Man In India, 97 (16) : 27-40

THE MODEL OF STUDENT-CENTERED TRAINING FOR MASTER STUDENTS AT TECHNICAL UNIVERSITY

Nikolay I. Pack[*], Georgiy M. Grinberg[**], Elena G. Doroshenko[***], Mikhail V. Lukyanenko[****] and Marina V. Savelyeva[*****]

Abstract: The significance of the research is determined by the necessity to improve the quality of masters' training at technical universities to meet the requirements of modern industry. Currently it demands specialists with new professional and meta-disciplinary competences, high level of readiness to participate in the distributed team performance environment, and high level of scientific and psychological socialization. In this context, the article refers to design and establish a student-learner model to train masters at technical universities under the conditions of e-learning and integration of university science and industry forming up-to-date professional and meta-disciplinary competences to students. The leading research focus to study the problem is a paradigm of a student-learner teaching students and didactic possibilities of educational clusters. We substantiate the incorporation the following components to a new model: an additional humanitarian-pedagogical unit based on collaboration of a technical university with pedagogical university; special educational-in-plant environment most close to real manufacture-technical regulations based on social partnership with production structures and interuniversity cooperation; international interuniversity research laboratory to study the problems information technology implementation and modern training resources. The article presents practical value to organize educational process for master programmes of training engineers at technical universities; the programmes providing high quality training graduates meeting the requirements of the current industry.

Keywords: Engineer, master training, graduate competences in aerospace field, student-centered model of training, educational road map.

INTRODUCTION

The history of establishing master education started not so long ago in Russian education, and quite a few issues of master training development at universities

[*] Doctor of Pedagogy, Professor, Head of the Department of Computer Science and Information Technologies in Education, Krasnoyarsk State Pedagogical University named after V. P. Astafiev, Krasnoyarsk, Russia

[**] Candidate of Pedagogy, Associate Professor of the Department of Automatic Control Systems at Reshetnev Siberian State University of Science and Technology (Reshetnev University), Krasnoyarsk, Russia. *Email: grinberg_gm@mail.ru*

[***] Candidate of Pedagogy, Associate Professor of the Department of Computer Science and Information Technologies in Education, Krasnoyarsk State Pedagogical University named after V. P. Astafiev, Krasnoyarsk, Russia

[****] Candidate of Engineering, Professor, Head of the Department of Automatic Control Systems at Reshetnev Siberian State University of Science and Technology (Reshetnev University), Krasnoyarsk, Russia

[*****] Candidate of Philology, Associate Professor, Head of the Department of Foreign Language at Reshetnev Siberian State University of Science and Technology (Reshetnev University), Krasnoyarsk, Russia

need to study seriously. The main assignment of master programmes at technical universities is to train highly skilled professionals for successful practical, analytical, consultative and scientific research activity in the industrial sphere. In spite of significant success in establishing master level of education in different universities, the problem of the quality in training is still important (DuPre & Williams, 2011). Currently we could observe a decrease in motivation of master students to take courses based on traditional formats of educational process. The students are not interested in taking lecture-seminar format courses, since they have already obtained certain knowledge and skills to work independently. They are not satisfied with the regulations of the schedule and standards of educational process, as the majority of master students get jobs, have their own families, and at the same time they have to combine education, job and life. We cannot expect good results from modernizing subject-oriented training and using resources of information-education environment, methodologies of e-learning and distant education technologies having become popular in the educational institutions lately (Robert, 2010).

Solving the problems of master training quality is constrained with retarding Federal state educational standards of higher education (FSES HE) from dynamic changes in industrial and business spheres. They currently require specialists with new professional competences, high level of readiness to distributed team work, high level of culture of scientific and psycho-pedagogical communication (Prikhodko & Sazonova, 2014). In this connection, there is a distinct contradiction among new requirements of the society to academic results of technical university graduates and the necessity to develop not only restricted professional competences, but meta-disciplinary and personal qualities to graduates and tendencies to reduce the academic period, academic facilities and resources. Within the time limits and the restricted current university laboratory material resources, we need to search for a new optimal and available model of integrated training engineer staff.

In many countries the current quality of university education is connected with the transition to humanitarian paradigm of learner-oriented education (Crumly, 2014). Learner-oriented education is a system focused on voluntary education and creating conditions, providing motivation to education, developing student personality, humane treatment of a student. The system requires from students to be active and responsible participants for building their educational trajectory, choosing the pace of education, tools and methods to achieve academic results (Hannafin & Hannafin, 2010).

Currently the issued regulatory educational enactments mainly eliminate restrictions to freedom of choice of student's education trajectory (Federal Law "On education in the Russian Federation", 2014). Due to the level of the current information – communication technologies (ICT), methodological theory and practice of electronic and distant learning can create organization pedagogical conditions to form student readiness to choose an individual educational trajectory,

independent training and education (Robert, 2010). Therefore, we need to find out the tools and approaches to create conditions for efficient realization of student-centered education at university, especially for masters' training.

The research goal is to design a new model of student-centered training master students at technical universities, contributing to formation of current professional and metadisciplinary competences of students, their high level readiness to distributed team work, high level culture of scientific and psycho-pedagogical communication.

LITERATURE REVIEW

The attempts to implement widely a student-centered paradigm to both a secondary school and a university are not successful (Pack et. al., 2015). The main problem is that junior students as well as schoolchildren cannot determine their education targets, organize their independent training and education. Unfortunately, neither a school nor a university pays the required attention to a student's ability to self-actualisation, self-realisation and independent training and education. Lack of maturity of these personal qualities does not allow the students to be active and responsible participants for building their educational trajectory, choosing a pace of learning, tools and methods to achieve academic results. Otherwise stated, students inwardly are not ready to accept the principles of student-centered education.

One more problem is connected with strict regulation of a discipline-centered education process. The educators are bent on students' methodic group training, therefore, they do not assess knowledge of their students but their assessment is focused on students' breakage of the regulations of the educational process (Pack et. al., 2015). The third problem is absence of a mechanism to realize the principles of student-centered education, underdevelopment of the material and technical resources and methodological support. The stated above reasons aggravate wide and efficient implementation of student-centered full-time education at universities.

We should highlight that elements of student-centered education have been used successfully for a long time in part-time university education. We have a temptation to transfer part-time education forms and methods to master training. However, so called part-time education has got the definite dissatisfaction to the final results of education based on both subjective and objective reasons. Therefore, we cannot focus on the advantages of part-time education only, but we have to search for innovative approaches.

The models of educational clusters have become rather attractive recently (Proskurina, 2011). These models are various. In most cases they unite several organizations, including schools, universities and business with contract relationship.

We define an educational cluster as a complex of interrelated institutions of professional education, integrated with industrial enterprises belonging to the

same field and having partner relationship. Organising viable and planned activity within a cluster is necessary to shape an educational technological platform, where cooperation and corporation of education, science and business spheres are possible without their total reconstruction (Smirnov, 2010). Within those educational clusters, it is possible to integrate science, education and life, to realize continuous practice-oriented professional training young people without total changes of the methods of life-sustaining activity, organization of workspace of cluster participants (a school, university, industry) based on the advantages of cloud technologies, electronic forms and tools of education.

Indeed, lately, the main world research is connected with expansion of e-learning at all education levels, creating and escalating distant learning, forming clouds to provide information and passive learning services. The USA and European universities are the most advanced in mass online courses (Massive Open Online Courses – MOOCs). The trajectory of educational systems in general, and e-learning in particular, shift toward its intellectualization, the change of knowledge paradigm to the constructivism, competence approach and development of cognitive abilities of students. The researchers – educators are searching for new models, methods and tools of education, allowing to provide learning affordability, life-long-learning, integration of education with science and life, development of creative and cognitive abilities of a student (Bazhenova & Pack, 2016). Therefore, new institutions and educational organizations and IT-industry tools appear, they help solve the urgent education problems declared by UNESCO.

Taking into account stated above classical model of training masters we can present a chart at Figure 1.

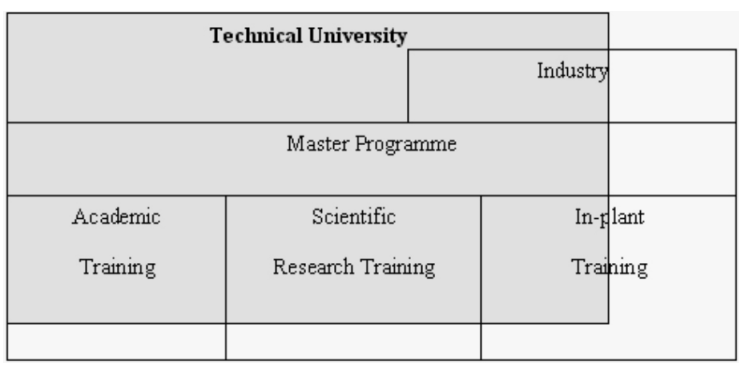

Figure 1: Classical chart of training master students at technical university

Master training consists of three main blocks: fundamental-content (academic training), scientific-research and on-the-job. Academic training represents a traditional chart of in-class-seminar teaching based on discipline-centered teaching. Scientific-research work of bachelor and master students, as a rule, is contained in

performing term papers and dissertations. On-the-job training of master students has seriously changed at technical universities.

In 1959 non-traditional higher educational institutions were established: they were famous integrated industrial educational systems of "Plant-Higher Technical Educational Institution (HTEI)" type, where educational and on-the-job training were integrated.

Training based on the system "Plant-HTEI" differs from traditional part-time education since more than half time the students study full-time (it has got its advantages), moreover, students' productive efforts are a constituent of an educational process. Students' productive efforts are included into a special discipline – engineering in-plant training.

Unfortunately, integrated in-plant and educational systems have separated lately due to economic mechanisms: "when basic plants have been "flatline" for some time, it is hard to realize so called integrated education (In western education it is also called "sandwich" or "productive education" (Lerner, 2017). Nowadays the universities have to search for partners and employers, make agreements about on-the-job training. The conceptual idea to create basic departments at the employers' industrial site came up short.

Therefore, neither an educator nor a master student, or employers are satisfied with the classical chart of training master students. The current organization of university education does not meet real life requirements. Even e-learning and distant learning fail to give the expected results within the realities of traditional educational institutions. In that context, we need new suitable organizational models of an educational process to provide "painless", cost-effective mechanisms to increase the quality of modern engineering education sharply.

METHODOLOGICAL FRAMEWORK

The proposed practice-oriented research is connected with realizing the idea of the project for the new master programme "Design and engineering supply of the development, production, test and maintenance of control systems of rocket and space technology".

The project is funded by V. Potanin Foundation within the Charity programme "V. Potanin's grant for educators realizing master programmes" for developing engineering education.

Within the project realization since June, 2016 up to June 2017, the team has developed the main educational programme of higher professional education to 24.04.02 "Systems of control and navigation" direction for the master programme "Design and engineering supply of the development, production, test and maintenance of control systems of rocket and space technology".

The concept of the research is based on the didactic principles taking into account the maximum of individual preference of students to the educational environment and its professionally-oriented character, the possibilities to increase the students' motivation to training in the environment of social partnership of a technical university with the manufacturing structures and interuniversity cooperation, applying practice-oriented, electronic and networking technologies in educational clusters.

RESULTS AND DISCUSSION

Currently a student-centered organization of educational process is becoming more valuable, because it optimizes the existing university personnel and material resources in their cooperation and corporation.

Within the new master programme "Design engineering supplying the development, production, test and maintenance of control systems of rocket and space technology", the department of automatic control systems of Siberian State University of Science and Technologies have developed and partially tested an innovative model of interuniversity cooperation based on cluster type (Figure 2).

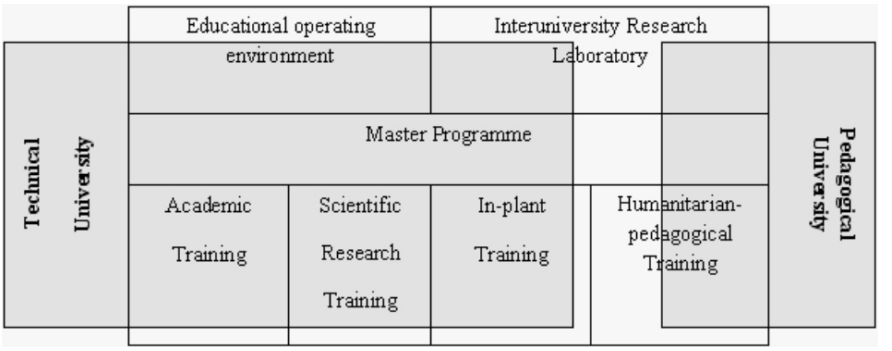

Figure 2: Innovative Model Of Master Training

We would like to present every chart element.

1. First of all, we highlight a new block – humanitarian pedagogical training. Besides the main competences, graduates' meta-disciplined and personal competences are important performance attributes for the master programme "Design and engineering supply of the development, production, test and maintenance of control systems of rocket and space technology" at Siberian State University of Science and Technologies named after academician M. F. Reshetnev. For example, managerial, pedagogical, creative and designing skills of master students can be developed if we choose suitable tools and methods of teaching. We could illustrate this with course "The current issues of science and education". The main goal of the discipline is

to contributing to the fundamental general scientific competence of master graduates for them to be able to solve educational and research tasks focused on scientific research and practical activity within knowledge application environment.

The course contents feature the current fundamental and applied issues of physical – mathematical and technical sciences, information technologies and cybernetics. It is significant to show that organizing scientific research and training students as a system present their research objects and obtain their own scientific problems.

Those problems of engineering pedagogy and engineering education are currently paid serious attention all over the world (Prikhodko & Sazonova, 2014, Barrett-Lennard, 2003). Annually, there are international conferences on engineering education IEEE EDUCON, within their framework there are priorities to discuss, such as international aspects of engineering education, knowledge management and computer technologies, a foreign language and Humanities in the engineering education, pre-university engineering education, research in the field of engineering pedagogy and engineering education, training educators for technical universities and others. International community on engineering pedagogy (IGIP) developed the requirements to the technical university educator qualifications, in 2013 the community renewed a curriculum to train an engineer-educator (Curriculum IGDP), based on the modern trends of engineering education (Russian monitoring center IGIP, 2017). Six out of 18 points of the plan are connected with mastering new teaching technologies.

Taking into account one of the most significant targets of training masters – training them to become educators and researchers, it is also important to study a philosophical methodological block of disciplines containing psychological pedagogical options. To train those disciplines, select their contents, tools, methods and forms, we have to consider the features of a master programme. For instance, we could include the course "Teaching technologies" into the list of elective disciplines of the curriculum and naturally bind it with the leading target to train master students. Another example is that a new Federal state educational standard of higher education in the direction of 24.04.02 "The control system of motion and navigation (master level)" (2015) is aimed at new targets of training masters: they have to master knowledge, skills and competences to be able to design, produce and maintain absolutely new, optimal, adaptive and intellectual systems, vehicles and complexes. It anticipates an innovative model to organize an educational process: integrating engineering research to the discipline programmes, guiding an educational process to the graduates' research activity, integrating the education and industry and practice-

oriented education and some other features. Under these conditions, the inner structure of classical university organization form of classes "lecture – seminar – laboratory class – practical class" greatly changes due to new teaching technologies, that contribute to developing master student's creative skills and creative thinking, the students are able to perform and make decisions within the constantly changing conditions. The training forms contribute to shaping students' personal qualities, since they are based on permanent enhancing students' performance, such as business games and workshops. Following these activities we can integrate both domain-specific and social contents of professional labour, transforming educational performance into the professional performance of a future specialist. The Russian scientists (Sandalova, 2010) reveal correlation interrelations of general cultural and general professional competences. They demonstrate developing such competences as an ability to work in a team, to work at the project impacts the development of other competences. There is a wide range of teaching technologies, while practicing them, in particular, we originate the students' performance, motivate their creative work; the students study the methods of productive performance, they may deal with various information; develop critical thinking; the master students learn how to share their opinions and value judgments. They learn how to collaborate and work in a team; develop skills of self-management in doing research (Babich, 2013, Motschnig-Pitrik and Nykl, 2003). As a result of learning and conscious applying the acquired competences positively influence the success in training and forming professional qualities of a future engineer. We could point out the technologies based on graphical methods of compressing information; technologies of developing critical thinking via reading and writing; technologies to teach discussion methodologies; techniques to generate ideas; case technologies; game technologies; project technologies as examples of teaching technologies greatly contributing to developing intellectual and communicative potential of a person. Acquiring is one of the grounds for the engineering pedagogical and organization managerial activities and it anticipates the development of the skills such general cultural and general professional ones (Kirko et. al., 2014) as: planning the results of training; based on the results an educator can select, compress and structure the teaching information; build logical consequence of information blocks; assess the results of training; organize feedback and improve the impact; use an individual approach and differentiate a level in training. The technology to manage education comprises: complete acquiring the taught material; different level training; programmed training; module training; problem-module training and some others. Studying methods of realizing teaching technologies allows a

master student to obtain skills of organizing procedures of educational and professional interaction with using electronic systems to manage training and internet services. Designing an educational programme to train master students, we should take into consideration that studying discipline "Modern teaching technologies" makes it possible to equip future engineers with multifunctional tools for successful academic, scientific and professional performance and mainstream new teaching technologies, tools and methods of educational performance to train students in real educational process.

2. The curriculum for master training of 24.04.02 direction provides both fundamental content training, scientific research and in-plant training.

   To improve the in-plant training of a master student, it is viable to create educational in-plant environment (Figure 3) demonstrates the model.

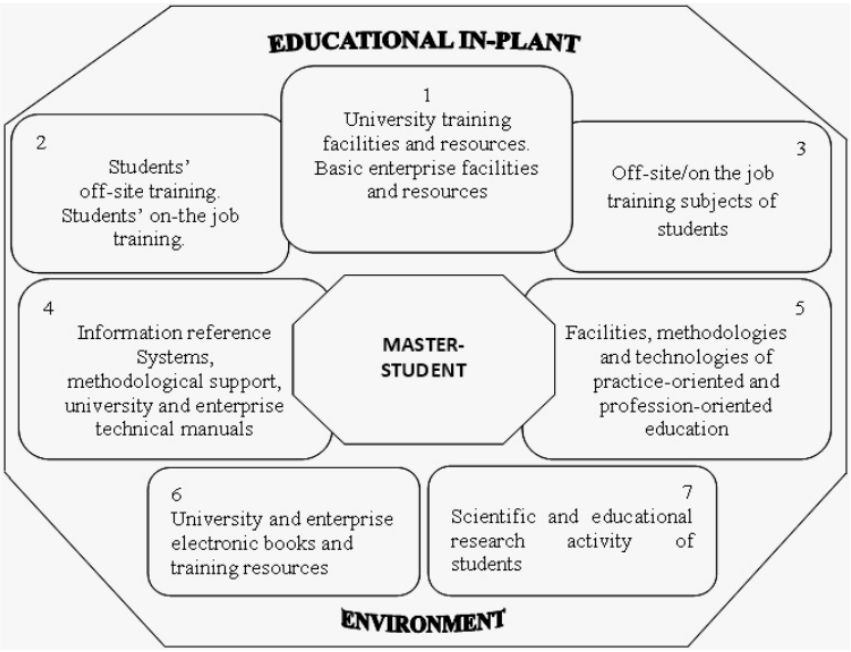

Figure 3: Model of educational in-plant environment

Module 1: Includes both University training facilities and resources and basic enterprise facilities and resources.

Module 2: Means traditional off-plant training (training out-plant) and on-the-job training (in-plant training), that obtains its practical orientation, direct connection with production functions.

Module 3: The students' learning out-plant subjects are the people, who the students interact with in the education process at the university (educators,

university staff and other students, and the most experienced and qualified industrial specialists, invited by the university to teach part-time).

The students' learning on-the-job training subjects are engineering manpower, specialists, workers of an enterprise.

Module 4: The university constituents combines with information-reference systems, technical, technological and regulation documents, the funds of science-technical library, patent and technological information department.

Module 5: The main assignment of the module is to supply a future engineer with both necessary knowledge and necessary skills and know-how for their professional activity, conceptual and technical skills, an personnel management skills

Module 6: In addition to electronic and software applications for educational purposes, the module includes simulating software application of special purpose.

Module 7: The module assumes that students should participate in scientific research activities at university and an enterprise.

The strategy of educational in-plant environment is aimed at realising different interactions of master students with the factors of educational environment, to supply both professional development of students and forming psychological and content-growth constituting various aspects of a conceptual model of a competent employee.

3. Among the different types of social interaction of universities there is charity, collaboration, investment, partnership. Under current conditions in the education all types of social interaction are realized, but it is evident that partnership is the most efficient, as it anticipates more complete interested and long-term inclusion into the solution of social-educational problems (Russian monitoring center IGIP, 2017). The key element to form social partnership is a social problem and an assignment to solve it. Today a serious social assignment is to reach new quality of the professional education, providing a complex of key competences, allowing a graduate to adapt to the society successfully, and self-study continuously, improving professional competence constantly.

   To create education aimed at developing key competences, it is necessary to realize some pedagogical terms, among them there are: providing activity approach to acquire social experience in the educational process; creating information-learning environment, directed to form the key competences; diagnosing and correcting the results of the process forming the key competences. In the educational sphere future specialists' acquiring knowledge and skills of the disciplines is more efficient, if the students are involved into the development of didactic tools for the disciplines based

on recursive approach "I am learning developing tools for the disciplines I am studying". The greater effect can be expected from the educational process, when a student from one university helps the students of a different university develop tools and approaches to learn their disciplines. The performance and success of such student's performance is evaluated from both internal (their own university position), and external (from other university position) sides.

The main integrating factor in the scientific sphere of activity is the themes of educational research, scientific research and project works to do them the subjects of educational institutions – social partners are involved. The complex projects are the most suitable for the purpose; the projects are aimed at solving real and significant problems for the region and tasks to develop all spheres of society life-sustaining activity. Based on the projects interesting learning and research tasks appear, the solution of them is often possible only for integrated efforts of partners within complex learning assignments, term papers and final research, and master dissertations. Due to the society increasing demand to the future specialists in the area of their readiness to virtual team-distributed project research professional activity, it is necessary to create suitable integrating conditions of research activity organization within university collaboration.

Virtual team-distributed research activity is a kind of interaction of participants involved into the scientific research (scientists, educators, students, specialists and others); the activity is based on a complete system realized within team-distributed work under the conditions of virtual space.

Increasing the performance of scientific research is possible in case of development and realization of a cluster conception while organizing scientific research of young people with the help of international open network laboratory. To control scientific research of the cluster participants, *scientific research information environment* is created with the module technological structure, including administrative portal and a bank of scientific problems and tasks. The developed approaches of cluster organization of scientific research work allow students and educators to integrate scientific potential to solve common practical and scientifically important tasks; this motivates their creative abilities and helps obtain necessary experience fast, acquire lacking scientific research competences. To coordinate scientific research work in a more efficient way the international laboratory of information technology problems and current learning technologies was established (the participants are Siberian State University of Science and Technologies named after academician M. F. Reshetnev, Krasnoyarsk State Pedagogical University, Siberian Federal University, Kazakhstan National pedagogical University named after Abay, University from the city Osiek, Croatia)

4. Realising the necessity and possibility of student-centered education, the researchers search for the methods of electronic learning at all levels of education, create and increase the range of distant courses, form integrated clouds to provide information education services, new IT education models (Bazhenova and Pack, 2016). The development of complete educational systems in general, and electronic learning in particular, shifts to its intellectualization, has got competence and cognitive character. The learning results in traditional methodological system are to acquire knowledge, skills and competences; they are transformed into professional development of a person with the knowledge of the content area meeting students' demands, motivation and capabilities.

   To regulate the rights and duties of students and educators there should be issued regulating acts, determining the requirements to knowledge, skills and competences of master students on the learnt disciplines and "rules of the game", that is suitable variants of strategies to achieve the results of education.

   The conditions to provide the support of those strategies become the specially designed information content environment (Vosniadou et. al., 2001, Motschnig-Pitrik & Holzinger, 2002). They keep a variety of information sources and tools to build and realize design individual learning trajectories of a student.

   The most suitable tool to create trajectories is *the technology of road maps* (Lee & Park, 2005, Andreeva & Pack, 2015). The learning road map on the discipline is an individual project to reach the targets and results planned by the student. As opposed to procedural curricula and programmes, where all events are planned strictly based on the resources, performers and terms, the learning road map anticipates flexibility to achieve the final result based on new ideas, technologies, resources, a student might obtain in the process of the planned learning activity by the student. Creating a learning road map helps a student visualize their academic future, teaches them to plan and realize their learning and scientific activity based on their responsibility and motivation.

CONCLUSION

The realization of new master programmes is a complex and multifactor process. The innovation model of interuniversity cooperation of cluster type was developed and partially tested at the example of the master programme "Design and engineering supply of the development, production, test and maintenance of control systems of rocket and space technology" at SibSU. The brief experience of its probation has already revealed the significant positive dynamics in performance of the innovative learning process.

Currently all necessary and suitable conditions are developed to eliminate the reasons of dissatisfaction of traditional learning process by the students and educators with realizing ideas of student-centered education.

To manage the scientific, educational and in-plant activities of a master student, it is viable to use learning road maps. The efficiency of technology of learning road maps is provided by the specially modeled structure of training master students under the conditions of interuniversity cooperation and corporation.

The effect of realizing learning road map of a master student depends on systematic diagnostics of their content education results and competence-oriented evaluation of their learning success.

Therefore, the proposed model of a new master programme is an efficient mechanism to realize principles of student-centered training of master students providing high quality of an educational process.

Acknowledgements

The authors highly appreciate V. Potanin Foundation for supporting the project "Developing a new master programme "Design and engineering supply of the development, production, test and maintenance of control systems of rocket and space technology", the article is a result of the project realization.

References

Andreeva, N.M., & Pack, N.I. (2015). About the roles of road maps when teaching information technologies in the electronic form to students of classical universities. *Open Education*, 3: 101-109.

Babich, N. (2013). Constructivism: training and teaching. *Herald of Krasnoyarsk State Pedagogical University named after V. P. Astafiev*, 3(25): 6-30.

Barrett-Lennard, G. T. (2003). Steps on a mindful journey: person-centered expressions. Ross-on-Wye, UK: PCCS Books.

Bazhenova, I.V., & Pack, N.I. (2016). Project-recursive technology within person-oriented education. *Pedagogical Education in Russia*, 7: 7-15.

Crumly, C. (2014). Pedagogies for student-centered learning: online and on-ground. Minneapolis: Fortress Press.

DuPre, C. & Williams, K. (2011). Undergraduates' perceptions of employer expectations. Journal of Career and Technical Education, 26(1), 8-19.

Federal Law "On education in the Russian Federation". (2014). Moscow: Omega.

Hannafin, M. J., & Hannafin, K. M. (2010). Cognition and student-centered, web-based learning: issues and implications for research and theory. In: *Learning and Instruction in the Digital Age*, US: Springer, 11-23.

Kirko, V.I., Pack, N.I., & Malakhova, E.V. (2014). Education for the future: new strategies of distance education of universities of eastern Siberia. *The Turkish Online Journal of Distance Education*, 15(4): 23-33.

Lee, S. & Park, Y. (2005). Customization of technology roadmaps according to roadmapping purposes: overall process and detailed modules. Technology Forecasting & Social Change, 72: 267-583.

Lerner, P. S. (2017). Eternal Youth of the 50 year old Higher Technical Educational Institution, [http://www.bim-bad.ru/biblioteka/article_full.php?aid=1290&binn_rubrik_pl_articles=183].

Motschnig-Pitrik, R. & Holzinger, A. (2002). Student-centred teaching meets new media: concept and case study. *IEEE Educational Technology & Society*, 5(4): 160-172.

Motschnig-Pitrik, R. & Nykl, L. (2003). Towards a cognitive-emotional model of Rogers' person-centered approach. *Journal of Humanistic Psychology*, 43(4): 8-45.

Pack, N.I., Doroshenko, E.G., & Khegay, L.B. (2015). On the need and possibility of organizing personally centered teaching. *Pedagogical Education in Russia*, 7: 16-23.

Prikhodko, V.M., & Sazonova, Z.S. (2014). Engineering pedagogy – a basis for vocational training of engineers and research and educational personnel. *Higher Education in Russia*, 4: 5-12.

Proskurina, T.L. (2011). Educational cluster as a regional innovative strategy. Educational Technologies, 3: 53-63.

Robert, I.V. (2010). Current information technologies: learning strategy issues, application perspectives. Moscow: IIE RAE.

Sandalova, S.J. (2010). Pedagogical resonance as a status for the subjects of learning activities. *Herald of Buryat State University*, 15: 262-266.

Smirnov, A.V. (2010). Educational clusters and innovative training at the university. Kazan: School.

The Russian monitoring center IGIP. (2016). [http://rmcigip.madi.ru/?page_id=13].

Vosniadou, S., Ioannides, C., Dimitrakopoulou, A., & Papademetriou, F. (2001). Designing learning environments to promote conceptual change in science. *Learning and Instruction*, 11(4-5): 381-419.