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**FUNDAMENTAL EDUCATION IN UNIVERSITY IN**  
**DEVELOPMENT OF FUTURE TEACHERS` PROFESSIONAL**  
**COMPETENCES**

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***Abstract***

The enormous social changes taking place in society have brought to the foreground the problem of the development of the creative potential of all society members and especially young people. The basis for the formation of a new generation of teachers, being able to solve the problem, is the changing content of higher pedagogical education, based on the principles of fundamentalization, humanization, differentiation, personal orientation of the entire educational process. This article is devoted to develop approaches to the study of General physics to strengthen the professional motivation of the future teacher, focusing on the use of special knowledge in the process of solving problems of development of the student's personality. The main methods of research are: the study of the experience of the organization of fundamental professional training of teachers in the universities of the country, modeling, allowing considering the process of studying the course of General physics, as the basis for the formation of professional competencies. The article presents a model of formation of professional competences of teachers in the course of General physics. The model is aimed at the formation on the basis of fundamental knowledge in physics of a special methodological culture of the teacher – formed systemic, critical, reflective thinking, motivational, cognitive, operational and activity readiness for constant self-development and self-education.

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**Keywords:** Fundamental training, general physics course, professional competences of physics teacher, general and special competences.



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## 1. Introduction

Teacher training requires the formation of his methodological reflection, the ability to navigate in modern scientific concepts, to assess adequately the level and limits of their professional competence, to see opportunities to increase their personal potential. At the same time, the development of higher education in Russia in recent decades has led to a contradictory situation in the training of teachers. On the one hand, there is a network of pedagogical educational institutions (pedagogical institutes and pedagogical universities based on them), on the other hand, classical universities (including newly formed on the basis of a number of pedagogical institutes and universities in recent years) are traditionally engaged in teacher training. The transformation of the pedagogical University into a classical one leads to the fact that the classical University often becomes the only higher education institution that trains teachers in a number of general subjects for the educational complex of the region, and, consequently, the teachers' detachment will be filled with the graduates of the University. The modern teacher is a bright, creative person, possessing new pedagogical technologies, the art of communication. The nature of modern pedagogical activity requires new thinking, which values are: the priority of individual thinking, self-development, self-study, the transition from the "knowledge" paradigm of learning to personality-oriented paradigm. The Federal State standard of secondary general education focuses teachers on the ability to structure the material, to determine the forms and methods of teaching, which requires, first of all, fundamental training in physics. At the same time, the researchers note that at the present stage "the most significant problem of the modern teacher is a substantial decrease in the level of his scientific, subject training in recent years" (Grebenev & Chuprunov, 2015, p. 3), which determines the relevance of the problem which considered in the article.

A number of studies are devoted to the problem of professional training of a physics teacher, both in a pedagogical University and in a classical University. In this case, the authors consider a variety of aspects of training. Senashenko and Senatorova (1997), considering the University training of teachers, emphasize that it "provides its graduates with incomparably deeper knowledge of the subject, opportunities for creative research attitude to the work of teachers, less authoritarian communicative potential and unconditional advantages in the production of circle work, conducting elective courses" (p. 4). Kolomin (2010), studying the possibilities of the course of General physics in the process of formation of the teacher, emphasizes that the subject competence, reflecting the availability of the necessary professional knowledge, is an obligatory component of the professional competence of the teacher of physics. The author provides a model of the general physics course, including the conceptual and procedural blocks (Kolomin, 2010). Anofrikova (1989) considering the formation of the generalized receptions of activity of the teacher, Smirnov (2012) in his study offers a model of formation of generalized methods of conducting physical experimental studies. Considering the educational physical experiment, Usoltsev and Pavlova (2011) emphasize its importance for the formation of professional competencies of the future teacher, as they are closely related to the subject content of the physics course, and, consequently, students are more motivated to acquire them. Belyanin (2012), developing a methodical system of formation of research competence of the future teacher in the study of physics, considers various forms of education: lectures, practical exercises to solve the problems, laboratory work, students' individual work.

## **2. Problem Statement**

The relevance of the studied problem is due, on the one hand, to the requirements of modern society to the level of training of a specialist with the breadth and depth of knowledge not only in their subject area, but also in related areas, and on the other – to the rapid obsolescence acquired in the process of training at the University professional competencies.

## **3. Research Questions**

The research question is to try to provide optimal conditions for the education of flexible and multifaceted scientific thinking, different ways of perceiving reality, to create an internal need for self-development and self-education of the future teacher of physics on the basis of fundamental education in a classical University.

## **4. Purpose of the Study**

Development of approaches to the study of general physics at the University as the basis for the formation of methodological competence of the future teacher of physics.

### **4.1. Research problem:**

- formation of students' style of scientific thinking, allowing to think in General scientific concepts, principles, and not to learn only ready-made guidelines;
- creation of conditions for stimulation and realization of creative abilities of the person.

## **5. Research Methods**

In the process of research the following methods were used: theoretical (analysis of psychological and pedagogical literature, materials and publications of pedagogical and printed media on the problem of research, modelling); diagnostic (questioning; testing; method of tasks and tasks); empirical (study of the experience of the organization of professional training of the teacher in the universities of the country, normative and educational documentation; pedagogical observation); experimental (ascertaining, search, training experiments).

### **5.1. The experimental base of the research**

Experimental base for research is the Federal State Autonomous Educational institution "North-Caucasian Federal University".

### **5.2. Investigation phase**

The study was conducted in three stages.

The first stage was dedicated to the theoretical study of the problem of training a physics teacher in a classical University, the analysis of psychological, pedagogical and methodological literature, the Federal state standards of training a physics teacher at the pedagogical Institute (University) and the

classical University, the definition of the initial positions of the study, the ascertaining experiment. At the second stage, the development of the content and model of formation of professional competencies of a physics teacher in the process of studying the course of General physics, the technology of their implementation in the educational process, mechanisms for diagnosing the formation and development of competencies using the student's self-development diary, a search experiment was started. The third stage was devoted to the training experiment, during which the effectiveness of the developed model of formation of professional competencies of a physics teacher in a classical University in the study of General physics was checked; the quality of training of a physics teacher was monitored.

## 6. Findings

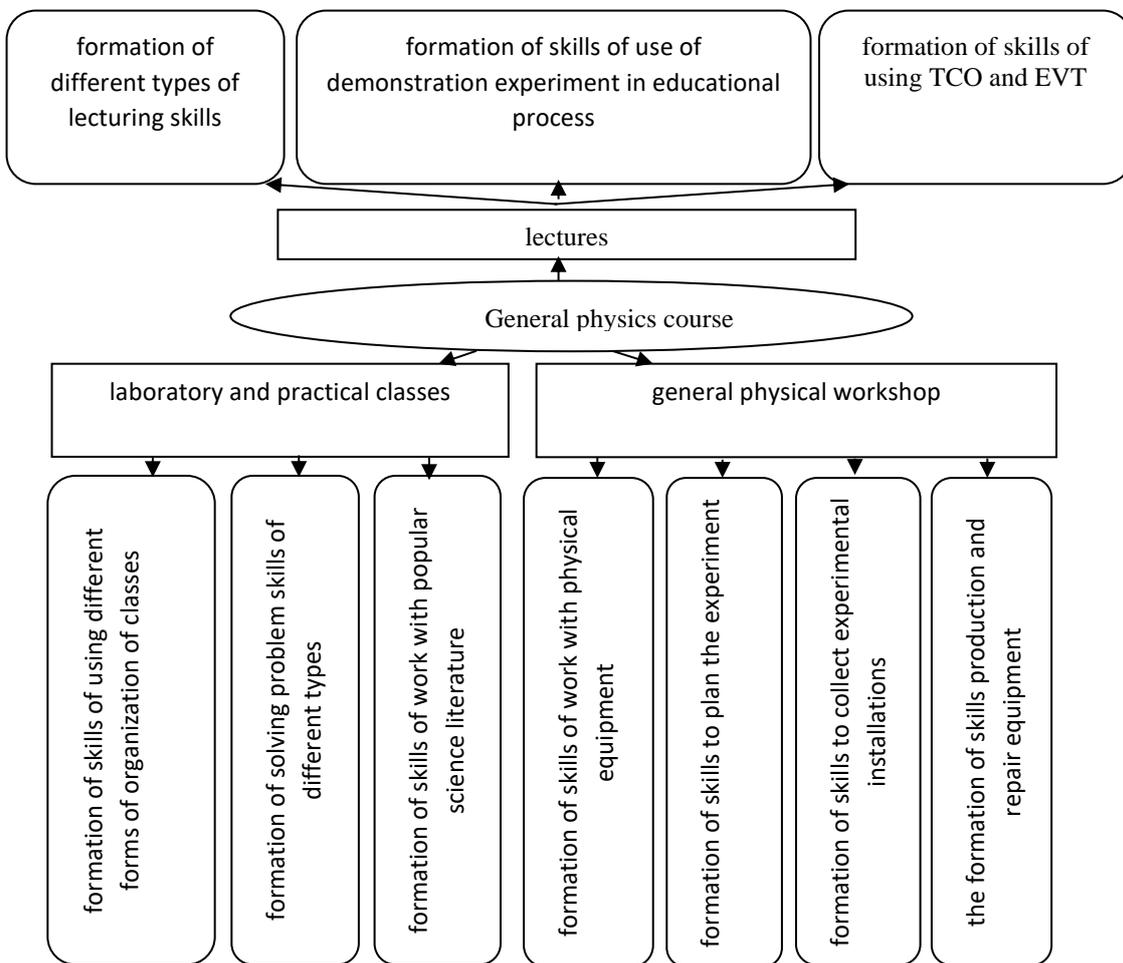
### 6.1. Structure and content of the model

The basis of professional education of the future teacher should be fundamental training in physics received by students in the study of General physics. It should be borne in mind that one of the most important functions of the course of General physics is to strengthen the professional motivation of the future teacher of physics, focusing it on the use of special knowledge in order to solve the problems of development of the student's personality. The course of general physics has the particular importance for the development of a professional teacher. On the one hand, it is the basis for further fundamental training of a specialist in the field of physics, and on the other – the basics of this course physics teacher expounds to the students in the course of their professional activities. When presenting educational material on General physics, it is necessary to focus students' attention on the relationship of physics with other fields of science and technology, so that they realize its fundamental role for all natural science and modern technology. At the same time, of great importance for the formation of professional competencies of the future teacher of physics are functional interdisciplinary connections that are established between special disciplines, in particular, the course of General physics and disciplines of the psychological and pedagogical loop. The main purposes of the implementation of functional interdisciplinary links of these loops of disciplines are:

- formation of a holistic scientific worldview;
- ensuring interdisciplinary integration of academic disciplines, especially special and general professional disciplines for further fundamentalization of higher education;
- formation of professional qualities of future teachers, independent scientific and professional thinking;
- to develop the students' academic, research, communication, organizational and other qualities required by the teacher;
- teaching students the ability to effectively use the scientific potential obtained in the study of physics, to solve the actual pedagogical problems.

In our opinion, while reading the course of General physics, it is necessary to give students information about the Polytechnic, ideological, moral potential of science, the struggle of scientific schools, the long and difficult way of knowing the truth, the moral feat of scientists, which can then be used by them in the organization of the educational process at school or any other educational institution.

Each lesson on the course of General physics at the University should solve at least two tasks: 1) to form 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. It should be noted that, unfortunately, the set of methods and forms of education used at the University in the organization of classes in General physics (and other school subjects) is inadequate advanced University practice. Meanwhile, the uses of various forms of education not only strengthen the professional orientation of teaching General physics, but also significantly enrich the process of teaching physics. The analysis of psychological-pedagogical and methodical literature on the problem of research allowed us to develop a model of formation of special professional competences of the teacher of physics in the course of General physics (Figure 01).



**Figure 01.** Model of formation of professional competences of the teacher of physics in the course of General physics

Let us consider in more detail the possibilities of various forms of organization of training sessions in General physics at the University for the formation of professional competencies of the future teacher of physics.

Lecture classes allow to give to the student – future teacher of physics samples of various types of lectures: lecture-conversation, lecture-visualization, lecture with use of feedback technique, lecture together, lecture-consultation and others which can be used in educational process of secondary

educational institutions. The use of lecture demonstrations helps to teach students to methodically correctly include in the structure of the lecture demonstration experiment, the correct use of TCO and electronic computing technologies.

Despite the characteristic features of the University laboratory and practical classes that distinguish it from a school lesson, when planning and conducting classes, it is necessary to provide for the use of various forms of organization that can serve as an example of a school lesson. At the same time, special attention should be paid to the combination of individual, group, collective forms of organization of classes, the use of active teaching methods, methods of attracting and maintaining attention. Use in the study of General physics of work in small groups and pairs of shift composition can increase the activity of students in the assimilation of new information. The need not only to learn yourself, but also to explain to group mates or a couple, provides depth and awareness of knowledge, and allows the student to master the active forms of organization of educational work, get the first teaching skills.

The selection of tasks is also of great importance in enhancing the professional orientation of laboratory and practical classes in general physics. The use of various types of tasks during the lesson, analysis of the method of their solution not only forms the professional skills of the future physics teacher, but also contributes to the development of interest in the study of the subject itself.

Another aspect of strengthening the professional orientation of the course of General physics is the study of additional and popular science literature, which aims to teach students to be interested in additional literature on the subject, use it in their daily work.

Physics is an experimental science, so for its successful assimilation the great importance is the optimal combination of theoretical and experimental part of the course. These circumstances lead to the need to improve the experimental skills of future teachers of physics in the process of their training at the University. At the same time, the future teacher is required not only the ability to prepare and conduct an experiment on the available demonstration and laboratory equipment, but also the ability to independently develop and produce the necessary experimental facilities and experiments on their basis, i.e. to approach the school physical experiment creatively.

The most important in the formation of experimental skills of future teachers of physics is the General physical workshop, which is held in parallel with the theoretical course of General physics. When organizing the workshop, students should be involved in activities such as planning an experiment, assembling a laboratory installation, repairing equipment, developing and manufacturing simple homemade demonstration and laboratory equipment.

The composition of professional competence of the teacher of physics, along with the above, includes research competence, the formation of which is also possible within the framework of the General physical workshop. For the formation of students' research competencies on the topic of each work of the workshop, we have developed creative tasks (for mini-studies), presented in the guidelines for the implementation of tasks for self-controlled work of students. In the development of tasks were used ideas taken from various methodological and popular science literature, as well as resulting from the educational and research work of the authors. The main purpose of creative tasks – the formation of research competencies of all undergraduate students, regardless of their abilities. Creative tasks are

developed in three levels of difficulty. Tasks of the first level – the most difficult. They only indicate a problem. For the tasks of the second level, the problem remains the same, only the wording is changed so that it contains tips: the range of devices and materials is limited, various ways of performing the task are outlined. The third level of tasks is simplified as much as possible, its formulation contains even more hints, but elements of creativity are still present in it. Consider as an example the creative tasks developed for laboratory works of the General physical workshop on the course "Electricity and magnetism".

Laboratory work « Study of electrical measuring devices. Resistance measurement. » The first level of complexity: connect the light bulb at 2.5 V, 0.3 A to a DC source with EMF 40 V, using a rheostat with a sliding contact at 200 Ohms, determining in advance its position on the rheostat. The second level of complexity: connect the light bulb 2.5 V, 0.3 A to DC current with the EMF of 40 V using a rheostat with a sliding contact at 200 Ohms. Having calculated the value of the additional resistance, determine in advance the position of the sliding contact on the rheostat. The third level of complexity: connect the light bulb 2.5 V, 0.3 A to DC current with the EMF of 40 V using a rheostat with a sliding contact at 200 Ohms. Calculating the value of the additional resistance and setting what part of the total resistance of the rheostat it is, determine in advance the position of the sliding contact on the rheostat.

Such organization of the General physics course, in our opinion, will not only improve the quality of teaching physics, but will also contribute to the solution of another problem: the training of future teachers of physics to teach physics.

## **6.2. Stages of implementation of the model**

Introduction of the developed model of formation of professional competences of the teacher of physics in a course of the General physics assumed carrying out the following stages:

- study of psychological and pedagogical literature devoted to the peculiarities of University pedagogical education; identification of the possibilities of General physics course in the formation of professional competencies of a physics teacher;
- checking the effectiveness of various methods, forms and means of organization of educational work on the course of General physics in the formation of professional competencies of the future teacher of physics; development of the content of educational and methodological materials for students;
- verification of the effectiveness of the developed model of formation of professional competencies of the teacher of physics.

During the pedagogical experiment the formation of the General special professional competences of the future teacher of physics was checked. To the General professional competencies that any subject teacher should have, we have included: Gnostic, constructive, organizational, communicative, analytical, prognostic, creative, projective, information. To special professional competences: experimental, ability to form experimental abilities at pupils, ability to solve physical problems, ability to train pupils in the solution of physical problems, ability to direct technical creativity of pupils, abilities of completing of a physics classroom.

### 6.3. Starting experiment

The starting experiment was aimed to identifying students' knowledge about the nature, content and conditions of professional activity of a physics teacher; the level of formation of individual professional competencies. For this purpose, questionnaires, targeted observation, scaling were used. The ascertaining experiment conducted at the I-IV courses showed that students in the majority have a positive attitude to the teaching profession. Thus, "the profession rather like than dislike" 52.4 %, 60 %, 76 % of students of II-IV courses, respectively, "really like" – 8 %, 14.3 % and 20 % of students were unable to determine their attitude to the teaching profession from 4 to 9.5 % of students and "did not like" teaching profession 4 %, 4.7 %, 8 % of students of II-IV courses, respectively. It should be noted that only 64 – 68, 7% of students imagine the character, content and conditions of professional activity of the teacher of physics. Among the qualities of the teaching profession, attractive to students are: a) work with children and young people (52 – 60 %); b) the ability to instill in children a love for their subject (24.1 – 44 %); C) the creative nature of the teacher's work (23.8 – 36 %); d) the possibility of self-improvement (20 – 32 %). Among the most unattractive qualities of the teaching profession, students noted: a) little is estimated the importance of the teacher's work (61,9 – 72 %); b) lack of discipline of children, unwillingness to learn (36 – 60 %); C) everyday work of the teacher (8 – 21.3 %). At the stage of starting experiment diagnostics of self-assessment of formation of separate professional competences of the teacher of physics which was used as initial when carrying out monitoring of development of professional competences was carried out.

The survey of IV year students allowed to reveal the degree of professional pedagogical orientation of the General physics course: 38.2 % of students believe that General physics classes are not prepared for professional activity at school, 49.6 % – found it difficult to answer this question and only 12.2 % of students answered that General physics classes (mainly lectures) are prepared for the teaching profession.

Thus, the ascertaining experiment revealed:

- insufficiently high level of formation of professional competences of future teachers of physics;
- low pedagogical orientation of the learning process at the University (especially the teaching of special subjects) on the formation of a competitive teacher of physics;
- the traditional commitment of most teachers and students to the "knowledge" paradigm of learning.

### 6.4. Searching experiment

The search experiment was aimed at clarifying the role, place and didactic capabilities of the course of General physics and General physical practice in the formation of professional competencies of a physics teacher, the development of a model for the formation of professional competencies. The experience of our administrative, teaching and research work allows us to agree with researchers (T. B. Grebenyuk, M. A. Danilov, F. F. Korolev, V. S. Ilyin, V. V. Kraevsky et al.), who believe that in the pedagogical experiment it is quite difficult to achieve an equalization of the composition of parallel groups in terms of the initial formation of knowledge, skills and abilities for the allocation of the experimental and control groups. In addition, the students of the control group are put in advance as if in

the "worst" (from the point of view of the proposed hypothesis of research) conditions of professional training of a physics teacher, which, in our opinion, is not quite ethical. Therefore, in our study, we found it possible to abandon the control groups and monitor the development of professional competencies, recording the changes taking place at certain stages of the study. To monitor the state of formation and development of professional skills in the course of the experiment, the "student's self-development diary" was used. The diary is intended for documented reflection of all types of educational and extra-curricular activities of the student during his training from I to IV course. These time frames of keeping a diary are determined by the model of formation of professional competencies of the teacher of physics developed by us. The use of self-assessment in monitoring the quality of training of teachers of physics at the University allows you to shift the emphasis in the educational process from "development of skills of the future teacher" to "self-development of the individual".

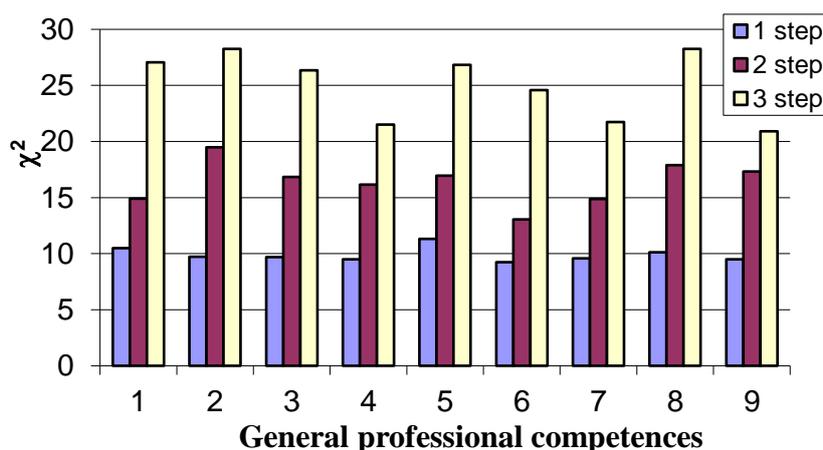
### 6.5. Training experiment

During the training experiment to determine the level of formation of professional competencies of the teacher of physics used the same methods as in the search experiment. Levels of development of professional skills by students were also determined by the results of a series of control sections.

To assess the effectiveness of the proposed model of formation of professional competencies of the teacher of physics, we used  $\chi^2$  – criterion that allows us to compare not the absolute average values of some values before and after the experiment, but the percentage distribution of data, which, in our opinion, is more objective.

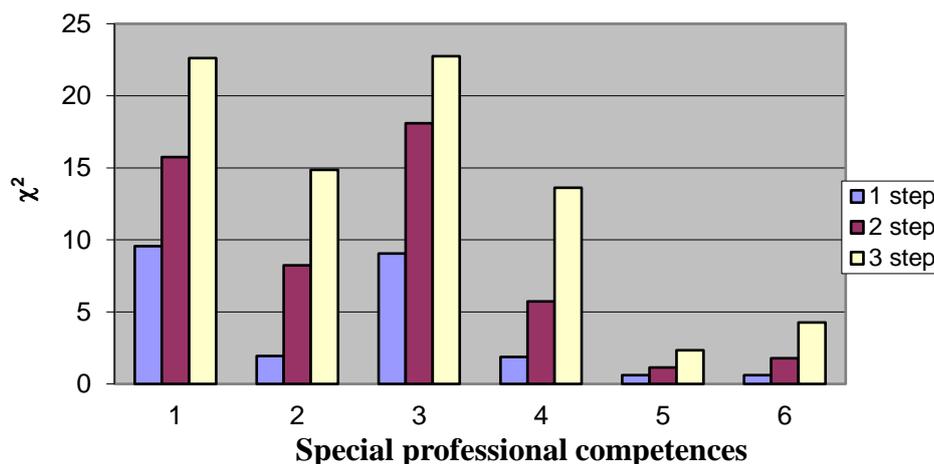
Since we monitored the development of professional competencies of students from the I to IV course, the training experiment was divided into three stages, and the results were compared at the end of II, III, IV courses.

For figures 02, 03 presents the data obtained when calculating  $\chi^2$  – criterion.



**Figure 02.** Monitoring the development of general professional competencies future physics teacher

Competences: 1 - gnostic, 2 - constructive, 3 - organizational, 4 - communicative, 5 - analytical, 6 - prognostic, 7 - creative, 8 - projective, 9 – informational



**Figure 03.** Monitoring the development of special professional competencies of the future physics teacher

Competences: 1 - experimental, 2 - the formation of students' experimental skills, 3 - the ability to solve problems, 4 - teaching students to solve physical problems, 5 - management of technical creativity of students, 6 - completing the physics office

Boundary value  $\chi^2$  – criterion corresponding to two degrees of freedom ( $m = 3$ ) and the probability of error tolerance of 0.01, as well of 9.21, which allows to make a conclusion about significant changes in the level of development of professional skills and the confirmation of the hypothesis of the study.

Empirical research has allowed to check the efficiency of the developed model of formation of professional competences of the future teacher of physics based on fundamental physical education.

### 6.6. Debatable question

The study of psychological and pedagogical literature has revealed studies on the formation of individual professional competencies of the future teacher of physics in the process of fundamental training at the University and pedagogical University: research competence (Belyanin, 2012), theoretical thinking (Vinogradov, 2005), methodological knowledge (Kitaygorodskaya, 1998; Sharonova, 1997). The fundamental nature of education as a basis for teacher training is considered in the works of Matrosov (2006) and Kolomin (2010). However, there are practically no comprehensive studies on the methods of teaching General physics to future teachers, offering theoretical grounds for building a course of General physics, which allows to contribute to the formation of students' professional competencies.

## 7. Conclusion

Fundamental training in the field of physics, which receives a graduate of the classical University, allows you to approach the problem of professional training of the future teacher from other positions than in the pedagogical University. It is classical universities with their fundamental nature of education that are able to prepare teachers of a new type, who deeply and professionally know 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 tasks that can bring a creative direction to school and help students in mastering the methods of scientific research. The epistemological aspect of fundamental education – the development of

methodology and the acquisition of knowledge skills – allows a University graduate to successfully navigate in any new environment and provides the opportunity to develop a variety of training options in one basic education.

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