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Technology to form Students' Readiness for Research in Engineering Universities

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Abstract*: The relevance of the problem under consideration is caused by the existing discrepancy between the increased need of society and the state for high quality engineering education, and the actual level of readiness of graduates of engineering universities to perform their professional functions, as well as insufficient development of the theoretical foundations of students training in research in the context of competence-oriented education. The purpose of the article is to solve the problem of training students for the research activity in the course of independent work and research during the educational process at engineering university. Based on the systematization and development of existing approaches to solving the problem of training of students of engineering universities for research, which contributes to the development of a functional model, the authors propose the method of preparing students for research. The article describes the development of practical experience in research activities during the participation of students in scientific seminars; represents the process of using the project method, end-to-end research tasks when preparing the course and qualification works; the issue is considered on consolidating and improving the experience of research activities of future engineers during all kinds of practical training. The pedagogical experiment was aimed at identifying the effectiveness of independent and research work in the course of formation of students' readiness for research activities in the framework of the functional model. The materials of the article can be used by the academic staff of engineering universities, specialists in the field of pedagogy, theory, and methodology of vocational education, as well as in the system of extended education.

***Keywords*: engineering education, research activity, readiness for research activity, project method, research tasks.**

I. INTRODUCTION

The world community is committed to the creation of a global strategy of human education, which contributes to the development of the international educational space with certain trends: "the transition from elite education to high-quality education for all; deepening international cooperation in the field of education; increasing the humanitarian component; the spread of innovations while maintaining the existing national traditions and national identity of countries and regions" [1]. Vectors of engineering education renewal become topical in the context of solving the problems of formation of the "European higher education zone" [2]. In the "Concept of modernization of Russian education for the period up to 2020" [3], it is noted that the main goal of higher education is to train a qualified specialist, competent and competitive, responsible, able to work in related fields. The problem of research training of students at engineering universities is relevant worldwide. The Forum on Engineering Education WEEF 2015 "Engineering Education for a Resilient Society" [4], which was organized in Florence by the International Federation of Engineering Education Societies (IFEES), determined that in the current context, exactly the engineering education within the university was able to prepare graduates focused on conducting engineering studies and research in their professional activities. Global requirements for graduates of engineering universities, peculiarities of modern production in Russia, the modernization of industry, and the development of high technology require the modernization of training competitive professionals with modern knowledge and skills, the necessary production and personal potential to work at high-tech enterprises. "The engineering education development is determined by the tasks of ensuring the global competitiveness of domestic products, and only then by the necessity of rapid import substitution of foreign products. To do this, it is necessary to significantly change the paradigm of engineering education, as well as the structure of the content and methods of training of engineers." [5] World is in a growing need for competitive engineering personnel, ready for active participation in innovative engineering processes, development of new ideas, solution of research production problems, thinking creatively, and capable of making nonstandard decisions, showing research behavior. All this requires the formation of readiness for research activities of students of engineering universities, who should be able to effectively implement professional competence in the activity, and independently solve nonstandard engineering problems.

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II. METHODS

A. General description

The research is based on the use of theoretical (study, analysis, and synthesis of pedagogical, social, engineering, economic literature on the problem under consideration; analysis of the research subject; modeling of the educational process; generalization of research results); empirical (study of normative documents, observation, conversations, testing, self-assessment, analysis of documentation, study of artifacts, pedagogical design); and experimental methods (pedagogical experiment, methods of mathematical processing of results).

B. Algorithm

Analysis of existing approaches to solving the problem of research training of engineering university students

Issues of qualitative improvement of preparation for research activities of students of engineering universities become of particular relevance, because one of the leading tasks of higher education is to involve students in research activities that will "not only preserve the world-famous Russian scientific schools but also grow the next generation of researchers focused on the needs of innovative knowledge-based economy" [6]. In the course of the research, the authors systematized, identified, and developed existing approaches to solving the problem of research training of students in engineering universities of Russia, contributing to the development of methodological foundations of this training, namely:

- preparing research activities through motivation (O.O. Nenasheva [7], A.L. Mazaletskaya [8], I.Yu. Danilova [9], etc.); orienting to scientific knowledge of students in the learning process, using research tasks; stimulating nonstandard approaches and methods of solution (E.A. Grebennikova [10], A.A. Gubaydullin [11], A.A. Ermakova [12], etc.);
- using a learner-centered approach based on the involvement of students in the process of active acquisition of knowledge, and development of creativity (E.P. Grosheva [13], A.M. Mityaeva [14], N.I. Naumkin [15], E.M. Timofeeva [16], etc.);
- focusing on self-educational activities using Internet resources, as well as project activities (O.S. Terekhina [17], T.M. Sannikova [18], I.A. Yanyuk [19]), etc;

The analysis of the works has shown that the researchers focus on the important aspects of preparation for research, much attention is paid to the content of engineering education, and the technological component of training. But the works do not sufficiently reflect the conceptual idea of preparing students for research activities, which requires specially organized measures, and has a significant potential to improve the quality of professional education; research activity is not considered as a basis for the formation of general cultural and professional competencies, in order to implement the requirements of educational standards, and accordingly, the preparation for research activities has not been studied from the standpoint of the basis of building innovative didactics of engineering university; the issues of changing the quality management system of education remain unaddressed; the issue of the organization of the developing educational environment of the university is not touched upon; no close connection between the university and employers is considered, as well as employers' participation in the preparing students for research activity [20]. The study of international experience has allowed identifying a number of provisions that were considered in the preparation of students of the engineering university to research activities. These include the application of special courses; familiarity and use of heuristic methods; implementation of research tasks and projects; development of industrial design skills, aesthetic development of students; and education of ethics. These aspects are presented in the works of P. Arden [21], W. Baumol [22], M. Baxter [23], A.Daemmrich [24], M. Kogan [25], E. Avksentieva [26], M. Sergeeva [27], and others.

In the course of systematization, analysis, interpretation, and development of the existing approaches in the new educational and socio-economic conditions, taking into account the specifics of the engineering activities, the requirements of educational and occupational standards, as well as employers, the authors have determined that the preparation for research activities has a significant potential in improving the quality of engineering education. This led to the need and timeliness of the creation and implementation of a holistic concept of research training of students of engineering university, whose integral part is students' independent work and research.

Organization of independent work and research of students of engineering university

When implementing the model of research training of students of engineering universities [28], special importance was given to the independent work of students, aimed at ensuring the effective assimilation of research experience and its content, providing students with opportunities for self-actualization, self-organization, self-education, and self-development. Types of independent work are classified according to the students' level of independent work, methods of monitoring and evaluation of results:

1. independent work is undertaken individually according to the given task;
2. out-of-class independent work to solve the problem proposed by a teacher or a student (preparation of an abstract, presentation, development of an event, etc.);
3. educational and research work (work on the project, course paper, and final qualifying work);
4. student research work, with the provision of results in the form of a report, paper (abstracts) at the conference, or a patent.

The originality of students independent work consisted in the fact that the work was based on independent efforts, the learning in these circumstances consisted in active independent research activity, such as reading and analysis of literature, abstracts reading, the solution of tasks of different level of complexity, the performance of laboratory and practical work, the implementation of projects, research tasks, etc. The authors have proved the legitimacy and feasibility of the use of creative tasks, which are intended mainly for the organization of individual work of the student. The peculiarity of these tasks was that they required the student to search, study, analyze, generalize, systematize of additional information, as well as needed longer time to prepare, and therefore were performed during the extracurricular time. Thus, an important condition when forming research competence of students of engineering universities was the organization of extracurricular independent research activities and research work. The initiative groups were established at the departments, involving students if so desired. Participation in the work of initiative groups contributed to meeting the needs of students in an in-depth study of the material, developed research thinking, contributed to the formation and improvement of research skills, and therefore the formation of research competence. Students performed tasks of theoretical and practical nature. The projects were carried out individually and collectively.

The work of the group was carried out since the first year (from 2nd semester) in different directions depending on the students' interest. Teachers helped in choosing the theme of the work (taking into account the preparedness of students and their inclinations), as well as provided guidance and assistance. Students were asked to perform tasks of both theoretical and practical nature. They carried out the review and abstracting of scientific literature, other sources of information, conducted experimental work (when applicable). Work in initiative groups allowed free selection of creative research and development.

At the first year of study, the report on the results of the work was presented at the meetings of the initiative group of the Department with the invitation of the teaching staff of the Department, as well as representatives of basic enterprises. Students made reports in the form of presentations on the results of the work done. In the following years, the continuation of the work of the initiative groups was not only individual but also collective; projects were developed within the framework of a single research program, whose implementation was carried out by methods common to all participants. This approach allowed speaking about a combination of variability and universality because the research and knowledge methods were selected from different sciences.

The final reporting of the work of the initiative groups was presented in the form of the annual scientific and practical student conferences and seminars, as well as international conferences held at the university (with the subsequent publication of conference proceedings and abstracts). Conferences and seminars contributed to stimulating interest in research; increasing creative activity; attracting more students to perform research tasks; forming skills of self-education, self-improvement, and self-actualization of the individual. Representatives of the underlying enterprises were involved in conferences and seminars as experts; the content of tasks was coordinated with them. The analysis of works testified to the acquisition of research experience by students [28].

The spirit of competition in the student team was a powerful incentive for the development of interest in research. The results of solving research problems and hypotheses were compared with experimental data, required an explanation of the mechanisms of transformation of the phenomenon under study into new qualities. Independent preparation of abstracts and papers at the conference, analysis of research projects, works of other students, observation of their creative and search activity testified to the acquisition of research experience.

When performing tasks, students not only expanded and deepened knowledge, developed research skills, but also formed the ability to consistently and clearly express the essence of the issue, the ability to express themselves in public speaking (i.e., overcoming the lack of emotion, and monotony of speech), the ability to take into account the pluralism of opinions and to show understanding, the ability to establish contact with the audience, the ability to control themselves in public speaking (to overcome excitement, etc.), the ability to get out of contact (avoiding confusion and incompleteness of speech). Attracting junior students to attend conferences was highly productive in terms of the development of motivation and experience in the research activities. It made them want to present the results of their own research developments.

An important point was the creation in the engineering university of the developing educational environment as a prerequisite for solving the problem of creating an innovative didactics of engineering university focused on training for research activities of graduates, characterized by the individual and productive style of engineering. The educational environment, as a competence-oriented space, includes spatial-subject, meaningful organizational, and information components, which provide the optimal educational activity of engineering university in the course of research training of students. Organization of developing an educational environment at engineering university provides motivation of students to prepare for research activities; interaction and joint activity of all subjects united by the common environment (students, teaching staff, university staff, representatives of basic enterprises); and self-regulation in preparing for research activities [20].

Scientific seminars appeared to be quite fruitful to form the practical experience of research activities. Their work involved university teachers, students, and representatives of basic enterprises. All participants were united by a common interest in a specific research problem, accumulated relevant information, and the presence of certain individual research experience. Such seminars allowed the participants to systematize information about the state of the problem taking into account the domestic and international experience, the state of affairs in the region, the city, as well as to coordinate positions, adjust settings, determine the best ways to solve the identified research problems. Students independently chose the search direction and the planned result of their participation in the seminar (report, article, abstract, project, etc.). Each participant felt involved in the common cause, responsible for their work.

This stimulated students intellectually and mentally contributed to the formation of motivation to study, that was encouraged also by healthy competition.

The annual visit to the International exhibition "Achievements of the oil and gas industry" also contributed to the formation of motivation for research activities. Students could clearly see the latest innovative developments in the field of technology and equipment for the oil and gas industry, as well as communicate with representatives of scientific communities and enterprises not only of the city and district but throughout Russia.

Participants of the initiative groups annually designed the stand "Innovations of students of Tyumen Industrial University" that was a powerful motivational factor in attracting students to research activities. An important form of students' research training was the implementation of the course paper and final qualifying work (FQW). For the successful implementation of course work, projects, and FQW, proper adjustments were made in the guidelines with an emphasis on the preparation for research activities (guidelines, tasks are placed in the electronic system of the educational process support Educon) [29].

The use of the project method brought positive results in the formation of research competences in students. The authors used different types of projects such as information, research, and the projects, which were carried out based on the instructions of the teacher. In terms of duration, they were short-term (development of a plan for solving a specific research task and its presentation fell within the framework of one academic session); medium-term (two to three weeks), and long-term (more than a month, semester, and academic year). The latter were used during different types of practice, in the performance of research tasks, course papers, and in the work of initiative groups.

Student projects, filled with practice-oriented subject content, allowed applying the knowledge gained in the course of training, and were a kind of result of interdisciplinary integration, acquired knowledge, mastered ways of research, and formed research skills. This type of work allowed students to form self-management skills, self-restraint, hard-working nature, the ability to plan work, take criticism, work in diverse teams, and the ability to assess the quality of other research projects.

Students' projects, filled with practice-oriented subject content, were focused on the complex application of formed competencies, mastered skills, and research activities. As part of the research, the authors used cross-cutting, complex (interdisciplinary) projects of integrative orientation. An important requirement in the organization of students' work was the presence of a problem, significant in terms of scientific relevance that required an integrated researcher's inquiry for its solution; practical and theoretical significance of the obtained results; structuring the project content, the indication of step-by-step results; and the use of different research methods. It should be noted that there were not many such works, they were developed mainly by the initiative group participants.

In the course of implementation of the functional model of research training of students of engineering universities, dynamics (from year to year) of increasing interest in the implementation of term papers (projects) were noted that contributed to improving the quality of their performance and presentation of results on the diploma defense. The opportunity to work for a long time in the chosen scientific direction contributed to the fact that by the time of preparation of the FQW, students thoroughly possessed theoretical information, had accumulated a solid empirical material, mastered a variety of research techniques and methods. Thus, the FQW accumulated all the research experience acquired by students that have reflected on the quality of its implementation. The use of integrated research projects, and end-to-end research tasks proved to be the most effective in the implementation of FQW (the topics of works were linked to the areas of research activities of the departments, and the requests of a particular enterprise). Long work on a certain topic, or particular area contributed to the fact that the FQW accumulated all the research experience acquired by students, which was reflected in the quality of implemented works.

Analysis of FQW in experimental groups has shown that the works were distinguished by a clear research plan, and consequently, the logic of research activities; the specificity of the requirements for the results; research orientation, the correctness of the choice of diagnostic tools, and methods of data processing and information. The authors noted an increase in the research quality in the experimental groups in the process of course project (works) execution, as well as in the implementation of FQW. Table 1 shows the results of course works (projects) and defense of FQW in 2016 [28].

Table 1: The results of the execution of FQW (2018) and course works (projects)

Grade	FQW, %		Course works (projects), %	
	Experimental groups	Control groups	Experimental groups	Control
5 (91-100 points)	57	18	52	22
	34	61	38	47
4 (76-90 points)	9	21	10	31
3 (61-75 points)	-	-	-	-

Particular attention was paid to the application, consolidation, and improvement of the experience of students' research activities during practice. All types of practices acted as one of the leading factors in the formation of students' readiness for research because during practices, essential aspects of the profession of the engineer were manifested very clearly.

When organizing and conducting the practice, tasks focused on solving real production problems were used that contributed to the students' mastery of the research methodology. Organization of educational practice (1st year) involved mastering by students of empirical research methods (observation, conversation, a generalization of results, logging, etc.); as well as analysis and comparison operations. The first industrial practice (2nd year) included the study of the research engineering experience of enterprise employees, the development of measures for the implementation of the practical program, the solution of actual research problems. The second practical course (3rd year) provided specially organized work of students on a research subject that promoted the transition to performance of research tasks in the production environment. During the practice, students performed tasks that were agreed with employers. Immersion in practical activity involved the implementation of research in the engineering sphere.

This resulted in the fact that themes of the FQW of 75% of students were associated with research conducted in the period of practices. All kinds of practices contributed to the increase of research activity of students, the development of research skills, the acquisition of individual research experience, the ability to independently discover the phenomena studied. The approach proposed by the authors involved teaching students to determine the correct course of solving the problem even with nonstandard conditions, which were prepared in advance, but were completely unexpected for the trainee.

They required him to urgently adjust the plan of his activities, change the requirements for the final result, select other methods, etc. This made it possible to develop students' ability to reasoning dynamically and act in unusual situations.

During the implementation of the research training model applicable to students of engineering universities (2013-2018), the authors monitored the employment of graduates. It can be stated that the purposeful preparation of students for research activities contributed to greater satisfaction of employers with the graduates training quality. Representatives of the basic enterprises, taking a direct part in the learning process, were more interested in students focused on research activities (in the course of working on research tasks, projects, presentation of the results of work, etc.). During the practice, many students showed their active stance, interest in solving actual production problems, and willingness to self-improvement in the future profession. This helped students to attract the attention of representatives of enterprises, resulting in the fact that the number of graduates employed at the place of practice increased from year to year. In addition, the motivation of students to continue their studies in the Master's degree increased as well (Table 2) [28].

Table 2: The employment of graduates of Surgut Oil and Gas Institute

Year	Basic enterprises		Nonbasic oil companies	Private oil and gas companies	Full-time Master's course	Not employed in oil and gas business
	Places of practice	Other subdivisions				
	%	%	%	%	%	%
2013	35	15	25	5	10	10
2014	37	1	20	8	5	15
2015	45	20	10	5	10	10
2016	60	10	10	5	10	5
2017	65	5	5	5	15	5
2018	70	5	5	5	15	5

However, it should be noted that employment issues are very capacious and multifaceted, and depend on a number of objective and subjective factors, therefore in the work, the only percentage of employment is noted, and the attempt to link the number of employed with the process of targeted research training of students of engineering university is made. The control and performance component provides for the teacher's control over the process of forming the research competence of students and, if necessary, its adjustment, as well as self-control on the part of the student. At that, the functions of self-control gradually increase, i.e. it acquires a conscious, strong-willed character, and the research activity becomes more meaningful. Control is carried out by the following methods: testing (Educon system), using questionnaires, verifying, defending tasks and projects, and monitoring systematically students' activities [30]. For the effectiveness of self-analysis, self-control, and self-assessment of the research results by the students, the following is provided: familiarity with the criteria reflecting the effectiveness of research activities; methods and techniques of control and self-control (questioning, testing, ranking, self-assessment, and observation); acquiring the skills of analysis and evaluating their own actions; as well as accessing to rating indicators. The peculiarity of monitoring and evaluation in the proposed model are a variety of forms of intermediate and current control; the possibility of choosing the form of the final report based on the results of the student's activities; and the use of pedagogical diagnostics, which allows predicting possible deviations and making proper adjustments.

III. RESULTS

Cognitive, personal, and activity components are distinguished as research readiness indicators. Formation dynamics of students' readiness for the research activity are presented in Table 3 [20].

Table 3: Formation dynamics of readiness for research activity, %

Personality component	Academic years							
Motivational component	2014-2013		2015-2016		2016-2017		2017-2018	
	Exp.	Contr.	Exp.	Contr.	Exp.	Contr.	Exp.	Contr.
Highest	0	0	3	0	3	1	3	1
High	0	0	27	2	37	3	45	9
Average	5	2	25	10	28	15	40	26
Low	53	38	30	58	29	61	10	54
Zero	42	60	15	30	3	20	2	10
Reflective component								
Highest	0	0	3	0	3	1	3	1

High	0	0	27	2	37	3	45	9
Average	5	2	25	10	28	15	40	26
Low	53	38	30	58	29	61	10	54
Zero	42	60	15	30	3	20	2	10
Cognitive component								
Highest	0	0	3	0	3	1	3	1
High	1	0	25	4	38	7	50	19
Average	4	2	25	18	32	25	40	38
Low	52	36	30	48	24	50	7	40
Zero	43	62	17	30	3	17	0	2
Activity component								
Highest	0	0	3	0	3	1	3	1
High	0	0	26	1	42	1	49	9
Average	5	2	27	20	35	30	40	43
Low	55	28	29	39	15	48	7	44
Zero	40	70	15	40	5	20	1	3

The analysis of experimental work results, as well as comparison of indicators of experimental and control groups, have shown the efficiency of the proposed functional model of students' preparation for research in the context of competence-oriented engineering education. The assumption of efficiency of the independent and research work influencing both the result and formation of readiness for research activity was proved experimentally. Changes in the experimental groups are stable in nature in terms of all components. The students of the experimental groups have shown statistically significant changes in the levels of formation of all components. These differences are statistically significant in comparison with the results of the control groups. The reliability of the results is confirmed by verification based on statistical analysis using the criteria of mathematical statistics, namely, Pearson's chi-squared test.

IV. CONCLUSION

Research training, aiming at the formation of the engineer, who is characterized by individual style and productive engineering activity, determines the maturity of readiness for research as developing integrative personal characteristics, providing active research attitude in relation to the activities and to himself as its subject, in terms of development and operation of innovative engineering technologies and industries. Preparation for research activity provides valuable attitude to research; ability to identify information insufficiency and at the activity level to master new knowledge for solving research engineering problems; ability to plan and conduct research, collect data, process them, and interpret the results obtained.

The theoretical significance of the study includes the following aspects.

- Theory and methodology of professional education are enriched with knowledge about the essence of the formation of students' readiness for research activities in the course of independent work and research in the educational process at the engineering university;
- In the content of the innovative didactics of the engineering university, presented in the form of a functional model, independent work and research of students are considered as a prerequisite for the research training of students, ensuring the development of creativity of students, their research abilities, forming functional research skills as a universal means of contact with the outside world;
- Independent work and research carried out using the developed practice-oriented techniques, special forms, and means of extracurricular activities; information technology, network educational resources; system of tasks, complex and end-to-end research projects, interactive forms and methods; self-control and self-assessment of students in the learning process are an integral part of the developed and experimentally tested functional model of preparing students of engineering university for research activities, providing for the organization of the developing educational environment of the university.

The practical significance of the study includes the following aspects.

- Developed and tested functional model of training students of engineering university for research activities, of which an integral part is an independent work and research, can be used in the practice of basic and additional engineering education in order to improve the efficiency of the formation of a competitive graduate;
- Recommendations on the organization of independent and research work for the academic staff of the engineering university, taking into account the requirements for the level of readiness of the teaching staff to implement this process can be used in the system of advanced training of teachers of engineering universities.

REFERENCES

1. I.M. Remorenko, "O vedenii urovnevogo obrazovaniya v sisteme vysshego professional'nogo obrazovaniya RF i razrabotke novyh FGOS VPO" [On the implementation of level-based education in the higher education system of the Russian Federation and the development of new Federal Educational Standards], *Report at the Meeting of rectors of higher education institutions*, 2009. Available: http://www.gosbook.ru/node/48100
2. A.S. Meshcheryakov, G.S. Kupriyanova, "Kompetentnost' i modul'nost' kak vektory obnovleniya professional'noj podgotovki specialistov inzhenernogo profilya: innovacionnyj aspect" [Competence and modularity as vectors of updating of professional training of specialists of an engineering profile: Innovative aspect], *Proceedings of Higher Educational Institutions*, vol. 3, 2013, pp. 224-238.

3. Koncepciya modernizacii Rossijskogo obrazovaniya na period do goda [The concept of modernization of Russian education for the period up to a year]. Available: http://sinncom.ru/content/reforma/index1.htm
4. Abstracts of the World Engineering Education Forum WEEF 2015. Florence, Italy, 2015. Available: www.weef2015.eu/callBforBpaper/topi
5. V.V. Putin, Nam nuzhna novaya ekonomika [We need a new economy]. Available: https://wek.ru/putin-nam-nuzhna-novaya-yekonomika
6. Ya. Kuzminov, I. Frumin, (Eds.), "Rossijskoe obrazovanie - 2020: model' obrazovaniya dlya ekonomiki, osnovannoj na znaniyah" [Russian education - 2020: Education model for the knowledge-based economy], Moscow: Publishing House of the State University – Higher School of Economics, 2008.
7. O.O. Nenasheva, "Nauchno-issledovatel'skaya deyatel'nost' kak faktor razvitiya aksiologicheskogo potenciala lichnosti studenta" [Research activity as a development factor of the axiological potential of the student's personality], Ph.D. thesis in pedagogical sciences, Orenburg, 2010, 221 p.
8. A.L. Mazaletskaya, "Dinamika motivacii nauchno-issledovatel'skoj deyatel'nosti na etapah professionalizacii" [Research motivation dynamics at the stages of professionalization], Ph.D. thesis in pedagogical sciences, Yaroslavl, 2011, 217 p.
9. I.Yu. Danilova, "Mnogourovnevaya model' organizacii nauchno-issledovatel'skoj raboty studentov kak sredstvo obespecheniya kachestva obrazovaniya v vuze" [Multilevel model of the research work organization of students as a means of ensuring the quality education at the university], Ph.D. thesis in pedagogical sciences, Moscow, 2010, 172 p.
10. E.A. Grebennikova, "Formirovanie tvorcheskoj aktivnosti studentov pri izuchenii obshchematematicheskih disciplin: Na primere inzhenernyh vuzov" [Formation of creative activity of students in the study of general mathematical disciplines] [Text]. Evidence from engineering universities. Ph.D. thesis in pedagogical sciences, Volgograd, 2006, 170 p.
11. A.A. Gubaydullin, "Formirovanie issledovatel'skoj kompetentnosti studentov v usloviyah proektnogo obucheniya" [Formation of research competence of students in the context of project training], Ph.D. thesis in pedagogical sciences, Kazan, 2011, 235 p.
12. A.A. Ermakova, "Formirovanie uchebno-issledovatel'skoj deyatel'nosti studentov kak sredstva bazovoj matematicheskoj podgotovki v tekhnicheskom vuze" [Formation of educational and research activity of students as a means of basic mathematical training in a technical university], Ph.D. thesis in pedagogical sciences, Astrakhan, 2010, 200 p.
13. E.P. Grosheva, "Podgotovka studentov tekhnicheskih vuzov k innovacionnoj deyatel'nosti pri obuchenii inzhenernomu tvorchestvu i patentovedeniyu" [Preparation of students of technical universities for innovation activities when teaching engineering creativity and patenting], Ph.D. thesis in pedagogical sciences, Saransk, 2010, 216 p.
14. A.M. Mitiaeva, "Kompetentnostnaya model' mnogourovnevogo vysshego obrazovaniya (na materiale formirovaniya uchebno-issledovatel'skoj kompetentnosti bakalavrov i magistrov)" [Competence-based model of multilevel higher education (on the material of educational and research competence formation of bachelors and masters)], Ph.D. thesis in pedagogical sciences, Volgograd, 2007, 399 p.
15. N.I. Naumkin, "Metodicheskaya sistema formirovaniya u studentov tekhnicheskih vuzov sposobnostej k innovacionnoj inzhenernoj deyatel'nosti v processe obucheniya obshchetekhnicheskim disciplinam" [Methodical system of formation abilities to innovative engineering activity in students of technical universities in the course of training in general technical disciplines], Higher Doctorate thesis in pedagogical sciences, Saransk, 2009, 499 p.
16. E.M. Timofeeva, "Formirovanie gotovnosti budushchego inzhenera-metallurga k nepreryvnoj uchebno-issledovatel'skoj deyatel'nosti" [Formation of readiness of the future metallurgical engineer for continuous training and research activities], Ph.D. thesis in pedagogical sciences, Belgorod, 2009, 227 p.
17. O.S. Terekhina, "Formirovanie issledovatel'skih umenij studentov inzhenernyh vuzov" [Formation of research skills in students of engineering universities], Ph.D. thesis in pedagogical sciences, Nizhny Novgorod, 2010, 181 p.
18. T.G. Tsunnikova, "Formirovanie nauchno-issledovatel'skoj kompetentnosti specialistov v tekhnicheskom universitete sredstvami mul'timedia podgotovki" [Formation of research competence in the specialists of the technical university by means of multimedia], Ph.D. thesis in pedagogical sciences, Moscow, 2008, 152 p.
19. I.A. Yanyuk, "Formirovanie issledovatel'skoj kompetentnosti studentov tekhnicheskih vuzov" [Formation of research competence in students of technical universities], Ph.D. thesis in pedagogical sciences, Shuya, 2010, 214 p.
20. O.O. Gorcshkova, "Preparing students for research activities in the context of competence-oriented engineering education", *Journal of Fundamental and Applied Sciences*, vol. 9(2S), 2017, pp. 1445-1467.
21. P. Arden, "It's not how good you are, it's how good you want to be", Phaidon Press, 2003.
22. W.J. Baumol, "The free-market innovation machine: Analyzing the growth miracle of capitalism", Princeton University Press, 2004.
23. M. Baxter, "Product design. Practical Methods for Systematic Development of New Products", London, Chapman & Hall, 2003.
24. A.A. Daemmrich, "R&D Meets MA. Proceedings of the 2003 Conference on Innovation and Creativity in Chemical R&D", Philadelphia: Chemical Heritage Foundation, 2004.
25. M. Kogan, "Lifelong learning in the UK", *European Journal of Education. Blackwell Publishers Ltd.*, vol. 35(35), 2005, pp. 34-45.
26. E.Y. Avksentieva, Y.A. Senterev, V.A. Kostezh, S.M. Platunova, "Application of cloud and fog computing in educational process upon implementation of the Master's Degree Program", *International Journal of Engineering and Advanced Technology (IJEAT)*, vol. 8(3), 2019, pp. 62-64.
27. M.G. Sergeeva, I.A. Pugachev, N.V. Ippolitova, S.U. Parfenov, J.M. Kalinina, A.V. Paklina, S.L. Sapfirov, "Professional competence principle in context of future profession", *Revista Espacios*, 39(38), 2018, p. 5.
28. O.O. Gorshkova, "Podgotovka studentov k issledovatel'skoj deyatel'nosti v kontekste kompetentnostno-orientirovannogo inzhenernogo obrazovaniya" [Preparation of students for research activities in the context of competence-oriented engineering education], Higher Doctorate thesis in pedagogical sciences, Moscow, 2016, 394 p.
29. O.O. Gorcshkova, "Network educational resources in the research student training", *Revista ESPACIOS*, 38(25), 2017, p. 11
30. O.O. Gorcshkova, "The development of research competence among the students of technical education", *Revista ESPACIOS*, 38(56), 2017, p. 19.