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RESEARCH ARTICLE

The Concept of Formation of Professional Competencies of a Physics Teacher at the University

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Abstract

Objectives: Actualization of the problems of professional education, consisting in insufficient reflection on the social transformations taking place in the world, requires timely resolution of the existing contradiction between the need for training of new-type pedagogical personnel with an expanded function of a teacher and the lack of development of the fundamental basis of its content. The aim of the study is to establish the conceptual foundations of professional education of teachers of natural sciences and physics in Azerbaijan. **Method**: This is a descriptive study which aims to describe the current situation. The document analysis method was used in this study. The document analysis method is often used in social sciences. In document analysis, the purpose is to access key resources. The documents were analyzed and data was provided after analysis. Expert knowledge can also be used in document analysis. In the study, expert knowledge was collected to get more accurate and relevant data. **Findings**: The result of the theoretical research was the identification of conceptual aspects of professional education of teachers of natural sciences and physics in Azerbaijan, expressed by a triunity of bases (principles, invariant set of knowledge, methodological culture) providing fundamentalization of pedagogical education through the methodology of the content of professional training with an invariant core, activating reflection and, accordingly, the degree of mobility of the process under study. The obtained results allowed us to formulate practice-oriented recommendations on the organization of fundamentalization of teacher education, achieved through 1) creating an integrative environment of education in the structure of the social system by synthesizing knowledge with the requirements of society; 2) introducing competencies that ensure the formation of students' methodological culture; 3) modeling the invariant core through the strengthening of practice-oriented activities in the context of innovative achievements in various fields of scientific knowledge. **Novelty**: consists in the fundamentalization of professional training of a physics teacher through methodologization of its content and organization of the invariant core, which integratively provides the solution of educational and developmental tasks and resolves the existing contradiction.

Keywords: Conceptual framework; Higher education; Professional training; Pedagogical education; Teacher of physics

1 Introduction

Preliminary theoretical analysis of the problem field of humanitarian education in general and professional training of physics teachers in particular, allowed to identify the key aspects of contradictions that provoke a decline in the quality of learning and, accordingly, the subsequent teaching of the subject, the role of which occupies priority positions in the "human society"[(1)]. The analysis of the results of research activities allowed us to systematize the problems identified by scientists, such as the need to actively involve students in the process of learning physics, rather than providing schoolchildren with ready-made knowledge[(2)], the importance of forming preliminary ideas of students[(3)]; shifting attention to visualization and learning and cognitive activities with abstract ideas[(4)]; emphasis on the importance of language and multiple representations in teaching and learning physics[(5)]; and the role of mathematics in teaching and learning physics[(6)]. Despite the extensive research material, it is necessary to recognize the fragmentation of their presentation and, accordingly, insufficient contribution to the change in the level of professional training of physics teachers, thus indicating the gaps in the organization of learning and teaching[(7)]. The narrow focus of the ongoing reforms of the professional education system[(8)] does not allow for resolving the existing contradiction in the training of a new type of teaching staff with an expanded function of a teacher[(9)], which necessitates research activities to identify the conceptual basis for fundamental changes in the required processes of modernization of professional training in Azerbaijan. The purpose of the study is to establish the conceptual foundations of professional training of science and physics teachers in Azerbaijan.

2 Methodology

This is a descriptive study that aims to describe the current situation. In this study, the document analysis method was used. The document analysis method is often used in social sciences. In document analysis, the purpose is to access key resources. The documents were analyzed and data was provided after analysis. Expert knowledge can also be used in document analysis. In the study, expert knowledge was collected to get more accurate and relevant data.

3 Results and Discussion

Theoretical understanding of the research problem:

Classical universities with their fundamental nature of education are able to prepare teachers of a new type, who know deeply and professionally the relevant field of science, who have a personal interest in its certain sections, who are able not only to solve but also to set new problems, who can bring creative direction to school and help students to master the methods of scientific research[(4)]. The World Declaration on Higher Education for the 21st Century states: "Higher education should contribute more actively to the development of the whole education system, in particular by improving teacher education, curriculum development and research in this field"[(10)].

Expansion of the functions of a teacher in modern society, complication of tasks and content of education of the young generation cause the increase of requirements to the personality of a teacher. To date, there is a contradiction between the content of modern pedagogical education and the requirements of the school, society, and the state to the personality and level of professional competence of a teacher[(11)].

A teacher today must have the most modern education, a high level of intellectual, moral and physical development, and a deep knowledge of anatomo-physiological and psychological characteristics of children. He is required to be highly professional in his work, socially active, conscious and creative attitude to his work, ability to cooperate with students [12]. The most important features of a teacher's professional image should be moral purity, demanding kindness, mental generosity, and love for children. A modern teacher is a personality capable of solving the main tasks of education:

- Versatile and timely development of children and youth, their creative abilities, formation of skills of self-education, self-realization of personality;
- Formation of a holistic worldview and modern scientific outlook in children and youth, development of a culture of interethnic relations;
- Organization of the educational process taking into account modern achievements of science, systematic updating of all aspects of education reflecting changes in culture, economy, engineering, and technology;
- Variability and personal orientation of the educational process (design of individual educational trajectories);
- Practical orientation of the educational process with the introduction of interactive, activity-based components (mastering project research and communicative methods);
- Forecasting, designing, and organizing the content and process sides of education and sociocultural environment;
- Ability to conduct independent research work, etc. [13].

Increasing the requirements for the quality of teacher education becomes an urgent problem and a condition for the development of the system of continuous teacher education, a stimulus for updating the content of teacher education based on the principles of fundamentality, universality, integrative, variability, continuity and its practical orientation [14].

Developing the concept of formation of professional competencies of a physics teacher at the university, we proceeded from the definition of the concept of "concept" as a system of "interrelated and arising one from another view on certain phenomena, processes; a way of understanding, interpretation of any phenomena, events; the basic idea of any theory; general idea, a main idea", as well as from the definition of the concept of "professional competencies", understood by us as "a set of key, basic and special competencies", emphasizing the following: "special competencies can be considered as the realization of key and basic competencies in the field of academic subject, a specific area of professional activity" [10], and also from the definition of the concept of "professional competencies", understood by us as "a set of key, basic and special competencies". Special competencies can be considered as the realization of key and basic competencies in the field of educational subject, a specific area of professional activity" [15].

The main provisions of the concept can be formulated as follows.

Competence-based approach to the training of physics teachers at the university allows the process of training instead of mastering specific methods of organizing the educational process at the physics lesson to master the general methods of analysis, design, and implementation of the pedagogical activity, to develop a research approach and own creative handwriting of the future teacher.

Let us highlight the most important, from our point of view, basic and special professional competencies characteristic for a physics teacher.

Basic competencies: gnostic, constructive, organizational, communicative, analytical, predictive, creative, projective, informational.

Special competencies: experimental, formation of students' experimental skills, solving physical problems, teaching students to solve physical problems, guiding students' technical creativity, staffing the physics classroom, etc. [16]. For the successful formation of professional competencies of a future physics teacher at the university it is important to know not only the goals of pedagogical education but also to present in detail its content, scientific requirements that are imposed on it, as well as the principles of its development.

3.1. Research results

Under the content of professional pedagogical education, we will understand the system of scientific knowledge, practical skills, and personal and professionally important qualities, which should be mastered by a student - future teacher of physics in the process of studying at the university. Cardinal changes in ideology, and the formation of a new paradigm of education inevitably led to the need to change the content of professional pedagogical education.

In accordance with the requirements for pedagogical education, the following principles should underlie the formation of the content of professional education of a future physics teacher:

- Fundamentalism - scientific validity and high quality of subject, psychological, pedagogical, socio-humanitarian, and general cultural training;
- Universality - completeness of the set of disciplines providing basic training in the unity of professional and general cultural components;
- Integrativeness - interdisciplinary connection, oriented to the formation of a holistic picture of the world, created by a set of basic disciplines on the basis of complementarity of content and unity of purpose and requirement;
- Variability - a flexible combination of compulsory basic disciplines, disciplines of choice, and specializations;
- Practical orientation of teacher education;
- Continuity is one of the necessary conditions for ensuring the continuity of teacher education, which implies common conceptual approaches at all levels of continuing education [17].

Unlike other types of professional education, pedagogical education should provide systemic knowledge of the human being as a subject of the educational process. This systemic nature should be defined not so much by a set of relevant disciplines included in the curriculum but by the whole context of university education, in which each discipline is considered, on the one hand, as a means of personal development of the student and, on the other hand, as a basis for his/her future professional activity aimed at the development of schoolchildren [18].

This approach to professional pedagogical education at the university implies the formation of the content of education in two main directions. Firstly, when forming the content of personally oriented higher professional pedagogical education, it is necessary, first of all, to proceed from the fact that at the center of the educational process in the university should be the student, who is the subject of his/her formation as a harmoniously developed personality.

Therefore, while developing the content of professional teacher education, striving to adapt curricula, programs, and textbooks to the maximum extent to the requirements of modern society to the level and quality of teacher training, it is necessary to adapt the content of education to the interests and needs of the student's personality, taking into account his/her individual characteristics, motivation and value orientation.

Secondly, the content of professional pedagogical education should become that specific sphere of social experience, which will later become the means and content of its professional pedagogical interaction with the pupil [19]. In this case, the content of subject disciplines should be aimed not at mastering a certain set of knowledge, but at mastering the logic of the subject material, and the formation of professional competencies of the future teacher.

Fundamental training in physics and formed on its basis of a high level of methodological culture allows to form in the future teacher of physics the appropriate level of technological culture, professional competence.

The high quality of subject, psychological, pedagogical, socio-humanitarian, and general cultural training of a teacher is impossible without strengthening the role of the fundamental component, which ensures the integration of scientific achievements from different fields of knowledge in education, in the formation of the content of teacher education [20].

Universities have traditional for higher pedagogical education and specific opportunities for successful training of a new type of teacher. The specificity of university pedagogical training is manifested, first of all:

- In the fundamentality and systemic nature of vocational and special education;
- In the focus of training on the development of research skills of the future teacher;
- In favorable conditions for the formation of a future specialist's broad general scientific and general cultural erudition, personal qualities necessary for the teacher of the new generation.

The fundamental training in physics, i.e. mastering an invariant set of knowledge, is the basis for the future teacher's development of thinking and intellectual-creative abilities, a special methodological culture - formed systemic, critical, reflective thinking, motivational, cognitive, operational-activity readiness for continuous self-development and self-education. Methodological culture in turn is the basis for the formation of a technological culture of the future teacher, which includes the following abilities:

- Analyze the changing pedagogical situation in specific conditions of professional activity;
- Define professional goals and formulate tasks to achieve them;
- To design professional activities that ensure the solution of the set tasks;
- To correct professional activity on the basis of reflection of its results.

Methodological and technological culture provide adaptation to professional activity, continuous personal and professional self-development, readiness for creative, innovative professional activity and are the basis for the formation of professional

competencies, which, when imposing specific learning objectives, allow to solve specific pedagogical and methodological problems.

Fundamentalization of pedagogical education provides professional flexibility, mobility of a specialist, ability to self-education, and professional self-development.

Teacher training is traditionally one of the priority tasks of classical universities. Its scientific basis is the works of such classics of Russian pedagogy as V. P. Vakhterov, P. F. Kapterev, P. F. Lesgaft, K. D. Ushinsky, and others.

At different stages of the development of pedagogical university education, pedagogical researchers made attempts to justify the content of the pedagogy course depending on the goals set by society; on the functions of the teacher; on the principles of organizing general pedagogical training, etc.

At the same time, today's university graduates are not always ready to solve complex pedagogical problems. This is due to the fact that having fundamental scientific knowledge in a special field, he often does not have the necessary psychological, pedagogical, and methodological knowledge and skills due to a significant shortage of study time allocated by the State requirements to the minimum content and level of professional training of a graduate to obtain the additional qualification "Teacher" for practical mastering of the teaching profession.

We agree with N. H. Rozov that "specialized pedagogical training of students of classical universities is especially important, because teaching any discipline is a real and subtle art, the most complex sphere of human activity, where even excellent mastery of the content of the subject itself does not guarantee success. A qualified teacher should not only deeply study his/her field of science, but also possess serious, at the modern level, knowledge of psychology, pedagogy, didactics, private methodology, educational technologies"[4].

Under the fundamentalization of professional pedagogical education of a physics teacher at the university, we understand the construction of its content at the level of methodology, which allows not only the free use of knowledge in the changing pedagogical reality but also develops pedagogical thinking that reflects this reality.

A teacher in the process of professional education at the university should receive an invariant core that would make him/her sufficiently mobile in the implementation of university training in the constantly changing conditions of educational practice. It is the fundamentality of education, according to E. V. Rybnikov, that allows a specialist to rebuild quickly enough and relatively painlessly, to acquire new specialties and specializations[2].

In the author's opinion, the complexity of solving the problem of fundamentalization in the process of training a specialist in education is primarily due to the fact that for each specialty a different solution to this problem is possible. It can be a clear orientation to the core knowledge, which is not only invariant in relation to other areas of knowledge, but also unites them, ensuring the competence of a specialist; and the introduction of integrative courses included in the structure of the educational program; and special attention to the methods of cognition, the central link of which is the ability to generalized transfer.

Fundamentalization of teacher education at the university, in our opinion, is designed to solve three interrelated problems:

- Educational - to form in students logically organized knowledge of the most general and important laws of pedagogy, psychology, and methodology;
- Developmental - to use this knowledge for the formation of pedagogical thinking, and development of conceptual apparatus applied to the analysis of pedagogical reality;
- Educational - to form a scientific worldview on the basis of this knowledge, to develop the ability to cognition[5].

The development of the professional qualities of a teacher implies the creative reworking of knowledge, skills, and abilities acquired in the study of various disciplines into its own pedagogical system.

Basic and most of the special professional competencies of a physics teacher are formed during the study of all disciplines of the curriculum.

Speaking about the formation of professional competencies of a physics teacher, researchers, most often, are limited by the possibilities of such disciplines as "Methods of teaching physics", "Scientific foundations of the school course of physics", "Workshop on methods of teaching physics", elective courses on methods of teaching physics. Meanwhile, basic (gnostic, constructive, organizational, communicative, analytical, predictive, creative, projective, informational, etc.) and part of special (experimental, ability to solve physical problems, etc.) professional competencies of a physics teacher can be formed during the study of disciplines of fundamental and psychological-pedagogical training.

For example, when studying the course of general physics, it is necessary to give students information about the polytechnic, world outlook, the moral potential of science, about the struggle of scientific schools, about the long and difficult path of knowledge of truth, about the moral feat of scientists, which can then be used by him when organizing the educational process at school or any other educational institution.

Each lesson in the course of general physics at the university should solve at least two tasks: 1) to form in students a certain amount of knowledge and skills on this topic; 2) to be a model of the pedagogical process, which in the future will be managed by the student himself. The course of pedagogy and psychology, being the leading course in the general pedagogical training of the future teacher of physics, has the purpose of equipping students with knowledge of the basics of pedagogical theory, the basics of pedagogical skills, the formation of pedagogical thinking. Knowledge and understanding of the peculiarities of the development and functioning of personality allows one to develop a more flexible strategy of behavior in different conditions.

At the classes on methods of teaching physics, practical training, during pedagogical practice, etc., the basic and part of the special competences mentioned above are consolidated and such special professional competences of a physics teacher are formed, as the ability to form students' experimental skills, the ability to solve physical problems, the ability to supervise students' technical creativity, etc., which cannot be formed in other disciplines.

Integrated training of a physics teacher at the university, including various forms of educational and extracurricular activities of the student, provides the disclosure and development of abilities, aptitudes, creative potential of the individual.

Professional training of a physics teacher at the university is a complex multilevel dynamic process with many links and dependencies between its components, the organization of which is possible on the basis of an integrated approach. Complexity reflects the interconnectedness, interdependence, versatility, and breadth of coverage of the problem of physics teacher training. As applied to the development of professional and pedagogical education, the principle of integrated approach implies:

- Subordination and coordination of the goals of the development of professional and pedagogical education, including ensuring the unity of the processes of functioning and development;
- Development of organizational and pedagogical foundations of professional and pedagogical education using the means and methods of a complex of sciences: management theory, qualimetry, psychology, sociology, etc.;
- Unity of the processes of learning, education, and development;
- Taking into account the influence of all factors determining the development of the system of professional pedagogical education: at the level of the individual - biological, psychological, social; at the level of the educational institution or the entire system of professional pedagogical education - socio-psychological, sociological, economic, political, legal, etc.;
- Taking into account the role of moral, value, humanistic, and cultural factors, the influence of which on professional-pedagogical education is increasing;
- Polydisciplinary competence of subjects of management of the development of the system of professional and pedagogical education, completeness and optimality of the content of educational programs [7].

An essential feature of university education is the organic combination of academic and research work of students, which creates favorable conditions for the training of a specialist who is able to approach creatively the solution of complex problems in the chosen field of activity.

The ability to make independent scientifically-based decisions, which determine the effectiveness of pedagogical activity, largely depends on the level of mastery of scientific research methods. Consequently, the solution to the problem of preparing a future teacher for professional creativity is closely connected with the inclusion of students in the active creative activity of research character. At the same time, the formation of students' research skills will be most effective if a number of conditions are met: 1) the system of educational research work should permeate all training sessions - theoretical and practical; 2) at all stages of educational research and research work it is necessary to take into account individual characteristics of students; 3) to ensure continuity in the formation of skills and skills of research activity it is necessary to provide thematic unity of educational-research and research work of the student in different courses [19].

When developing curricula and course content for the subjects of the psycho-pedagogical cycle (including the methodology of teaching physics), it is necessary to provide for the students' performance of creative, research tasks, in the course of which they will learn to solve professional problems of varying degrees of complexity. academic and research work of students

The main purpose of the complex organization of the academic and research work of students on pedagogy and methods of teaching physics is the training of a physics teacher capable of working in educational institutions of different types, providing individualization of education, personality-oriented teaching, and education; training of a specialist capable of professional growth and professional mobility in the conditions of informatization of society and development of new technologies of teaching and education.

The developed concept of the formation of professional competencies of a physics teacher to the university assumes the deployment of the following elements in the process of university education:

- Building a model for the formation of professional competencies;
- Determination of the content of levels and stages of formation of a competitive specialist;

- Determination of the technology of formation of professional competencies of a physics teacher in a classical university.

One of the main prerequisites for modeling the professional training of a physics teacher at the university is a personality-oriented orientation of the learning process, based on the harmonization of the professional side of the activity with personal characteristics, specific interests, abilities, and aptitudes of the future specialist. Based on this premise, the personality-oriented model of the formation of professional competencies of a physics teacher at the university should be based on the implementation of the following principles:

- Continuity of all stages of teacher training at the university;
- Maximum activity of students in learning and research work;
- Organization of training, academic, and research work of students in the "zone of nearest development" of research skills of students;
- Combination of collective and individual forms of organizing the learning process;
- Optimization of teaching, developing, and diagnostic functions of the educational process in the university.

The goal of university pedagogical education is to form the foundations of pedagogical activity: a stable interest in the pedagogical profession, a system of scientific knowledge about this type of activity, and the ability to use this knowledge as a tool for professional thinking and for solving professional problems. The achievement of this goal is realized by the whole content of university education, which includes methodological, fundamental, and professional training, as well as extracurricular academic and educational work with students.

4 Conclusion

The basis of education as one of the social subsystems is reflection, the neglect of which causes a contradictory situation in the training of a new type of pedagogical personnel with an expanded function of a teacher. The problem of professional training lies in the inconsistency of its content to the required "concept" as a system of interrelated views; ways of understanding and interpreting phenomena. Bringing conformity to the requirements is carried out in compliance with the principles (fundamentalism, universality, integrative, variability, continuity, practice-oriented) with adaptation to the personal needs of the student, mastering the logic of the subject material, invariant set of knowledge, and methodological culture (systemic, critical, reflective thinking, motivational, cognitive, operational-activity readiness for self-development and self-education).

Thanks to the triunity of bases (principles, invariant set of knowledge, methodological culture) the fundamentalization of pedagogical education of a physics teacher in higher education is provided. In this case, the goal is achieved by methodologizing the content of professional training with an invariant core that provides the degree of mobility necessary for active reflection.

Thus, for the first time, it is proposed to fundamentalize the professional training of a physics teacher through the methodology of its content and the organization of the invariant core, which integratively provides the solution of educational and developmental tasks and resolves the existing contradiction. The practical orientation of the obtained results and, consequently, the practical significance of the study, is provided by the key recommendations to the organization of fundamentalization of teacher education, achieved through:

1. Creating an integrative environment of education in the structure of the social system by synthesizing knowledge with the requirements of society;
2. Introducing competencies that ensure the formation of students' methodological culture;
3. Modeling of the invariant core through the strengthening of practice-oriented activity in the context of innovative achievements in various fields of scientific knowledge.

A promising direction of research activity is modeling of the invariant core by establishing values in the ratio of basic and special competences of a physics teacher.

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