Man In India, 97 (11) : 517-529

A MODEL OF THE FUTURE TEACHERS' PROFESSIONAL COMPETENCE FORMATION IN THE PROCESS OF PHYSICS TEACHING

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Background/Objective: The relevance of the research is conditioned by the modern pedagogical theory and practice of training the future physics teachers.The goal of the research is to develop a model of the process for the future teachers' professional competence formation in the course of physics teaching and try this model out. ***Methods:*** When conducting the present research, the following research methods were used: modeling a methodical system of teaching general physics to undergraduate students seeking the Bachelor's and Specialist's degrees in the education fields "5V01000-Physics and 5V060400-Physics". ***Findings:*** a model of methodical system is presented in this article. This model includes the following subsystems: target subsystem, content-related subsystem (content description of the directions of physics course, description of the content of the sections of physics course structured according to the foundations specified) and technology subsystem. ***Improvement/Application:*** Practical value of the research is determined by the fact that the results of this research provide a methodical base of the activity of the Department of Social Subjects and Methodical Department associated with the development of education programs, content, technologies, methodical complexes for training future physics teachers (in the education fields of the Bachelor's and Specialist programs).

Keywords: Model, Physics Teaching, Methodical System, Professional Competence, Future Physics teachers

1. INTRODUCTION

For the time being, a competence-based approach serves as a base for updating the content as of a general as well of a professional education. The term "competence" came from the Latin words "*competens*" and "*competentis*" which mean "fit, able". In the Dictionary of the Modern Kazakh Literary Language competence is defined as awareness of some field of knowledge. Competent means "knowledgeable, proficient, informed".

Currently, the relevant task of not only the Kazakh but also the world education is the improvement of a general education as well as of a professional one. For the solution of the aforementioned task, the goals and results of education are reconsidered, the content of education is changed and the term "professional

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competence" is increasingly coming into use and includes such terms as "qualification", "professionalism" and "professional readiness", etc.

In the Republic of Kazakhstan, the term "professional competence" has come into use due to the reforms of higher education. According to the concept of the Kazakh education updating, the main goal of professional education is the preparation of a qualified employee which can be competitive in the labor market, has excellent professional skills, effectively does his or her job, have a good grasp of the fields related to his or her professional activity and has a constant willingness to professional self-improvement.

Despite the constant growth of the publications dedicated to the development of competence-based approach in education (Baumert & Kunter, 2011), this problem in the field of natural-science disciplines teaching has not been studied enough. Different interpretation of the terms "competence" and "competency" exists to date. The single system of diagnostics of formedness of various types of competence and methods of formation of various types of competence are missing. Despite a number of the research works devoted to diagnostics of competence formedness of the students (Kaiser *et al.,* 2015), this problem is far from solution.

Currently, education programs provide for studying the subject itself and methods of subject teaching at schools in various courses of study. Often these courses do not properly support each other or are not connected with each other at all. This also concerns such subject as physics and methods of physics teaching at school. At teachers' college it seems appropriate to study some matters associated with teaching methods in the process of studying this subject. Moreover, one can see that much less time is provided for carrying out the laboratory and practical works in physics compared to the time provided for carrying the laboratory and practical works in general physics. When conducting a survey among young teachers, it was revealed that often, especially at the beginning of their professional career, young teachers give their classes "according to a sample", i.e. the way they had been taught at the University. For this reason, at carrying the laboratory and practical works in physics when forming a professional competence of a teacher, we pay attention to the content and performance of such works at schools, in which case education process has a professional direction.

Highlighting the importance of the laboratory and practical works in physics in terms of professional competence formation, we made analysis of the pedagogical and psychological literature with regard to the subject studied.

Analyzing the above, one can make a conclusion that despite a significant number of the research works devoted to the problem of implementation of competence-based approach at higher education institutions, the discrepancies between the need for a physics teacher being capable of solving the new professional tasks and immaturity of the system of education of the teachers capable of solving such tasks still exist.

All aforementioned makes the subject of the research "Model of Professional competence formation of the Future Teachers in the Process of Physics Teaching" relevant.

2. MATERIALS AND METHODS

2.1. Research Methods

The main methods of the research were laws, education programs, theory of knowledge, general didactic principles of personality formation, science and practice integration theory, pedagogical and psychological fundamental principles in the field of development of a creative activity, pedagogical research in the field of formation of a professional competence and use of the results of the pedagogical programs, the use of computer models of the experiments and demonstration of physical phenomena; mathematical statistics and performance of a pedagogical experiment.

2.2. Experimental facilities of the research

Experimental facilities of the research were H.A. Yassawi International Kazakh-Turkish University, M. Auezov South Kazakhstan State University and Moscow City Teacher' Training University.

2.3. Research Stages

The research of the problem was conducted in three stages:

The first stage included defining the research problem in native and foreign literature; studying the peculiarities of forming professional competence of the future physics teachers; studying and summing up an educational experience in formation and assessment of the future physics teacher's professional competence.

At the second stage the models of professional competence formation of the future physics teachers were developed. The system of tasks for professional competence formation and the system of assessment of professional competence formedness level in the future physics teacher were developed as well. The preliminary pedagogical experiment was also conducted at the second stage.

At the third stage the experimental work on checking the efficiency of the suggested model of the future teachers' professional competence formation was completed, theoretical and practical conclusions were made specific and the results obtained were generalized and systematized.

3. RESULTS

3.1. Structure and Content of the Model

To form professional competence of the future teacher in the process of physics teaching, the authors developed a conceptual-process model in the present research

(Figure 1).The precondition for the formation of the aforementioned model was the analysis of the works dedicated to the research of the issues related to the theory and methodology of professional education (Adolf, 2011, Gelfman et al, 2009), as well as to the theory and methods of physics teaching at school and at higher education institutions in the process of a physics teacher training (Agibova, 2009).

The model presented consists of five main interrelated components: target, diagnostic, conceptual, process and resultative ones.

The goal of the research serves as a system-forming element in the model developed in the present research. The above goal is to develop a professional competence of the students doing their course of study in the field "5V011000 – Physics" and possession of this competence should determine the ability to successfully develop the universal leaning activities of the pupils at physics teaching.

Conceptual component of the model is aimed at revealing and setting the goals of the students' education. In the current conditions, an accomplished teacher should be well aware of the requirements of the Federal State Educational Standards, secure correspondence to the above Standards, predict, diagnose and correct the results of acquisition of the learning material by the pupils, if required. Thus, target component of a model presented in this article is aimed at formation of professional readiness, so that in the future the competence formed will help a teacher to implement the requirements of the Federal State Educational Standards of a general education.

Conceptual component of the developed model composes the education content which serves as a tool for the development of the future physics teacher's professional competence. The content of education is determined by regulatory documents, such as the State Standards and qualification requirements for the future teachers' education. In our case, the content of education is aimed at the development of the components of professional competence, namely: communicative, worldview, organizational and informational ones. Additionally to the aforementioned, the development of the hereinbefore expressed components of professional competence should result in the development of the ability of the future physics teacher to form the universal learning activities (communicative, regulative, cognitive and personal ones) in the process of physics teaching.

The next component of the model of the teacher's professional readiness formation is a process component. This component encompasses a didactic system aimed at forming four components of professional competence: worldview, communicative, organizational and informational ones. This system represents the system of methods, techniques and didactic approaches to the performance of the laboratory and practical works in physics with implementation into education process of various knowledge which is not typical for a traditional performance of such works: solution of case problems associated with the subject of a laboratory

or practical work, effective use of case method, performance of dictations in physics; the use of reflection tables; enhancement of the role of the independent work of the students (the use of the developed course of tasks); self-assessment of education results; the use of the auxiliary laboratory chart; generation of methodological recommendations with regard to the laboratory work for implementation of at school.

Diagnostic component of a model is aimed at determining the level of professional competence formedness at the initial and final stages of education of a student using diagnostic cards. This card consists of 11 case offers. Each of these offers is connected with one or two components of professional competence. The students are suggested to answer the questions which represent the abovementioned case offers as follows: "Agree", "Partially agree" and "Disagree". Each answer assessment is made based on a certain number of points and total points evidence of formedness level of this or that component of professional competence. Additionally, the results of self-assessment are joined by the results of tutor's assessment based on the criteria developed by us. In more detail, diagnostic techniques are described in the second section of the present article. Diagnostic component of the model is aimed at revealing the difficulties in the formation and diagnostics of professional competence of a teacher.

The resultative component is a final component of the model. This component shows final development and dynamics of the students' professional competence development after conducting an experiment associated with checking the hypothesis suggested in the research. The above component also helps analyze the degree of formedness of the teacher's professional competence components nd enables to judge about the further development of professional skills. The check of the practical skill of the students associated with composing the tasks is also done at this stage.

3.2. Stages of Professional Competence Formation and Development

One can distinguish the following sequence of the students' professional competence formation and development:

1. stage: Assessing the formedness level of professional competence components at the initial stage;
2. stage: Developing professional competence components in the process of carrying out the laboratory and practical works in the frame of didactic system suggested;
3. stage: Assessing the formedness level of the students' professional competence components (after carrying out the laboratory and practical works);
4. stage: Checking the efficiency of the obtained methodical knowledge and abilities of the students in practice when forming and developing a professional competence.

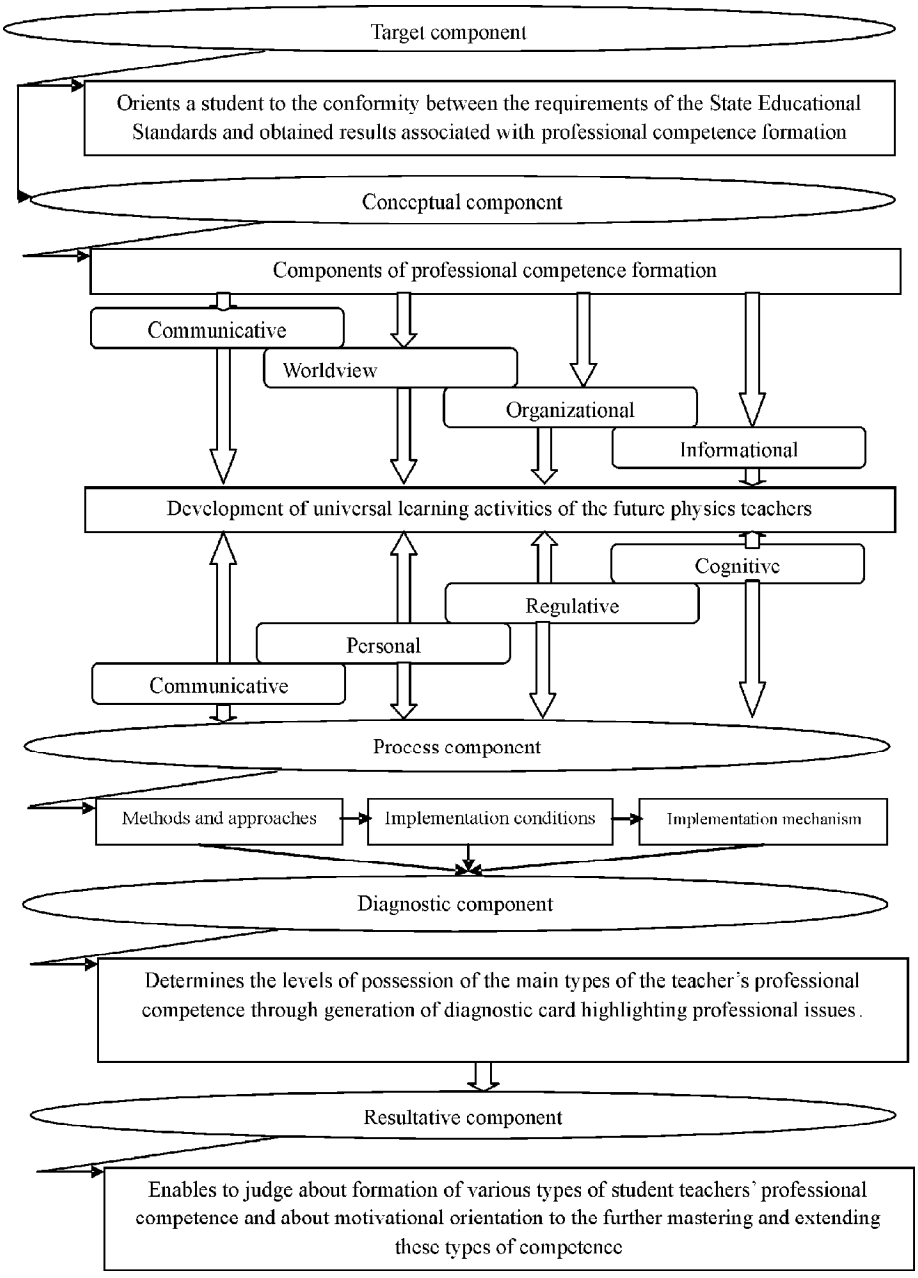

Figure 1: Model of the future physics teachers' professional competence formation

3.3. Didactic Conditions of the Students' Professional Competence Formation

For implementation of a model developed, the required relevant didactic conditions should be created.

There are many definitions of the term "didactic conditions". Under "didactic conditions" a set of measures are normally understood, which are aimed at improving the efficiency of the activity of a teacher or at a directional selection, design and use of the elements of the content, methods, techniques and organizational forms of education for the achievement of the educational goals (Mukhrov, 2012).

The process of revealing the pedagogical conditions in the summarized form can provide for performing the following actions (Pavlov, 2013):

- Revealing the main components which are important for goal achievement;
- Selecting the activities which should improve the efficiency of each component;
- Making the obtained pedagogical conditions more orderly;
- Checking each pedagogical condition revealed.

Considering all aforementioned, one should distinguish the following ***didactic conditions*** of a student's professional competence formation required for the organization of the universal learning activities at physics lessons:

- Education process should be aimed at realizing by a student of the importance of his or her future profession;
- Enhancement of the role of the independent work when educating the undergraduate students seeking the Bachelor's degree in Pedagogy;
- Development of the methodical skills and abilities for competence formation;
- Improvement of the education process organization using a didactic system (Ramankulov *et al,* 2015).

The first condition provides for appropriate education of a Bachelor of Pedagogy being to large extent determined by realizing the importance of his or her profession.

The second condition provides for the independent work resulting in the development of skill and abilities, which in the future will enable a teacher to independently set educational goals and independently solve professional tasks selecting the relevant methods and means.

Fulfillment of the third condition should enable the future teacher to join in the education process, to skillfully organize an educational-bringing-up process and successfully use the mastered teaching methods as well as develop the new ones.

The forth condition provides for the use of up-to-date educational-professional tasks aimed at professional competence formation of a physics teacher.

Thus, we determined the main stages of a student's professional competence formation required for the development of the universal learning activities at physics lessons as well as goals, means and methods of professional competence formation. We also developed relatively simple diagnostic techniques which enable to make assessment of the fomedeness level of professional competence and revealed the pedagogical conditions for professional competence formation of the future physics teachers.

3.4. Experimental Check of the Efficiency of the Model for the Future Physics Teachers' Professional Competence Formation

For checking the efficiency of a model, an educational experiment was carried out on the basis of H.A.Yassawi International Kazakh-Turkish University and M. Auezov South Kazakhstan State University. 60 students of the Department of Physics participated in the experiment. These students were divided into two groups.

The first group consisted of 29 people and was a control one (CG). The lessons in those groups were given using traditional teaching methods. The second group consisted of 31 people and was an experimental one (EG). The students which were in the second group carried out the laboratory and practical works according to the teaching methods described in the present article.

At the initial stage prior to the laboratory and practical works, all the students were suggested to answer 11 questions which represented case offers. Each of those case offers was aimed at determining the formedness level of four components of professional competence: worldview, communicative, organizational and informational ones as well as at determining a professional competence in general.

The analysis of the results of an educational experiment showed (Berdi et al, 2015) that at the initial stage (prior to an experiment) both control and experimental groups had almost equal percentage of the students with the same level of professional competence (Figure 2). Thus, 28% of the CG students and 26% of the EG students had a low level of professional competence, in both groups a percentage of the students with low and average levels of professional competence was the same (21% and 41%, respectively). Prior to the experiment, 10% of the students in CG and 12% of the students in EG demonstrated a high level of professional competence.

Upon completion of the course of the laboratory works, the number of CG students who had low, average, high and inadmissible levels of professional competence was compared. The results of the comparison are shown in Figure 3. One can see (Figure 3) that carrying out the laboratory works in a "classical" way results in a decreased number of the students with an inadmissible level of professional competence formedness.

Prior to the laboratory works in a control group, 27% of the students had an inadmissible level of professional competence formedness. After completion of

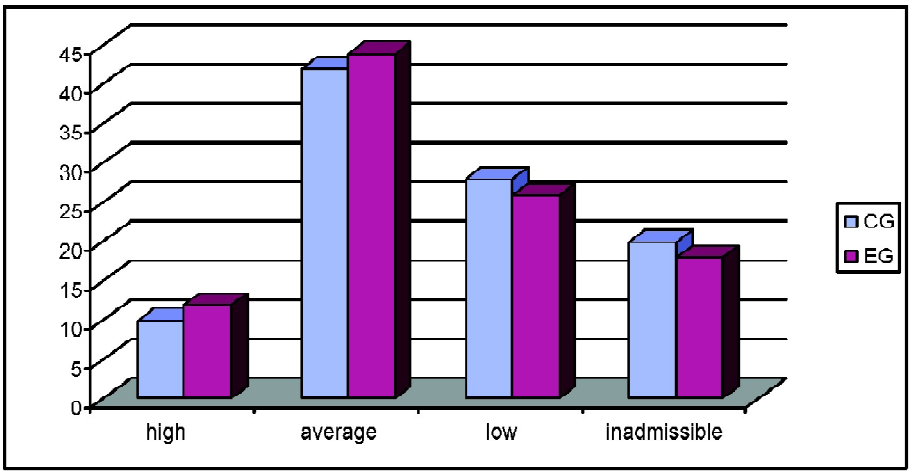

Figure 2: Comparison of the level of the students' professional competence formedness in the control and experimental groups prior to the experiment, %

the laboratory works, this number decreased up to 17%, however the students did not increase their existing average level of professional competence formedness to high one. This evidences of the fact, that a traditional way of carrying out the laboratory works in physics affects the professional competence formation.

Comparison of the number of students in the control and experimental groups after carrying out the laboratory and practical works based on the developed mode (Figure 3) showed that in CG a number of the students having an inadmissible

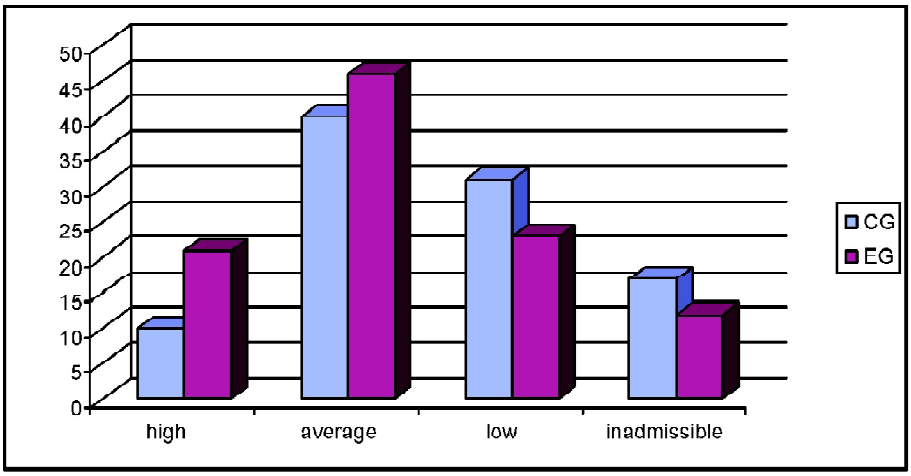

Figure 3: Comparison of the level of the students' professional competence formedness in the control and experimental groups after the experiment, %

level of professional competence made 17% and in EG this level was 12%; a number of the students with a low level of professional competence formedness in CG made 31% and in EG this number amounted to 23%.

One can see that after the experiment a number of the students having an average and high levels of professional competence formedness in EG is bigger compared to a number of the students having the same level in CG. Thus, in EG 46% of the students had an average level of professional competence formedness and in CG 40% of the students had such level of professional competence formedness. In EG 21 % of the students had a high level of professional competence formedness and only 10% of the students had such level in CG. These results evidence that the system developed increases the level of professional competence, which proves the correctness of this system.

Thus, the use of the developed model of the teacher's professional readiness formation at the laboratory works in physics enables to increase a number of the students who have an average and high levels of professional competence formedness compared to the number of the students who carried out the laboratory and practical works in a traditional way (Usembayeva *et al,* 2015).

4. DISCUSSION

Formation and development of professional competence cannot be properly implemented without well-developed diagnostic techniques using which it would be possible to make assessment of formedness level of a competence studied. Diagnostics is primarily aimed at revealing the strengths and weaknesses in professional activity of a teacher, his or her potentialities and needs and enables to foresee possible difficulties in implementing the education process. Many scholars are involved in the development of assessment systems (Romanova, 2010., Grabchuk, 2011, Velde, 1997), however any universal diagnostic methods of competence formedness level have not been offered yet. Scholars normally develop such assessment techniques which are aimed at assessing certain types of professional competence in a particular field of human activity (education and business, etc.). This problem is relevant not only for the Russian scholars but also for the Western ones. It is known (Lang, 2007) that at Harvard University the Holms Partnership project was implemented, the idea of which revolved around the teachers' training for their professional activity and assessment of this activity. This assessment was divided into the stages: assessment at the interview for a job at education institution specialized in teachers' education; assessment prior to teaching practice; assessment prior to school practice.

K.M. Grabchuk and E.V. Filatova (2011) in their research work suggested the diagnostic system of professional competence of the future caseworker based on the assessment of a graduate, expert assessment of a tutor and on the assessment of the clients of the institutions of social safety net.

In the article (Sibikin, 2011), it was suggested to assess the professional competence formedness level of the students of higher education institutions doing their course of study in the education field "Information Technology". The idea of this assessment was to determine the formedness level of each type of graduate's competence specified by the Federal State Educational Standards of higher professional education, after which a general assessment of a graduate's professional competence was made.

Thus, any selected or developed methods of diagnostics of the competence formedness level should be scientifically grounded and provide for a clear and open procedure of carrying out a diagnostic procedure (Mezentseva, 2014).

The examples studied show all complicity and ambiguousness of the assessment methods of formedness level of various types of professional competence. Despite the difference in counting the quantitative characteristics which show the level of professional competence formedness, the majority of the methods primarily provide for testing, questioning and expert assessment. The analysis made shows that not every scholar can make use of the teaching methods specified due to the complicity of their implementation procedure and assessment of the studied types of professional competence as well as due to a specific subject field, i.e. professional competence formation based on a particular academic discipline. Therefore, the research work associated with the development of relatively simple method of assessment of the level of professional competence formedness should continue.

5. CONCLUSION

The research conducted enables to make the following conclusions:

The model of professional competence formation of a teacher at physics lessons was developed and implemented. The above model consists of target component which determines a goal of education and orients a student to the conformity between the requirements of the State Educational Standards and obtained results associated with formation of various types of professional competence; diagnostic component which determines the level of possession of the main types of a teacher's professional competence through generation of diagnostic card highlighting professional issues; conceptual component which answers for the professional competence formation consisting of four types of components: worldview, organizational, communicative and informational ones; process component which covers the main methods, conditions and mechanisms for implementation of professional competence formation; resultative component which enables to judge about the student teachers' professional competence formation. It is shown that the use of this model enables to form professional competence of the future physics teacher.

It is experimentally proved that solving the problems and carrying out short-term laboratory and practical works (the materials had been prepared by the students

which participated in the experiment) result in more effective formation of the universal learning activities at physics lessons.

Thus, the findings of both theoretical analysis and experiment prove the main statements of the hypothesis suggested in this study and allow considering that the main objective of research work was reached.

However, this article does not solve all the problems associated with formation and assessment of a teacher's professional competence, for which reason this research should continue.

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