

## Development of Structural Components of Future Technicians' Professional Competencies during Their Studies of General Disciplines in College

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### ABSTRACT

The relevance of the problem stems from the necessity to develop and implement the formation model for structural components of future technicians' professional competencies during their studies of general professional disciplines. The purpose of the article is to carry out a theoretical study, to develop and approbate a model that forms the structural components of future maintenance and repair of automobile technicians' professional competencies during their studies of general professional discipline "Materials science". The leading method towards studies of this problem is technologies and methods of educational process modeling; works on educational research methodology. The article theoretically proves, develops and approbates a formation model for future maintenance and repair of automobiles technicians' professional competencies during their studies of general professional discipline "Materials science". This article may be useful for developing the competence-oriented content for training courses aimed at the formation of structural components of professional competencies.

### KEYWORDS

Model, professional competencies, general professional disciplines, didactic conditions of model implementation

### ARTICLE HISTORY

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### Introduction

In the last decade, in the social and professional sphere of Russian society the role and number of professionals working with maintenance and repair of automobiles has been increasing steadily. At the same time generalist professions combining management, control and maintenance of mechanized

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and automated systems come to replace the traditional highly specialized professions (Hannelore & Esenina, 2015; Kayumova & Morozova, 2016).

Possessing excellent level of modern methods of organization, planning, operation, maintaining and repair of automobiles and increasing ecological compatibility, safety and comfort of vehicles, a specialist should be able to find rational decisions in complicated professional situations which significantly boosts the efficiency of their performance (Dorozhkin & Zeer, 2014; Kalimullin & Dobrotvorskaya, 2016; Masalimova & Ivanov, 2016; Vedishenkova, Nikitina & Zhumabaeva, 2016).

Automobile modernization is a very rapid process and future technicians must be prepared to master new technologies used in the automobile engineering and manufacturing. In order to use modern technologies and integrated systems, a technician should organize himself/herself and think – to plan, to find solutions, to deal with problems, which significantly improves the results of his/her professional activity (Romantsev, 1997; Kalimullin, Khodyreva & Koinova-Zoellner, 2016; Zeleeva, Bykova & Varbanova, 2016).

Development of the competence approach concept in Russian conditions reflects orientations towards identifying the global trends in development of education, which involves prevention of possible gap in the education field between Russia and Western countries and conservation of high prestige of the Russian professional school (Atutov, 1986), the education in modern conditions should be convertible (Novikov, 2000).

The competence approach is a gradual transition from knowledge and skills transmission towards creation of conditions for mastering the complex of competencies involving graduate's potential and ability to survive and sustainably live in today's multi-factor socio-political, market, economic, information and communication saturated space (Pavlova, 2006; Dorozhkin, Zaitseva & Tatarskikh, 2016; Gabdulchakov, Kusainov & Kalimullin, 2016).

General professional disciplines that give opportunities to start a qualified labor providing a human's professional and social adaptation are very important in the formation of professional competencies (Tkachenko & Glazunov, 2001; Abykanova et al., 2016; Gabdreeva & Khalfieva, 2016; Khuziakhmetov et al., 2016).

Thus, it must be assumed that the structural components of professional competencies in forms of knowledge, skills and abilities obtained during the general disciplines studies contribute to the most efficient formation of future maintenance and repair of automobiles technicians' professional competences.

## **Materials and Methods**

### ***Research methods***

During the research the following methods were used: theoretical (analysis of psycho-pedagogical, methodical and special literature on the research problem); diagnostic (survey, testing, method of tasks and assignments); empirical (the study of educational institutions work experience, regulatory and instructional documents; generalization of pedagogical experience in preparation of mid-level specialists in the system of vocational education); experimental (summative, formative and control experiments); methods of mathematical statistics and graphic display of results.

### ***Experiment research base***

Experimental research work was carried out in the college included in the structure of the Ural State Forestry Engineering University.

### ***Stages of research***

The study of the problem was conducted in three stages:

The first stage included the following: study and analysis of scientific and theoretical, psychological, pedagogical and methodological sources; studies of dissertations and normative documents on the stated theme; the main areas of research were specified, the contradictions were formulated, the purpose, object, subject, hypothesis and tasks of the study were determined.

On the second stage the peculiarities of general professional training of future transport specialists in the mid-level secondary vocational education (SVE) system were analyzed; the competence model of the graduate majoring in SVE "Maintenance and repair of automobiles" with qualification "technician" was determined; the competence-oriented content of general professional discipline "Materials science" was developed; the model of graduate's professional competencies during their studies of general professional discipline "Materials science" was developed; the didactic conditions contributing to the implementation of this model were substantiated; the hypothesis of the study was specified.

On the third stage the results were processed and systematized, the conclusions were formulated, the introduction of scientific and methodological support of professional discipline "Materials science" for SVE specialty "Maintenance and repair of automobiles" to the pedagogic process was conducted, the results of the study were recorded.

### **Results**

#### ***The role of general professional disciplines in the development of professional competencies***

General professional disciplines occupy an important place in the training of future specialists for professional work (Listvin, 2015). The objective of these disciplines in our case is a formation of the general knowledge system in the field of maintenance and repair of automobiles, the development of technical thinking and skills to solve specific production objectives. One of the most important general professional disciplines is "Materials science". Based on the analysis of survey results given by the employers – representatives of transport companies, the experience of future automobile specialists' training in the SVE system, the requirements of the competence approach to the content development of specialists' training, the study identified professional competencies of a maintenance and repair of automobiles technician. Structural components of these competencies should be formed during studies of general professional discipline "Materials science". The respondents assigned the professional competencies according to their importance in the following way:

– organization and carrying out the maintenance and repair of automobiles (86%);



- implementation of technical control over storage, operation, maintenance and repair of automobiles (75%);
- development of technological processes of units and parts repair (58%);
- monitoring and evaluation of the specialists' work quality (51%);
- organization of safe operations during maintenance and repair of automobiles (49%).

The structural composition of maintenance and repair of automobiles technician's professional competencies (knowledge, skills and abilities), formed during the studies of general professional discipline "Materials science", is presented below (Figure 1).

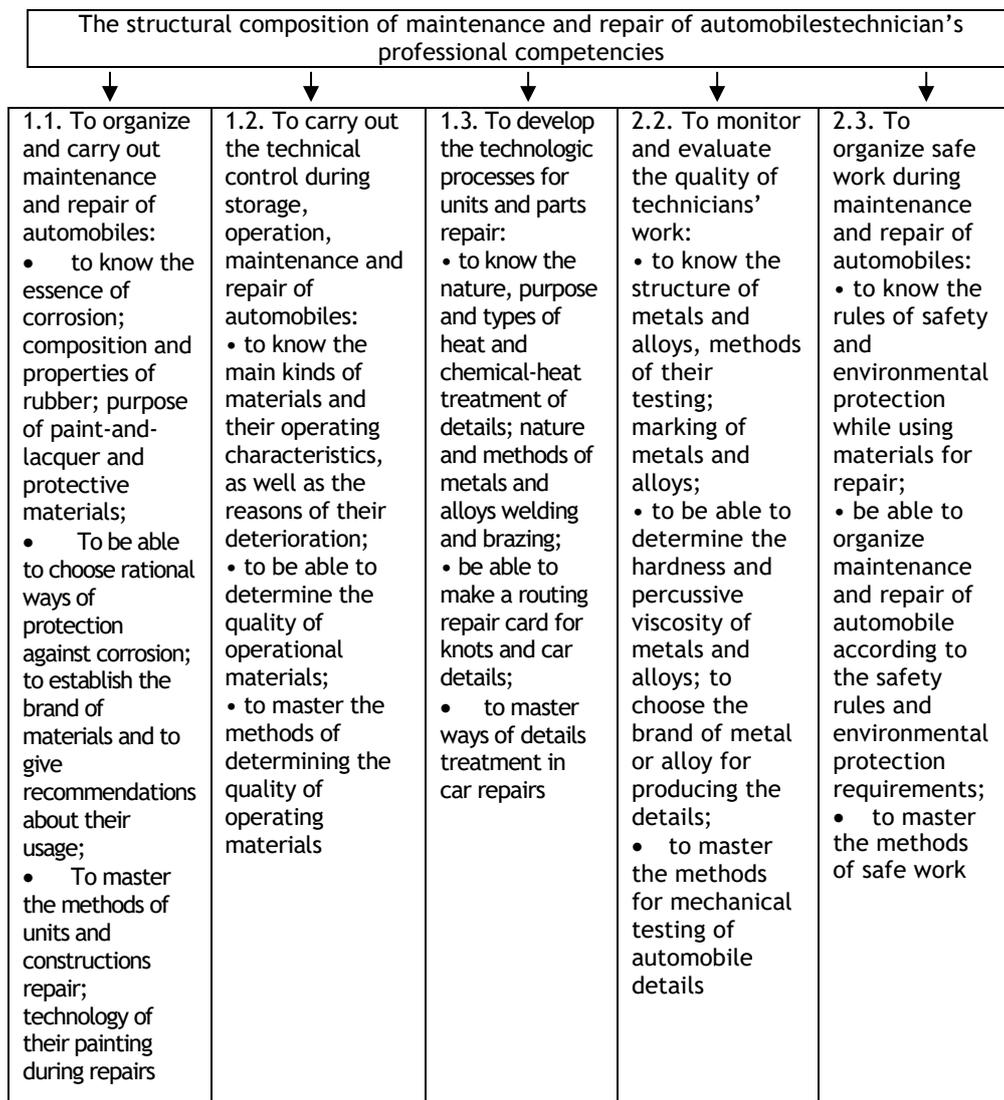


Figure 1. The structural composition of the maintenance and repair of automobile technician's professional competencies

### *The approaches in the model development*

The usage of the *system approach* allows to reach integrity of the model building, to set up logical and systematic relationships of its structural components, to define content-functional nature not only of the model components, but also of the process of structural components formation of the future technicians' professional competencies in general during their studies of the general professional discipline "Materials science".

By using the *activity approach*, we considered the formation of structural components of the future technicians' professional competencies as new sophisticated personal formations gradually developing during the study of general professional discipline "Materials science". The implementation of this approach is manifested by humanistic orientation of structural components formation of the professional competencies, where the student's personality acts as the subject of activity and, by developing in activity, determines its character and manages it.

The system and activity approaches assume that the development of requirements for graduates should be based on a close link between vocational training and the work field. These approaches set up the logic of qualification requirements development for graduates that is based on the analysis of their professional activities (field, types and objectives of professional activity); the establishment of qualification characteristics and professionally important qualities; the selection of the educational content ensuring the formation of qualification characteristics.

The *competence approach* focuses on the result of training, and the result is not considered as the amount of learnt information, but a person's ability to operate in different professional situations. The competence approach assumes the formation of structural components of technician's professional competencies considering the main allocated types of their professional activity on the basis of competence-oriented content of the discipline "Materials science" and the relevant scientific and methodological support.

The *technological approach* characterizes the procedural aspect of the competence approach and implies the establishment of links between expected results of education, methods of their formation and evaluation. The technological approach enhances the significance of educational technologies and their correspondence and effectiveness in ensuring expected results of education, determines the necessary innovative teaching technologies aimed at formation of the structural components of future technicians' professional competencies, as well as focus on the diagnostics of achievements reached by the students during the learning process. Control and measuring equipment (including interdisciplinary) for structural components of professional competencies are being developed. In order to increase the level of structural components formation of future technician's professional competencies the following is used: the method of problematic tasks, modeling of professional situations, case method, portfolio compilation, didactic games, project method, and information technologies.

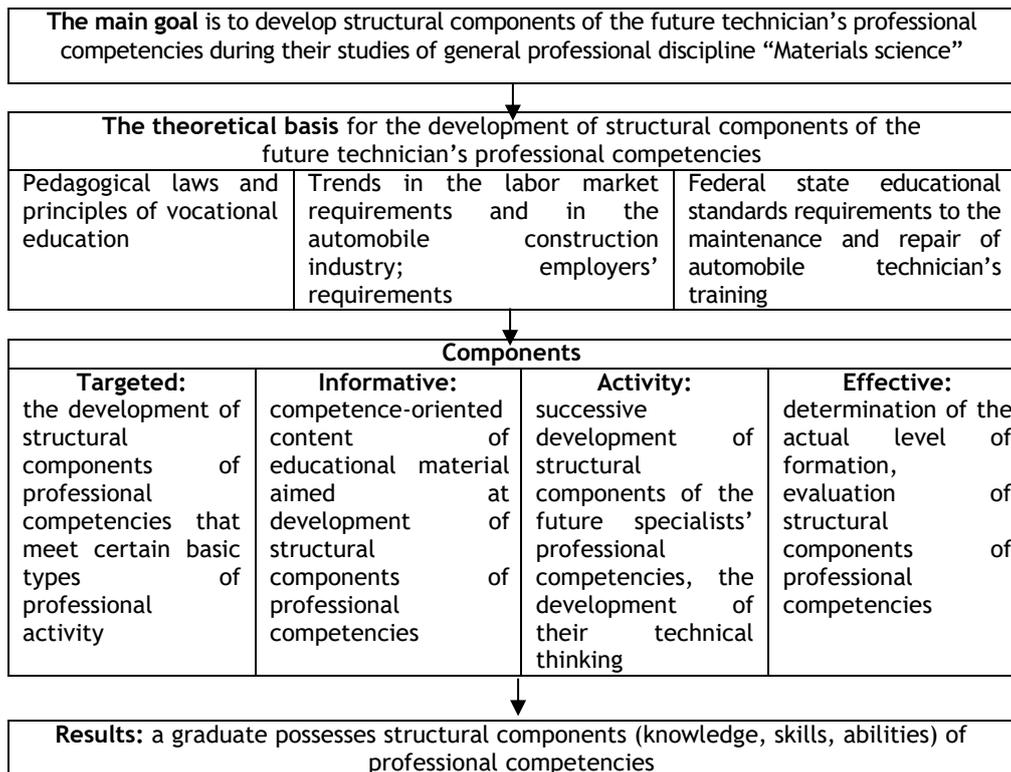
### ***The content of the formation model for structural components of professional competencies***

The developed formation model for structural components of future technicians' professional competencies during studies of general professional discipline



“Materials science” includes targeted, informative, activity and effective components (Figure 2).

The targeted component reflects the aim and purpose of the model – development of structural components of professional competencies corresponding to the main kinds of future technician’s professional activity during their studies of general professional discipline “Materials science”.



**Figure 2.** Model representing the development of structural components of future maintenance and repair of automobile technicians’ professional competencies during their studies of general professional discipline “Materials science”.

The informative component is interrelated with the targeted, activity and effective ones. It represents a competence-oriented content of educational material of general professional discipline “Materials science” aimed at the development of structural components of future specialists’ professional competencies in the form of a system of knowledge, skills and abilities in maintenance and repair of automobiles. To form the structural components of professional competencies, the competence-oriented content of general professional discipline “Materials science” should be based on the unity of terminology, symbols and units of measurement, alloys marking in accordance with active standards and the International Unit System (SI), as well as on national standards and the requirements of normative and technical documentation, and be practical.

The activity component of the model is interrelated with the targeted, informative and effective components. It is responsible for the sequence of

structural components formation of future specialists' professional competencies, the development of their technical thinking, projective, research, technical skills, creativity, independence, activity during the study of general professional discipline "Materials science". The implementation of activity component is only possible with the application of appropriate forms, methods and means for development of structural components of future technicians' professional competencies. In accordance with foregoing approaches, we chose the learning technologies that, on one hand, give possibility to organize a complex, diverse productive educational and cognitive student's activity, allowing to use his potential and abilities at their full, and on the other hand, are focused on the usage of the subjective student's experience, their personal individual qualities, on the subject-subject relations during the educational process.

The effective component of the model is closely related to the targeted, informative and activity components and provides for the definition of the actual level of formation and evaluation of the structural components of professional competencies. This component aims to develop the reflective function, which manifests itself in the student's ability to comprehend his own learning activities, to give it an appropriate evaluation focusing both on the acquired knowledge and on the structure of the activity itself.

### ***Conditions of model implementation***

The study identified a set of necessary didactic conditions for implementing the model of structural components formation of future technicians' professional competencies during their studies of general professional discipline "Materials science".

The first didactic condition –developing the competence-oriented content of general professional discipline "Materials science" in accordance with the peculiarities of the maintenance and repair of automobiles technician's professional activity, which involves the development and use of individual training programs, granting students the freedom to choose the ways to perform educational tasks, the construction of subject knowledge to implement the method of research projects according to the students' own choice. At the same time, it is necessary to rely on the students' abilities, possibilities, aspirations, to collaborate with teachers and other categories of professional teaching staff, also the self-activity of the students should be used in a more active way.

The second didactic condition – development of scientific and methodological support for general professional discipline "Materials science" based on the formation of structural components of future technicians' professional competencies that provides for the selection and implementation of professional training technologies (innovation forms of learning in order to activate students' creativity; organization of classes in small groups, didactic games, trainings etc.), development of appropriate didactic support, system for monitoring students' formation of structural components of professional competencies (technologies of diagnostics, research methods, tools).

The third didactic condition of implementing the model of development of structural components of the leading technicians' professional competencies – development of the program "Projecting competence-oriented content and corresponding didactic support for general professional disciplines and professional units", aimed at the increase of the level of teachers' professional



and pedagogical qualifications taking into account the type and level of their professional education, specific problems emerging in the process of development of college students' professional competencies.

### *The model implementation results*

Taking into account the identified teaching conditions for implementation of the model forming the structural components of future technicians' professional competencies during their studies of the general professional discipline "Materials science", the objectives and purposes of the discipline were clarified and specified; the competence-oriented content of educational material that takes into account the requirements of modern employers, the main trends of the automobile construction and specifics of technician's professional activities in maintenance and repair of automobile were designed; scientific and methodological support of "Materials science" discipline that favored formation of structural components of future specialists' professional competences were developed.

The model's effectiveness was tested by the research of students' learning results in control and experimental groups (Table 1).

**Table 1.** The results of research

Period of study	Number of students	Distribution of students by level of structural components formation of professional competencies, %			
		Low	Threshold	Medium	High
Before the implementation of the model to the learning process (control group)	25	21	43	28	8
	45	16	48	24	12
After the implementation of the model to the learning process (experimental group)	65	12	29	33	26
	35	9	23	36	32

The results of the training were measured by using the following methods: observation, survey, testing, self-assessment, mutual assessment, etc.

Experimental research was carried out in control and experimental groups while they were studying the discipline "Materials science" which is a part of SVE major "Maintenance and repair of automobile".

Training of the students in experimental groups was carried out on the basis of the formation model of structural components of future technicians' professional competencies enrolled to the SVE major "Maintenance and repair of automobile" during studies of general professional discipline "Materials science". During four educational years the work was carried out with 170 students.

The following tasks were solved during students' training in the experimental groups: development of certain structural components of students' professional competencies (knowledge, skills, abilities) of the main types of technician's professional activity during their studies of the general professional discipline "Materials science"; development of professionally important qualities in future specialists' effective professional activity necessary in the automobile enterprises and favoring self-development and self-realization.

## Discussions

Researches carried out by V.I. Baydenko (2004), V.A. Bolotov & E.G. Serikov (2003), S.A. Demchenkova (2009), E.F. Zeer, A.M. Pavlova & E.E. Symanyuk (2005) and others are devoted to different aspects of the competence approach in professional education. Peculiarities of the general professional training in the SVE are reflected in the works of A.P. Belyaeva (1991), L.G. Semushina (2002), N.G. Yaroshenko (2002) and others. But there are no works devoted to special research of the problems connected to development of the structural components of transport specialists' professional competencies through the contents of general professional disciplines in the SVE system.

In accordance with changes in the approaches to the content of professional education, the competence approach is an approach focused on the result of education, representing not the sum of learnt information but a person's ability to act in various problematic situations. In modern conditions the competence approach means the gradual transition from the broadcast of knowledge and formation of skills to creation of conditions to acquire the complex of competencies, including the potential and the graduate's abilities to survival and sustainable living in conditions of modern, multi-factor and socio-political, market and economic, and rich with information and communication space. The idea of implementing competence-based approach in vocational education was a result of the situation change on the labor market and as a result of the definition of those requirements forming on the market towards the employee.

Many of the ideas of the competence approach emerged as a result of the study of the labor market and as a result of the determination of those requirements that are forming on the market towards the employee. In this sense, first of all, there is a question about approaches reflected in the content of specialists' training, the content of their future labor, and also taking into account its dynamic changes, that is, the content of the specialists' training should be anticipatory. The competence approach assumes the following: a comprehensive image of professional activity; standards of professional activity; open and diverse range of strategies and techniques of professional development based on the development of professional competencies; orientation towards the professional culture as a condition of professional competence formation; high creative potential, orientation towards the creative professional activity; high significance of common professional competencies in the field of professional activity. The competence approach opens up new opportunities for understanding the future specialist's professional development through the development of his professional thinking. One of the most important questions is about the diversity of forms and types of thinking; orientation towards the developing heuristic potential and values of the person in professional work is carried out. Being a part of the competence approach, understanding of thinking allows to go to his systematic, integrative characteristics reflecting in a variety of approaches to the typology of thinking in general and professional thinking. This approach creates methodological prerequisites for understanding and defining peculiarities of professional thinking.

In the formation of professional competencies, the peculiarity of the competence training does not assume the retention of the ready knowledge – the origins of the knowledge can be traced (Gromyko, 2000). The learners themselves formulate the concepts needed to solve the problem. With such



approach, learning activity, while gaining research, practical and conversional character, becomes the subject of retention itself. The integration of concepts, types of activity, experiences of personal position manifestation to the educational content is carried out during the process of acquiring experience of independent activity in the process of cultural creativity together with teachers. Thus, the professional competence appears as a synthesis of cognitive, material, practical and personal experience. At the same time competence, being a result of learning, doesn't come directly out of it, but becomes a consequence of individual's self-development and generalization of personal and activity experience (Bolotov & Serikov, 2003).

### Conclusion

In the course of our research the structural components of technicians' professional competencies studied in "Maintenance and repair of automobile" major were defined and justified in accordance with the main types of their professional activities.

The role of the general professional discipline "Materials science" in the development of the future automobile experts' professional competencies was substantiated.

The formation model of the future maintenance and repair of automobile technicians' professional competencies during the study of general professional discipline "Materials science" was theoretically established, developed and tested in the course of experimental work.

### Recommendations

Created formation model of future automobile specialists' professional competencies during the studies of the general professional discipline "Materials science" can be used in developing the basic educational programs implementing Federal State Educational Standard of SVE specialties.

Our study does not claim to be an exhaustive research of all the aspects of the problem. Within constant development of students' training content, the systematic correction of a formation model of future experts' professional competencies during their studies of the general professional disciplines and didactic conditions for its effective implementation is necessary.

### Disclosure statement

No potential conflict of interest was reported by the authors.

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## References

- Abykanova, B., Tashkeyeva, G., Idrissov, S., Bilyalova, Z. & Sadirbekova, D. (2016) Professional Competence of a Teacher in Higher Educational Institution. *International Journal of Environmental and Science Education*, 11(8), 2197-2206. doi: 10.12973/ijese.2016.560a
- Atutov, P.R. (1986). *Polytechnic education of students: Approximation of general education and vocational schools*. Moscow: Pedagogy, 176 p.
- Baydenko, V.I. (2004). *Competencies in professional education. Higher education in Russia*, 11, 5-15.
- Belyaeva, A.P. (1991). *Didactic principles of professional training in vocational schools*. Moscow: Higher School, 208 p.
- Bolotov, V.A. & Serikov, E.G. (2003). *Competence model: from the idea to the educational program. Pedagogy*, 10, 8-14.
- Demchenkova, S.A. (2009). Formation of SVE students' innovative behaviour on the basis of competence approach. *Secondary Vocational Education: application to monthly theoretical and scientific methodological journal*, 5, 13-21.
- Dorozhkin, E.M. & Zeer, E.F. (2014). Methodology of professional pedagogical education: theory and practice (theoretical and methodological foundations of vocational teacher education). *The Education and science journal*, 9, 4-20.
- Dorozhkin, E.M., Zaitseva, E.V. & Tatarskikh, B.Y. (2016). Impact of Student Government Bodies on Students' Professional Development. *IEJME-Mathematics Education*, 11(7), 2666-2677.
- Gabdreeva, G.S. & Khalfieva, A.R. (2016). A Structural Analysis of the Complex of Professionally Important Qualities of Male and Female Managers. *International Journal of Environmental and Science Education*, 11(3), 339-347. doi: 10.12973/ijese.2016.320a
- Gabdulchakov, V.F., Kusainov, A.K. & Kalimullin, A.M. (2016). Education Reform at the Science University and the New Strategy for Training Science Teachers. *International Journal of Environmental and Science Education*, 11(3), 163-172.
- Gromyko, Y.V. (2000). The concept and the project in the theory of developmental education by V.V. Davydov. *News of the Russian Academy of Education*, 2, 36-43.
- Hannelore, D. & Esenina, E.Y. (2015). Old woman in very modern international dress (german dual system of vet in Germany and in the world). *The Education and science journal*, 8, 34-49.
- Kalimullin, A.M. & Dobrotvorskaya, S.G. (2016). Higher Education Marketing Strategies Based on Factors Impacting the Enrollees' Choice of a University and an Academic Program. *International Journal of Environmental and Science Education*, 11(13), 6025-6040.
- Kalimullin, A.M., Khodyreva, E.A. & Koinova-Zoellner, J. (2016). Development of Internal System of Education Quality Assessment at a University. *International Journal of Environmental and Science Education*, 11(13), 6002-6013.
- Kayumova, L.R. & Morozova, M.A. (2016). Using the Technology of Critical Thinking Development (CTD) as a Means of Forming Competencies of Students Majoring in "Life Safety". *International Journal of Environmental and Science Education*, 11(8), 2113-2122. doi: 10.12973/ijese.2016.582a
- Khuziakhmetov, A.N., Belova, N.A., Kashkareva, E.A. & Kapranova, V.A. (2016). Future Teachers' Training for Learners' Individual Projects Management. *International Journal of Environmental and Science Education*, 11(3), 237-244. doi: 10.12973/ijese.2016.307a
- Listvin, A.A. (2015). Secondary vocational education: content and implementation issues. *The Education and science journal*, 3, 62-70.
- Masalimova, A.R. & Ivanov, V.G. (2016). Formation of Graduates' Professional Competence in Terms of Interaction Between Educational Environment and Production. *International Journal of Environmental and Science Education*, 11(9), 2735-2743.
- Novikov, A.M. (2000). *Russian education in the new era: paradoxes, heritage, directions of development*. Moscow: Evges, 272 p.
- Pavlova, L.A. (2006). Competence approach in the secondary vocational education system. *Secondary Vocational Education*, 8, 58-61.
- Romantsev, G.M. (1997). *Theoretical basics of higher vocational education*. Ekaterinburg: Publishing House of the Russian State Vocational Pedagogical University, 333 p.



- Semushina, L.G. (2002). Identity formation problems of the specialist with secondary vocational education and their implementation to the state educational standards. *Scientific methodical collection*, 49-63.
- Tkachenko, E.V. & Glazunov, A.T. (2001). *Basic professional education: problems of regionalization and development*. Cheboksary: Chuvash State University, 253 p.
- Vedishenkova, M.V., Nikitina, Y.L. & Zhumabaeva, A. (2016). The Development of Parents Pedagogical Competence in Pre-School Science Education Institution. *International Journal of Environmental and Science Education*, 11(3), 107-117. doi: 10.12973/ijese.2016.295a
- Yaroshenko, N.G. (2002). The new generation of the State Educational standards of secondary vocational education and projection of vocational training programs. *Secondary Vocational Education*, 7, 12-15.
- Zeer, E.F., Pavlov, A.M. & Symanyuk, E.E. (2005). *Modernization of professional education: competence approach*. Moscow: Moscow Psychological and Social Institute, 216 p.
- Zeleeva, V.P., Bykova, S.S. & Varbanova, S. (2016). Psychological and Pedagogical Support for Students' Adaptation to Learning Activity in High Science School. *International Journal of Environmental and Science Education*, 11(3), 151-161. doi: 10.12973/ijese.2016.299a