engineer.

It has been established that targeted formation of the professional communicative competence (PCC) of future specialists at foreign language classes leads to better results of a foreign language learning; the level of maturity of communication skills determines the degree of use of such knowledge and skills in other disciplines, what leads to overall improvement of the academic
progress. The high index of correlation between evaluation of the level of maturity of the professional communicative competence and average overall academic progress has been discovered \( r = 0.89 \).

The provided results evidence the statistically significant advantages of the students in the experimental group. In order to determine the significance of the communicative competence, we applied the Student’s test in each of the aspects. The results of verification of hypotheses on statistically significant excess of parameters of PCC maturity for each aspect are provided in Table 1.

**Table 1. Results of statistical processing**

| PCC Aspects | Criteria | Hypothesis H |
|-------------|----------|--------------|
|             | Sample ts| Critical (at \( \alpha = 0.05, k=52 \)) tcr | |
| 1. Cognitive| 2.06     | 2.01         | H1 |
| 2. Interactive| 2.19   |             | H1 |
| 3. Perceptive| 2.86    |             | H1 |

Designations: ts – criterion sample value; tcr - criterion critical value; \( \alpha \) – significance value; k – degree of variance; H1 – hypothesis of statistically significant excess of the parameter value for the students in the experimental group.

In order to obtain more reliable and authentic results we checked the normality of grade distribution in each aspect of PCC (Table 2.).

Consequently, to a high degree of accuracy it may be concluded that there is a substantial difference between the mean grade for execution of the final task by the students in experimental and control groups.

**Table 2. Testing of distribution normality**

| PCC Aspects | Criteria | Hypothesis H |
|-------------|----------|--------------|
|             | EG sample| CG sample    | critical |
| 1. Cognitive| 0.94     | 0.916        | 3.84     | H1 |
| 2. Interactive| 0.772   | 3.164        |          | H1 |
| 3. Perceptive| 1.49    | 1.08         |          | H1 |

H1 – hypothesis of normal distribution in EG and CG is confirmed.

Teaching foreign languages should be one of the means and elements of the learning environment that ensures the formation of professional competence of students [17]. Based on the theoretical analysis of the literature, professional communicative competence of a specialist can be defined as a set of specific personal and professional communication qualities and communication skills. Its structure comprises three components: cognitive, interactive and perceptive, which we extrapolate to the process of formation of the communicative competence of the specialists in the field of infocommunication technologies.

The analysis of peculiar features of the professional activities of future software engineers led to the following conclusion: as the area of professional activity of the software engineers includes collection, processing, storage, transmission and methods of extraction of information, arrangement of the information channels, advanced means and methods of the information protection in global and local networks, it can be said that all types of professional activity are of communicative nature.

The communication in man-machine system has some peculiarities and specifics of professional activity of future IT specialists must be taken into account to determine the structure of the communicative competence of a specialist in the field of infocommunication technologies. The
aspects of the traditional structure of the communicative competence cannot be mechanically assigned to the man/machine system specialists.

An organic combination of various aspects, comprising all sides of the professional communication, such as cognition of the communication organization means and methods, principles of organization of the face-to-face communication, consideration for man-machine communication conditions is needed to form the communicative competence of an IT specialist.

The structure of the professional communicative competence including three main aspects: cognitive, interactive, perceptive, reflecting the key areas of professional activity has been developed and described in details to achieve the aforementioned objectives.

The cognitive aspect of the communicative competence of an IT specialist is determined in the context of this work as the process of cognition of the communication means and methods.

The interactive aspect of the communicative competence of an IT specialist means the arrangement and formation of the process of mutual information exchange. The perceptive aspect of the communicative competence of an IT specialist presumes the knowledge of regulatory and technical peculiarities of man and machine interaction.

The organization of man and machine interaction is the main task of professional activity of a software engineer in all the above three aspects. Thus, being the means of professional activity, the professional communication skills included in communicative competence of a specialist in man-machine-type profession constitute a part of professional competence for the given type of profession, which according to the principles of competence-based approach to formation of the scope of education must be taken into account in the course of training of IT specialists.

During the experiment preparation, it was established that the following conditions must be ensured to form the necessary communicative competence of the students: involvement of the students in quasi-professional activities; teacher qualification; technological infrastructure; use of active training methods [18].

Methodological basis of the study is the dialectical cognition method as the basis of academic pedagogics; provisions of the philosophy of enduring value of cognition, essence of the activity transforming the personality, improving its capabilities; theory of system and complex, personal and activity approaches to study of pedagogical phenomena; personality formation ideas, professional establishment, links between the theory and practice, education and human qualimetry.

In this work we rely on the research studies of the communicative competence problem in different aspects:

– definition, composition, types, diagnostics, development, etc. [19,20];
– peculiarities of formation of the communicative competence under conditions of educational process[21,22];
– specifics of the personal communicative competence improvement [19];
– formation of communicative competence as the key component of professional qualification of a modern specialist, as a precondition for academic and professional success of a person [23,24];
– improvement of cross-cultural communication of university students as the way to increase their academic mobility [25,26].

To obtain the settled goal – to introduce the system of professional communicative competence of future IT specialists work, we proposed the system of continuous training of the future IT specialists in English. Didactic basis of the system was the “Translation in the Field of Professional Communication” course for which the main components ensuring the integrity of the educational process were developed.

The structural and organizational system of the “Translation in the Field of Professional Communication” course used in bachelor training made it possible to form the professional communicative competence of the future graduates. “Translation in the Field of Professional Communication” special course was included in the basic and variable part of the cycle of disciplines in the area of “Infocommunication Technologies and Communication Systems”. The course was included in order to ensure both the link within the cycle of disciplines and the link with professional and special subjects. That link gives the opportunity to the students to prepare for their professional work more effectively [27].
According to the Federal State Education Standards of the Higher Education for the “Infocommunication Technologies and Communication Systems” discipline the classroom and independent work hours were distributed as follows: 2 credits in the basic block of disciplines and 4 credits in variable part as professional competence is formed in this block.

The conceptual component of the system of communicative competence formation determines the structure of the “Translation in the Field of Professional Communication” course and reflects the sequence of introduction of classroom disciplines. Based on the analysis of discipline study plans ten professional educational blocks are distinguished.

- Programming languages and graphical user interface; “Algorithmic Languages and Programming”
- Computer system; “Computer and System Organization”
- Internet and telecommunication; “Computer Networks and Telecommunications” “Network Technologies”
- Peripheral devices; “Peripheral Devices”
- Operating system; “Operating systems”
- Databases; “Databases”
- Web technology and programming techniques; “Programming Techniques”
- Microprocessor system; “Microprocessor systems”
- Computer graphics; “Computer graphics”
- Information security. “Information protection methods and means”

Discipline blocks of the course are grouped by subjects corresponding to the study plan disciplines of the “Infocommunication Technologies and Communication Systems” speciality. Each discipline block is uniordinal, i.e. designed for the same period of study and has the same structure within the block. The design of discipline blocks by discipline from the first to the last course, from simple to complicated makes it possible for the students to enjoy the continuous learning of a foreign language that has positive effect on the success of student’s training.

The discipline blocks are grouped by the following subjects, where each of them corresponds to the discipline or a number of disciplines of the study plan.

Conceptual aspect reflects the basic principles on which the “Translation in the Field of Professional Communication” course is based:

- principle of continuous language learning by a specialist;
- principle of intersubject connection of the English language course with other disciplines;
- principle of professional orientation of the English language course.

The teaching process within each discipline block has the same arrangement and includes three stages. The first is the training stage consisting of lexical training and translation of vocationally-orientated texts. The second is the controlling stage including a set of tests in the material learnt, consisting of the final external control and self-control. At this stage, the level of translation skills gained for each discipline block is controlled. The third stage is developing and controlling at the same time as it includes a business game (educational and cognitive element) which is also the final control of the level of communication skills gained in each discipline block. Thus, the key functions of the educational process: training, controlling and developing are implemented within each discipline block.

In order to ensure the organizational and methodical component the “Translation in the Field of Professional Communication” Integrated Didactic Package has been developed to reflect the integration of special disciplines and English language learned according to the educational standard, as well as module block, studied within the framework of additional education, e.g.: foundations of the theory of formal languages, language of computerized information systems and their role in programming.

The implementation of the system provides for uninterrupted formation of the professional communicative competence characterized by an integral quality — readiness of programmers to use a foreign language in professional activities (Table 3.).

Table 3. Organizational and methodical component of the “Translation in the Field of
Professional Communication” course

| Elements of teaching materials | Didactic content                                                                 | Communicative function                                                                 |
|-------------------------------|----------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
| Traditional                   |                                                                                   |                                                                                      |
| English-Russian Dictionary     | Contains 850 specialized English terms and acronyms, their Russian equivalents and interpretation in English | Focus on formation of perceptive aspect of PCC of an IT specialist                    |
| Workbook for preparation for role-plays | List of role game scenarios and methodical recommendations for preparation and holding | Focus on formation of perceptive, interactive aspect of PCC of an IT specialist, translation skills |
| Electronic                    |                                                                                   |                                                                                      |
| Vocationally-orientated chrestomathy | Electronic texts for reading created with the help of a text editor and saturated with flash animation | Focus on formation of perceptive aspect of PCC of an IT specialist, multimedia competence |
| Testing program               | Diagnostic tasks aimed at different forms of test control and self-control of three levels of complexity | Focus on formation of perceptive, cognitive aspect of PCC of an IT specialist, multimedia competence |

Moreover, didactic package included the methodical guidelines for teachers and students on the discipline subjects; study guides for students in annotation, precis-writing, grammar, testing; multimedia electronic textbooks on different subjects of the “Translation in the Field of Professional Competence” course; a set of pedagogical texts and trainings for students for intermediate and examination testing on all disciplines for the entire training cycle.

The use of computer technologies for processing of a vocationally-oriented text promotes:

a) a foreign text examination on a computer, which is characterized by promptness (difference between the perception on the paper and on the screen);

b) teaches the user to select the optimal forms of presentation on the screen of various types of information and to create hypertext, search for means to identify the core information etc.;

c) improvement of the professional multimedia competence, development of skills in operation of text programs.

The suggested teaching package ensuring didactic content of the “Translation in the Field of Professional Communication” elective course is a universal tool that can be easily adapted to new topics due to its flexible variable structure. Procedural and activity component determines the forms and methods of classes within the “Translation in the Field of Professional Communication” course.

In addition to traditional training methods, organizational forms and means, the active training methods such as group training and business game method were applied which contribute to the efficient development of the professional communicative competence of IT specialists [28].

During learning the “Translation in the Field of Professional Communication” course the communication-oriented tasks designed for elimination of phonetic, lexical and grammatical difficulties were used. The students worked with the general technical and other scientific texts, with various tasks contributing to development of skills in training reading, reading with the total coverage of the content, deep understanding of the text. In the course of study, the students learned to identify the main points, to analyse and generalize. In addition, there were the tasks to make sure that the read texts are understood and to consolidate the lexical and grammatical material of the text. For the purpose of professional communicative competence, the tasks were used that are based on
application of active training methods imitating professional activity and problem oriented tasks and facilitating active speech practice of the students. Besides, discussing professionally important topics by students improves their foreign language competences [29].

When teaching translation of complex vocationally-oriented texts filled with terms in the field of “Infocommunication Technologies and Communication Means”, the group work and training were used. There were used such effective techniques as text fragmentation, test structuring, charting, precis-writing and annotating of unadapted specialized literature, etc. These types of work are especially efficient in translation of texts saturated with specialized terms.

The role game was used by us in order to promote: formation of the professional communicative competence of the trainees; gaining skills in professional and business communication and improvement of professional translation knowledge and skills, skills in PC, Internet and other communications use. At the role game preparation stage the teacher describes the situation, explains the problem and proposes one of possible solutions. The materials are selected and arranged based on a situation or problem which arose interest in the trainees of student age. Role organization of a class and reconstruction of a situation create the desire to speak and express the opinion [30]. The novelty principle is maintained in arrangement of different speech situations (to listen and record the comments, select a partner for dialogue, arrange the communication on one’s own). The variety of work techniques is expressed in performance of different speech exercises: listen, read and select, underline, conduct a dialogue with a partner. During classes, the students gain the skills to carry on a dialogue – to solve a problem. The vocabulary and grammatical categories are mastered in a dialogue, i. e. the ability to maintain the communication and express own opinion.

Favourable environment for achievement of the communication objective was also ensured by the dynamics in organization of this kind of classes. It was organized in a manner to ensure free communication in pairs formed with consideration for the language skills of the partners and then in pairs formed at the discretion of the persons involved, then in small groups and, finally, in the general group together with a teacher. To create a good learning climate the teacher is involved in the discussion as a kind of social activity and guides it [31]. Such organization of the activity facilitates comfortable communication, improvement of emotional state of communicants, which exerts positive influence of development of communicative competence of the students in general. Besides, it is necessary to take into consideration both the psychological climate in the classroom and the psychological impact of the audit of students’ work [32].

Upon completion of the course, the students gained the ability to review the unadapted specialized literature, to annotate own graduation works; the skills in public speaking at conferences for experience exchange; research and development works of the students with unadapted information technologies.

It is impossible to imagine the training process in a modern university without the use of information and educational technologies implemented via computer. Over the last years the computers have become so extensively used in the education that special term has emerged – “computer training technology”. The computer technologies develop the ideas of computer-aided learning, open the new, not yet investigated technological options connected with unique capabilities of modern computers and electronic communication facilities [33].

The modern specialized software for foreign language learning is characterized by a wide range of functional capabilities related to presentation of the training materials and improvement of language and speaking skills, which, in addition to the use of multimedia, allows the application of such software for development of trainees’ skills in various types of speech activities.
An important feature of the computer making it standing out from other technical training means is that thanks to interactive mode of interaction with the trainees the computer is an ideal tool for implementation of individually differentiated approach to the specialist training.

Moreover, a large memory capacity of the modern computers, their high response speed and the ability to record the acts of the trainees allow for the computer application for intensification of a student independent work.

The students were encouraged to succeed by implementing innovative teaching methods. In order to maintain dynamics of formation of the communicative competence of the students, the motivation activity and motives of students were taken into account [34]. The classes held in form of a game and training promoted the efficient psychological adaptation of the students invoking verbal thinking and the ability to make decisions on their own.

The data obtained in the course of the experiment confirmed the results of the expert appraisal: thanks to the continuous language learning by the students of the experimental group as compared to the control group students, the level of maturity of cognitive, interactive and perceptive skills, being a part of structure of the professional communicative competence, increased considerably.

4. Conclusions
The study results showed that the developed system of formation of the professional communicative competence of a programmer was based on provisions concerning general issues of methodology of pedagogics, philosophic provisions on dependence of trainee’s personality formation and development on social aspects; dialectic method of reality cognition, ideas of native psychologists about the leading role of activity in formation of a specialist and motivation development theory constituting the methodological basis of the study.

In the paper we defined structure of professional communicative competence comprising three components: cognitive, interactive and perceptive, which we extrapolate to the process of formation of the communicative competence of the specialists in the field of infocommunication technologies.

During the experimental work we introduced the system of continuous training of the future IT specialists in English, which is the training package combining various methods and technologies of the professional competence formation, whose use promotes achievement of the best didactic results. The proposed course is also the precondition for continuous English language learning by students and allows strengthening of the foreign language intersubject status.

For the purpose of formation of professional communicative competence the selection of criteria for evaluation of the maturity level is of special importance. In the course of study, the following evaluation criteria were developed: knowledge of technical terms, methods of information placement, recording of valeological and taxon characteristics, use of anti-virus software. The criteria of evaluation of the professional communicative competence in terms of cognitive, interactive and perceptive components backed by communicative approach to a foreign language learning have been defined.

Thus, based on processing of the experiment results, training according to the proposed experimental method exerts positive influence on the level of acquisition of knowledge in the English language discipline and, correspondingly, on formation of the professional communicative competence of a software engineer and on development of positive motivation to professional activity. These facts once again confirm the efficiency of the experimental training system vs. traditional one.

Today the programmer profession is getting one of the most popular and programmer’s readiness to communicate in a foreign language is not just welcomed but becomes an integral feature of his or her professionalism.

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