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Methodology of Forming Professional Skills in Students Based on an Integrative Approach

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ABSTRACT

This article explores the challenge of equipping master's students in software engineering with the skills necessary for professional communication. It examines the job functions of programmers and the competencies outlined in the Federal State Educational Standards, highlighting a gap in readiness for professional communication. The research aims to develop a model to enhance this readiness in future master's students. The study involves creating and testing a model-building algorithm, analyzing relevant documents, refining the concept of communication readiness, and constructing a structural educational model. The methodology incorporates systemic, competency-based, and integrative approaches, using various analytical and modeling methods. The findings reveal a lack of sufficient readiness for professional communication among software engineering students. To address this, the authors propose an interdisciplinary model within the university curriculum, focusing on interactive teaching methods, interdisciplinary projects, and modern educational internet resources to boost student motivation and engagement. This model holds potential for application in master's level training programs, offering a framework to develop competencies in various aspects of professional communication, including business, scientific, and intercultural communication skills.

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1. INTRODUCTION

Problem Statement for Construction Rapid changes in all aspects of human life, driven by innovative economic processes, increased academic mobility of professionals [29], the expansion of international connections within professional communities, and the development of the digital space (Alexashina, 2017), have led to a shift towards the paradigm of "lifelong learning." In light of these changes, the issue of preparing professionals capable of promptly responding to innovations in their field, increasing their level of education, and engaging in productive dialogue with colleagues, including at the international level, has become increasingly relevant. The need to develop communication skills in the professional sphere is particularly acute for master's students in software engineering. This is because IT development relies on the exchange and influx of new knowledge, acquired through direct communication with colleagues worldwide (both face-to-face and online), studying technical documentation, reading professional literature, blogs, and forums of leading experts, participating in webinars, massive open online courses, and more. Failure to maintain and continuously update communication processes in this field leads to stagnation.

Given the high demand for graduates of software engineering in the labor market and the popularity and international nature of this field, we selected the higher education program in the field of preparation 09.04.04 Software Engineering as an "experimental platform" for developing a methodological framework. The task of constructing a model for developing the readiness of future master's students in software engineering for professional communication should begin with defining the concept of "construction" and developing an algorithm for constructing the desired pedagogical process. Algorithm for Solving Construction Tasks As a key category of the studied pedagogical process, pedagogical construction is a purposeful process of creating a pedagogical structure that addresses a specific pedagogical problem. The procedure of construction involves executing certain steps, the sequence of which depends on the pedagogical task at hand. For instance, N.A. Masyukova suggests that construction should involve actions such as diagnosing reality, actualizing the goals of reorganizing reality, designing the image of the final result, step-by-step design of mutual approval towards achieving the design goal over time, refining and correlating the actions set during communication, and a comprehensive diagnosis of the results of implementing the design.

2. LITERATURE REVIEW

2.1. Document Analysis and Justification of the Problem's Relevance

The societal demand for what a master's degree holder in software engineering should be capable of is reflected in legal documents such as the Professional Standard "Programmer" (Order of the Ministry of Labor of Russia dated 18.11.2013 No. 679n) (see http://www.consultant.ru/document/cons_doc_LAW_157085/) and the Federal State Educational Standard for Higher Education in the field of preparation 09.04.04 Software Engineering (Master's level) (see http://www.consultant.ru/document/cons_doc_LAW_171763/). These documents emphasize the importance of preparing future master's graduates in software engineering for professional communication and optimizing this process in higher education institutions.

The active implementation of professional standards aims at a thorough examination of the qualification requirements outlined in them for professionals engaged in a specific type of professional activity. An analysis of the "Programmer" Professional Standard revealed that the ability to communicate with stakeholders is necessary for performing a range of job

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functions: 3.4.1. Labor function "Analysis of software requirements," 3.4.2. Labor function "Development of technical specifications for software components and their interaction," 3.4.3. Labor function "Design of software." Consequently, finding mechanisms for developing this skill within educational programs is an important task for educational and scientific personnel [10].

Based on the analysis of the Federal State Educational Standards for Higher Education (FGOS VPO) 3+ in the field of preparation "Software Engineering" (Master's level), we can identify the following general professional competencies as significant for our research:

(i) Proficiency in at least one foreign language at the level of social and professional communication, along with the ability to apply specialized vocabulary and professional terminology (GPC-4).
(ii) The ability to analyze and assess one's competence levels in combination with the ability and readiness for self-regulation of further education and professional mobility (GPC-3).
(iii) After analyzing the Professional Standard and the corresponding FGOS 3+, we compared the specified job functions and competencies and identified a "missing" quality – the readiness of future master's graduates in software engineering for professional communication.

2.2. Current Literature Review

A review of the literature has revealed numerous research approaches to defining professional communication and its structural components (K.E. Bezukladnikov, I.L. Bim, N.D. Galskova, G.V. Elizarova, M.N. Novoselov, D.V. Kursevich, S.V. Romanova, S.I. Safonova, N.I. Chernykh, and others).

In the process of theoretical analysis, we considered such generic concepts as "communication" and "foreign language communication."

In pedagogical research, definitions of "communication" emphasize the nature of interaction and information exchange. Communication is defined as "the process of transmitting information from one person to another through language, speech, or other symbolic systems in the process of interpersonal interaction", and as a "specific type of activity that involves information exchange between members of a language community to achieve mutual understanding and interaction". In our research, we rely on a broader definition by E.S. Rapatsevich, which views communication "as a process of communication and interpersonal interaction, as well as information exchange". The author considers foreign language communication to be legitimately defined in a broad sense as "informational interaction between subjects through a foreign language" (Safonova, 2015).

From the standpoint of a competency-based approach in scholarly literature, we also encounter such concepts as "foreign language professional communicative competence" (M.N. Novoselov) and "readiness for professionally oriented foreign language communication" (S.V. Romanova). M.N. Novoselov identifies the unity of two main components in the structure of "foreign language professional communicative competence": communicative and professional (Novoselov, 2013).

In general terms, M.N. Novoselov and K.E. Bezukladnikov define the foreign language professional communicative competence of future master's graduates as "a personal psychological formation, which, in the unity and interrelation of communicative and professional components, includes long-term readiness and ability, alongside cognitive and behavioral aspects, to engage in professional and research activities in a foreign language" (Novoselov, 2013). Of particular relevance to our research is the authors' emphasis that the development of foreign language professional communicative competence in future master's

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graduates integrates with other competencies, manifests in a new quality, and thus enables a creative approach to solving professional tasks (Novoselov, 2013).

However, the interpretation provided by S.V. Romanova is most closely aligned with our research. She defines the concept of "readiness for professionally oriented foreign language communication" as "an integrative characteristic of a specialist's personality, representing a synthesis of motivational attitudes, theoretical knowledge, and practical, professionally significant skills, contributing to productive collaboration and the making of constructive decisions in the sphere of future professional activities".

Having analyzed the interpretations mentioned above, we have refined the concept of "readiness of future master's students in software engineering for professional communication." We define it as an integrative characteristic of a software engineering specialist's personality. It represents a synthesis of theoretical knowledge, professionally significant skills, and practical abilities, all in unity and interrelation between communicative and professional aspects. This readiness facilitates information exchange and productive interaction among stakeholders to effectively perform job functions.

This definition directs us towards selecting relevant professionally significant skills, theoretical knowledge, and professional activity skills that will enable future master's students in software engineering to become active participants in the communication process. By comparing job functions, general professional competencies, and previous research, we have identified a list of knowledge, skills, and competencies necessary for future master's students in software engineering in the field of professional communication. These include: Knowledge of professional terminology (e.g., object-oriented database, code refactoring), norms and rules of business communication (e.g., attentiveness and respect for the interlocutor, proper message interpretation), business communication culture (as a specific form of behavior, non-verbal, psychological, logical, and linguistic etiquette rules), and rules for information processing (extracting informational objects from other informational objects).

The ability to articulate one's position (e.g., adhering to a specific argumentation strategy), using professional terminology in communication (e.g., communicating with non-specialists on professional matters), and employing modern electronic communication tools (e.g., cloud services, messengers, email services). Proficiency in team collaboration skills (e.g., the ability to interact and emotional intelligence), negotiation skills (e.g., asking questions correctly, emotionally engaging the interlocutor, analyzing opponents' responses, and responding appropriately), business correspondence skills (e.g., avoiding specific terminology), and public speaking skills (e.g., presentation, poster presentation). Thus, after identifying key knowledge, skills, and competencies that constitute the readiness of future master's students in software engineering for professional communication, we formulated the problem: How to develop the readiness of future master's students in software engineering for professional communication to enable them to successfully perform job functions.

3. METHODS

During the course of our research on the preparation of future master's students in software engineering for professional communication, we employed various research methods, including document analysis, theoretical analysis and synthesis, observation, analysis of educational activities, and modeling. Document analysis, focusing on the professional standard (see http://www.consultant.ru/document/cons_doc_LAW_157085/) and the Federal State Educational Standards for Higher Education (FSES HE) (see

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http://www.consultant.ru/document/cons_doc_LAW_171763/), revealed a significant competency gap – the readiness of future programmers for professional communication.

Theoretical analysis of the literature allowed us to explore fundamental concepts such as "communication" and "foreign language communication." We concluded that there are multiple approaches to defining professional communication competence, both in general and specifically in a foreign language, with the identification of its structural components. Based on the analysis and synthesis of theoretical data, we identified a crucial definition for our research, namely, "readiness for professionally oriented foreign language communication". Utilizing methods of external and embedded observation in the educational process, along with an analysis of educational activity products (diagnostic work, tests, control snapshots), helped us assess the level of readiness of future master's students in software engineering for professional communication. It was determined that this level was insufficient for them to perform job functions effectively. To visually represent the process of developing readiness for professional communication in master's students in software engineering, it is necessary to employ modeling methods and create a schematic model that reflects its structure and key components. Adhering to a systems approach (drawing from I.V. Blauberg, E.G. Yudin, V.N. Sadovsky, V.A. Slastenin, G.N. Serikov, I.O. Kotlyarova, 2018, and others) in studying the process of forming readiness in future master's students in software engineering for professional communication, we can depict this process as a structural model comprising target, substantive, procedural, and criteria-level components (**Figure 1**).

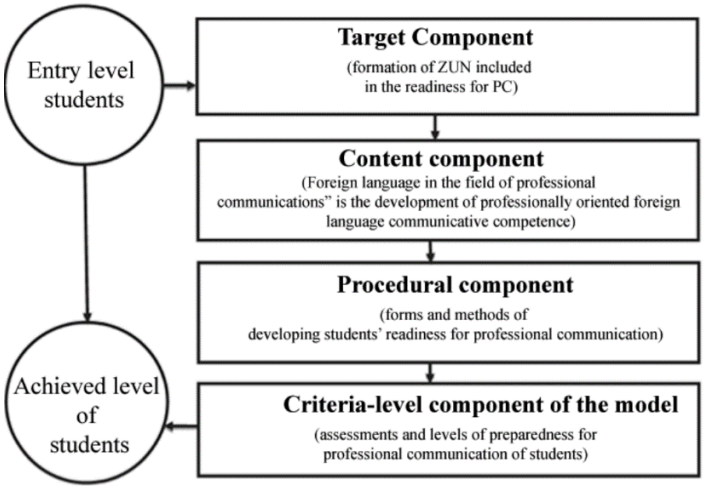

Figure 1. Structural components of the model.

The components of the developed model were populated based on a competency-based approach, which represents a "set of general principles for defining educational goals, selecting educational content, organizing the educational process, and assessing educational outcomes". Accordingly, these principles served as guidelines for formulating the goals of the model operation, and content selection, at the organizational level, and the results level.

Since the process of developing readiness in future master's students in software engineering for professional communication is constructed with consideration of an interdisciplinary approach, it is advisable to use an integrative approach as the methodological foundation. Its role is to logically structure the substantive and procedural components of the model. Specifically, it helps establish connections within the sections of one discipline (intrapersonal integration), identify interdisciplinary links in the subjects of the educational program, and design the content of various interdisciplinary projects (interdisciplinary integration).

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4. RESULTS AND DISCUSSION

The article addresses the pressing issue of preparing master's level students for professional communication. Based on a theoretical analysis of the job functions of programmers outlined in the professional standard and an analysis of competencies specified in the Federal State Educational Standards for Higher Education (FGOS VO 3+), the authors identify a critical aspect – readiness for professional communication. Consequently, there is a need to find effective measures that contribute to the development of this readiness.

The research presented in this article aims to construct a model for developing the readiness of future master's students in software engineering for professional communication. To achieve this goal, the following tasks were accomplished: 1) the development and testing of an algorithm for constructing the model; 2) justification of the relevance of the research problem through document analysis; 3) refinement of the definition of readiness of future master's students in software engineering for professional communication and identification of the necessary knowledge, skills, and competencies through an analysis of scientific sources; 4) construction of a structural model of the educational process and the provision of substantive content to its components using modeling methods. To address these tasks, the authors relied on the methodology of systemic, competency-based, and integrative approaches, utilizing document analysis, theoretical analysis and synthesis, observation, analysis of educational activity products, and modeling methods that were appropriate for the objectives.

Based on observations and analysis of educational activity products, it was observed that the level of readiness of future master's students in software engineering for professional communication was insufficient. To enhance its quality, a model for developing this readiness was designed. A distinctive feature of this model is its use of the interdisciplinary principle in the university's educational process. The most effective methods chosen for developing readiness for professional communication include interactive teaching methods, interdisciplinary projects, and modern educational internet resources that enhance student motivation and engagement. The theoretical and practical results of this work can be utilized in master's level student training programs. The scheme proposed by the authors can serve as a foundation for developing models and methodological frameworks for students to acquire competencies in oral and written business communication, scientific communication, intercultural aspects of interaction with specialists, and more. At the goal level, the central premise of the target component is the development of students' ability to independently solve problems in the field of professional communication, relying on accepted norms and patterns (Shaturnaya, 2014).

The achievement of this goal is realized through a phased formation of knowledge, skills, and abilities (KSA) comprising the Professional Communication (PC) competence. The process of forming KSA implies a progression from knowledge in the first stage to skills in the second stage and, finally, to the ability to master them in the third stage, namely: 1st stage of problem-solving - formation of knowledge in the field of professional terminology, norms and rules of professional business communication, business communication etiquette, rules of information processing. 2nd stage of problem-solving - development of skills in expressing one's position, using professional terminology in professional communication, and applying modern electronic communication tools. 3rd stage of problem-solving - cultivation of skills in teamwork, conducting business negotiations, business correspondence, and public speaking (Shaturnaya, 2014).

The substantive component of the model integrates the disciplines B.1.02 "Foreign Language in Professional Communications" and B.1.01 "Protection and Security of Software

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Systems" of the core curriculum for the Master's program in "Security and Protection of Software Systems" within the field of "Software Engineering."

Considering the competency-based approach to content selection in education, which emphasizes competencies as integral elements, and recognizing that the desired readiness includes cross-disciplinary competencies, we favored disciplines from the core part of the master's program. This preference was due to their mandatory nature, irrespective of the program's specific profile. For instance, the objective of the discipline "Foreign Language in Professional Communications" is to develop professionally oriented foreign language communicative competence sufficient for conducting professional, scientific, and informational activities and for further self-education. On the other hand, the aim of the "Protection and Security of Software Systems" discipline is to equip master's students with knowledge and skills in software system protection, the ability to organize systemic protection for software systems, including networked ones, and competence in analyzing the security level of software systems.

The integration of these selected disciplines into one system, viewed through the lens of professional communication, imparts the desired synergistic effect to the educational process and contributes to the formation of readiness for professional communication among master's students in software engineering. Furthermore, the transfer of knowledge from one subject area to another enables the design of content for various interdisciplinary projects.

Selection of project topics was carried out by identifying the key aspects of professional communication, the mastery of which plays a crucial role in professional activities, and based on the need to establish a rational structure for educational material. Enriching the content of education with themes related to professional communication (Shaturnaya, 2014), explaining theoretical phenomena and processes in the context of communication, prepares master's students to enter the business environment, adhere to its rules, and subsequently apply them in the execution of their job functions. The procedural component defines the forms and methods for developing the readiness for professional communication among master's students in software engineering. Modeling the process of readiness for professional communication within an interdisciplinary context guides us in selecting teaching methods and formats to successfully address the set objectives. To achieve this, it is essential to consider methodological recommendations, the specifics of the tasks, the content of the material, and the capabilities of the students. In our view, to enhance the preparedness of master's students in software engineering for professional communication, including in a foreign language, it is advisable to employ interactive teaching methods (Kotlyarova, 2015).

Following the number of selected topics in the content component, the procedural component has been organized into 5 blocks, united based on organizational and thematic principles. Within each block, the discipline "Software System Security" includes lectures of a specific type: visual lectures, problem-based lectures, lectures with pre-planned errors, and more. For the discipline "Foreign Language in Professional Communication," this theoretical material is practiced using highly communicative methods (Kotlyarova, 2015; Shaturnaya, 2014), such as discussions, roundtable discussions, case studies, etc. The final form of work involves interdisciplinary projects or role-playing games. In addition to classroom work, the procedural component includes the application of the "flipped classroom" technology [26], for example, completing assignments in an online format using the "Electronic YSU" system.

The criteria and levels of readiness for professional communication among master's students in software engineering are implemented in the criteria-level component of the model (see the table).

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Considering the nature of the key concept, motivational, cognitive, activity-based, and reflective assessment criteria for the formation of readiness for professional communication among master's students were identified (Alexashina, 2017). Given that the expected result of forming readiness among future masters for professional communication through interdisciplinary integration is a transition from a basic level to a more advanced one, the levels of the formed parameter will be low, medium, and high. The implementation of the developed model is expected to result in a change in the level of readiness among future master's students in software engineering for professional communication, raising it to a higher level compared to the initial level.

5. CONCLUSION

In the course of our work on constructing a model for the development of readiness among future software engineering master's students for professional communication, we have formulated the research problem and justified its relevance. To address this problem, we conducted an analysis of theoretical sources, refined the definition of readiness for future software engineering master's students in professional communication, and identified a list of knowledge, skills, and abilities that constitute this readiness.

To represent the studied process in the form of a scheme, we developed an algorithm for constructing the model. Applying the obtained algorithm, as well as the methodology of systemic, competency-based, and integrative approaches, we designed the structure of the model for the process of forming readiness among future software engineering master's students for professional communication (which reflects its key parameters). We have also provided a substantive description of its structural components (target, content, procedural, and criteria-level components), which constitute the outcome of our work.

6. AUTHORS' NOTE

The authors declare that there is no conflict of interest regarding the publication of this article. The authors confirmed that the paper was free of plagiarism.

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