Concept of Research Training of Students in Context of Competence-Oriented Technical Education

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ABSTRACT
The relevance of the problem under study is conditioned by the incongruence between professional competences, acquired by graduates of technical institutes during the training process, increased demands of high-technology enterprises, scientific institutes, design organisations, employers. The purpose of the paper consists in solution of the problem of development and realisation of the concept of research training of students in the context of competence-oriented technical education. Based on the analysis, systematization and development of existing scientific and pedagogical approaches to solution of the problem of research training of students of technical institutes, the basic approaches and principles, being the methodological foundations when designing the concept of research training of students of technical institutes, were distinguished. The concept of research training of students in the context of the competence-oriented engineering education was created as a system of provisions in the field of professional training, including a programme-based system of education quality management; taking into account requirements of employers for research training of a graduate, specifics of research training as a basis of building a new didactics of an engineering higher school allowing realisation of requirements of educational standards on formation of a set of competences. The role of the process of research training of students as an obligatory part of realisation of educational standards in the context of formation of common cultural, professional, special competences and development of professional activity of an engineer was defined. The concept determines the necessity of monitoring the education quality, including the monitoring of the degree of students’ research competence formation. Empirical methods (observation, questionnaire, conversations, testings, self-assessment, analysis of documentation, studying products of activity, pedagogical designing) allowed determining the level of research competence formation of students of technical institutes at all stages of experimental work on realisation of the concept of research training. To interpret the results of the experiment, the methods of mathematical statistics having allowed proving their authenticity and effectiveness of realising the concept of research training in the educational process of technical institutes were used, which contributes to the formation of students’ research competence, development of their creativity, motivation, value attitude to research, formation of the orientation basis of
activity. The materials of the paper are of practical relevance for teaching staff of technical institutes, for experts of the supplementary education system in the framework of organising refresher courses for managers and teachers of technical institutes; for experts in the field of methods, theory and practice of professional training.

Introduction

Technological demands of global economy place challenges before Russia related to integration of the country into the world economic space, formation of favourable investment climate, competitive recovery of domestic industry. This determines the change of the nature of technical education, demanding from the graduate the mastery of a wider spectrum of key competences, ability to develop and introduce competitive technical equipment and technologies, orientation to research activity in the profession. Incongruence between professional competences, acquired by graduates of technical institutes during training, increased demands of hi-tech enterprises, scientific institutes, designing organisations, employers is one of the basic contradictions of the Russian higher technical education. There is a shortage of experts majoring in engineering, who are able to develop and introduce new, competitive technologies, technical equipment and are oriented towards research activity.

One of the key conditions of development of the higher technical education system, mentioned in “Concepts of long-term socio-economic development of the Russian Federation for the period up to 2020”, is involvement of students into research and scientific work, which will allow preserving schools of thought, nurturing a new generation of researchers.

The change of the nature of engineering activity, conditioned by tendencies of modern production, transformation of industrial society into post-industrial, determines the image of the graduate of the technical institute, making demands for technical education, the strategic goal of which is establishment of an adaptive system providing training of the graduate in the context of professional mobility and competitiveness, as well as one’s formation as a socially and humanism-oriented personality, being ready for research activity. Thus, the necessity and timeliness of creation and introduction of the holistic concept of research training of students in the context of competence-oriented technical education are obvious.

Research methods

There are theoretical (study, analysis and synthesis of pedagogical, social, engineering, economic literature on the problem under consideration; analysis of the research subject; modelling the education process; generalization of research results); empirical (study of normative documents, observation, conversations, testing, self-assessment, analysis of documentation, study of products of activity, pedagogical designing); experimental (a pedagogical experiment, methods of mathematical treatment of results) methods.

Results and discussion of research results

Methodological foundations of training students of technical institutes for research activity

Engineering activity, the specifics of which is determined by peculiarities of modern production, contributes to a fundamental change of an expert’s image, and, accordingly, to the techniques of one’s training as well; therefore, the necessity to create the concept of research training of students of technical institutes in the context of the competence approach, which will be adequate to modern realia, is evident.

When solving the problem of research training of students of technical institutes, the main reference point at the methodological level for the authors was the competence approach as a new understanding of the meaning
of modern technical education in the framework of the Bologna Process. “Many ideas of the competence approach appeared as a result of studying the situation on the labour market, determining those demands for an employee that are formed on it” [16]. Such kind of education evolves owing to the need for such training of experts that would satisfy the society, production and higher school graduates themselves.

Having analysed works concerning the issues of competence-oriented education ([4], [7], [23], [24], [25], [29], [30], etc.), the authors determined that the established theoretical and methodological base of the competence approach allows decomposing the structure of higher technical education, re-orienting its purposeful and effective attitudes. The competence approach is a “set of innovative theoretical and methodological ways and techniques of designing goals, content, technologies and results of education in the framework of philosophy of pragmatism and constructivism” [14].

The competence approach reflects a transition of education to a new attitude towards ability and readiness of the subject for effective activity in different scopes provided that there is a high degree of freedom, autonomy, development of personalized meanings, as compared to then existing subject-knowledge informative orientation.

The competence approach is oriented to transformation of goals of professional training, shift of emphasis to the student’s personality. The main idea consists “not in the attempt to refuse “knowledge” orientation of education for the sake of competences, but in the fact that it is necessary to possess certain personal characteristics and be able to find and select necessary knowledge in information repositories, created by humankind, rather than to have knowledge” [3]. The competence approach reinforces the practical orientation of professional education, its subject-professional and pragmatic aspects. Besides, it provides for reevaluation of training results (formation of competences contributing to training of a competitive graduate) and, on this basis, implies a specific organisation of the educational process: reinforcement of problem-research, practice-oriented directedness; the emphasis is put on active, interactive technologies, use of information resources, a rating system, organisation of different forms of monitoring [31,32].

The following aspects of the competence approach to the renovation of education are identified: making education pragmatic, which is aimed at development of students’ ability to apply knowledge and skills in practical situations; increasing attention to generalised subject abilities; mastery of key competences providing interaction of a human being with other people in real social and professional situations [14].

Renovation of the content, forms of study is promoted by the fact that it is organised in the context of the future professional activity of the graduate. This implies inclusion of all kinds of learning activity associated with that of professional one in curricula and syllabi, organisation of practices including research tasks, projects completion, taking into account the needs of backbone enterprises; implementation of research and scientific work at the curricular and extracurricular time.

To realise the competence approach in technical education, it is necessary to implement the following principles:

- humanitarization of education, which will provide personality-developing nature of professional training, will contribute to effective self-development and self-realisation;
- integrity and interdisciplinarity, which is oriented to integration of disciplines at the level of content, technologies, and will provide their relevance to professional activity of an engineer as well;
- continuity of training from the viewpoint of content and technologies in the educational process will provide consistency of pedagogical requirements, oriented to development of readiness for research activity,
formation of creative, productive thinking, as well as personal qualities that determine the competences under formation;

- diagnosticity provides for a stage-by-stage process of determining the level of formation of competences when using a criterion-evaluative set.

The competence approach was initially oriented to achieving specific results in the form of acquisition by the student of a complex of competences, characterising efficiency of professional education. They serve for presenting and designing educational results adequate to the rapidly changing world. Engineers-experts “form not only certain knowledge and skills, but also specific competences, focused on ability to apply them in practice when creating new competitive products” [9]. Consequently, designing the volume, the level, the content of theoretical and empirical knowledge, practical skills, work experience is in direct relationship with education results, expressed in the form of competences.

Approval and introduction of FSES of HE (Federal State Educational Standard of Higher Education) contributed to consolidation of legislative and regulatory frameworks of the competence approach at the government level (possibilities of FSES of HPE on formation of students’ readiness for research activity were considered in the previous paragraph).

The competence approach in the methodological aspect bases on traditional approaches (axiological, value-motivational, synergetic, integrative, activity-based, context-dependent) to organisation of the educational process in the engineering higher school and can be optimally organised if the requirements of traditional approaches are met. The competence approach provides application of the mentioned approaches at a qualitatively new level, acting as an area of their interaction. Its meaning can be supplemented with the system of principles of traditional approaches. Therefore, the competence approach is considered by the authors in connection with traditional approaches as some “correlate” (A.G. Bermous). It acts as a link between practice and theory and is able to realise the connections among higher schools and employers, having practical and effective-purposeful orientation.

Let us consider traditional approaches from the viewpoint of research training of students of engineering institutes.

The systemic approach is realised during theoretical understanding, substantiation of holistic systems and methods of cognition allowing consideration of research training of a student as an integral system. It discloses the unity of its value, functional, activity-based aspects. The concept of the “pedagogical system”, which (having analysed a multitude of definitions [6], [15], [20], etc.) is understood as an integrity in which interacting components contribute to the fact that the system performs the function of education, achieving the set results, namely training the student for research activity, is of great importance for solving the tasks of this research. Let us consider the following as components of the pedagogical system: a training goal, tasks, content, an educational process, students, teachers, training aids, pedagogical technologies, forms and methods of training. Interaction of the components of the pedagogical system generates a pedagogical process.

The study of provisions of the axiological approach allows regarding technical education as a socio-pedagogical phenomenon, which performs the following functions: cultural-creative, humanitarian and socialization functions. The axiological approach implies transmission, storage, reproduction and development of the culture of research using educational means. They contribute to acquisition and reproduction by a human being of certain social experience necessary for adaptation in society, realisation in professional activity.

The value-motivational approach [22] provides for activity aimed at organising interaction among students and teachers as subjects of the education process, contributing to formation of the value system when adopting an
overall purpose, formation of motivation, contributing to “conscious acceptance and realisation of these values, establishing a correspondence between results of labour and a status attitude of participants of the educational process, facilitating a continuous growth of education quality” [22]. The value-motivational approach during research training contributes to harmonization of goals of students and teachers, formation of collective subjects of activity, motivated participation of subjects in research activity.

The synergetic approach as a theory of self-organisation orientates to formation of a new result of engineering education. The provisions of this approach allow considering formation of students’ ability for self-organisation of inner resources and their orientating to research training during the educational process at higher schools as one of the main principles of engineering education. The synergetic approach contributes to consideration of objects and subjects of engineering education as complex self-organising systems, the main property of which is ability for self-development. Use of the synergetic approach when designing the concept of training students for research activity contributes to enrichment of the educational process with dialogue methods and techniques of pedagogical interaction, which intensifies the process of students’ development.

The integrative approach provides for elimination of disconnectedness of higher school disciplines owing to cross-curriculum connections, deepening and consolidation of students’ knowledge, formation of ability to compare, analyse and classify the obtained information; after all, phenomena of the objective world do not exist in isolation in separate sciences, they are closely connected, united with each other, and they must be studied in this unity. The authors share the opinion of A.N. Sergeev that all academic disciplines must be interrelated and interdependent despite the fact that each of them is a separate branch of science with its methodology, terminology system, methods [21].

The personality-oriented approach allows developing a student’s personality as a subject of research activity. A technological potential of this approach consists of methods “corresponding to such requirements as: dialogic nature; activity-creative nature; orientation to support of student’s individual development; providing a learner with a necessary space, freedom for making independent decisions, creativity, choosing the content and ways of learning and behaviour” [8]. Realisation of the personality-oriented approach during training for research activity contributes to formation of partnership interrelations between teachers and students.

According to the government strategy of education renovation, designing of all components of the training system is implemented based on the activity approach, in particular on the basis of formulation of competences in the activity format. In the studies on the activity approach ([2], [10], [17], [19]), the personality is accepted as a subject of activity, forming in it, as well as in communication, which determines the nature of the activity itself. The essence of the activity approach consists in training students based on productive activity, which forms them. According to the research of A. Diesterweg “knowledge and skills … cannot be given or communicated” [13]. It is possible to be drawn to knowledge and skills and to achieve certain results only through activity. From the position of training for research activity, the provision about organisation of activity, in which the student acquires models of professional activity, assesses their possibilities and prospects of application, is important.

The context approach, created in the development of the activity approach – “in the language of science and by means of the entire system of forms, methods and means of training, models sequentially the subject and social content of the future professional activity of students” [9]. During research training, the content of professional activity of an engineer will be modelled in the forms of students’ activity. Students must assess the training process using comprehensible criteria; then there is personal activity of the student, ones’ interested participation in forming oneself as an expert” [9].
The competence approach starts with cardinal reconsideration of the training results; it implies a new approach to designing expected results, and only then, on this basis, the content of training and the training process change in a varying degree. Thus, “a context approach can be considered as an effective means for achieving goals, set in connection with realisation of the competence approach” [7].

The competence approach to building the concept of research training of students of technical institutes is concretized in principles regulating this process: succession, integration, unity of educational space, training intensification, creativeness and activity-based orientation, reflexivity; let us consider them.

The succession principle allows building the concept having preserved consistency and continuity of research training of students in the course of general professional training. Succession provides an optimal connection between the stages of student’s formation as a subject of research activity. Succession implies preservation at each stage of an accumulated system of knowledge, formed abilities, skills and determines possibilities of subsequent development.

The integration principle is aimed at holistic perception of knowledge in conditions of integrating materials in different scientific fields, presence of inter-disciplinary dependences and connections. “Integration implies combining parts into something whole” [18]. Pedagogical integration during research training implies unity of the following constituents: teaching-learning-research, which contributes to integration of theoretical and practical training; interdisciplinary integration of disciplines; integration of efforts of all participants of the educational process oriented to research training of students of a technical institute; integration of independent work of students and different forms of classroom work. The integration principle discloses the cross-curriculum integrative nature of research training, manifests itself in connections of disciplines realised by means of active, interactive, informational and communicative technologies.

The principle of unity of educational space determines formation of developing educational environment of a technical institute containing personnel, management and information resources, oriented to research training. Research space, formed in the developing educational environment, combining research and learning activity of subjects of the educational process, is practice-oriented.

The practice-orientedness principle implies consideration of requirements of employers and provisions of professional standards during research training, formation of the system of partnership with backbone enterprises.

The principle of training intensification is considered as an increase in development of student personality owing to one’s maximum allowed involvement in implementation of different types of scientific, learning, research activity. The main factors of intensification during research training are: enhancement of training purposefulness; strengthening of motivation and positive personality orientation to formation of readiness; an increase of informative capacity of education content; application of active, interactive methods and forms of training; development of skills of research activity; use of information technologies, network educational resources.

The principle of creativity and activity-based directedness implies creation of conditions for creative development of both students and teachers in the atmosphere of collaboration and co-creation. The indicators of creativity are: “originality and irregularity; nature of reaction, emphasizing its rapidity; emotionality, imagination, flexibility; analysis and reflection; independence and activity” [26]. Activity-based directedness determines the fact that the basis of the process of research training is ways of student’s work, approximated to real research activity of an engineer in the framework of each course, co-creation of students and teachers during activity.

The reflexivity principle implies involvement of reflexivity in learning and research activity for the purpose of development of students’ self-control, their involvement in the process of co-management of education quality.
during their self-organisation in the course of research training, which is aimed at changing of relation to training results, development of aspiration for self-perfection and self-realisation.

The analysis conducted showed that the considered approaches supplement each other and realise different plans when considering the issue of research training. The competence approach, interacting with traditional approaches (axiological, value-motivational, synergetic, integrative, activity-based, context), is backbone and introduces principle changes in the process of education, expressed in the strengthening of practical orientation and instrumental directedness of engineering education, creates optimal opportunities for research training of students. Methodological principles concretize provisions of the competence approach and, along with it, are methodological bases when creating the concept. Realisation of the competence approach and methodological principles of technical institutes implies the possibility of changing the management system of the higher school, in particular education quality management, oriented to research training of students.

Content of the concept of research training of students of technical institutes

The concept of research training of students of engineering institutes (hereinafter concept) is a complex of attitudes and concepts in the field of professional training of students built on the basis of the theory of the competence approach and principles of designing the process of formation of research competence, generalizing progressive educational experience in this field, formed as of today, considering the fundamental needs of modern society and production. The concept of research preparation of students in the context of competence-oriented engineering education determines research training as a basis of building innovation didactics of an engineering higher school in the framework of the developing national system of qualifications, allows realising requirements of FSES of HE for formation of a set of professional, special, common cultural competences.

The concept describes a process of research training of students, means and methods of its realisation and includes (Figure 1): common provisions (purpose, tasks, prerequisites of development, methodological support, a normative base, a terminology system); methodological support (a competence approach, methodological principles); content – a functional model of training a student of an engineering higher school for research activity; verification.

Figure 1 Concept structure of research training of students
The purpose of the concept is substantiation of the process of formation of a creative subject of engineering activity with a developed research attitude and reflection, ready for active participation in innovation engineering processes, capable to develop new ideas, solve research production tasks and make non-standard decisions.

The following tasks were solved in the concept:

- methodological foundations of preparing students of engineering higher schools for research activity were defined;
- principles constituting the basis of effective selection of content and technologies of preparation for research activity were formulated;
- components were structured and integrated into the holistic functional model, necessary changes were introduced into the process of professional preparation;
- criteria and indicators of readiness for research activity of a student of an engineering higher school were determined.

When building the concept, it was determined that prerequisites of its development are:

- peculiarities of modern engineering education (change of the educational paradigm, introduction of the competence approach in engineering education, introduction of FSES of HE, which consider research activity as an integral part of engineering activity; search for innovation pedagogical solutions, providing enhancement of effectiveness of engineering education);
- changing structure, content and nature of engineering activity, which is underlain by research aspects;
- changing requirements for a graduate of an engineering higher school according to professional standards, demanding preparation of specialists, capable of providing high production results and being ready to realise exploratory search;
- age-related and socio-pedagogical peculiarities of students of engineering higher schools, contributing to professional training for research activity;
- experience of pedagogical science on professional training of engineers capable of adapting to changing production conditions; historical prerequisites taking into account the experience of preparation for research activity; results and experience of pedagogical studies in the field of improving content, forms and methods of engineering education.

The mentioned prerequisites were the motives of formation of the concept; besides, it is necessary to note that the more the higher school is capable of progress, the higher the level of research activity of students and teachers. In engineer’s activity, the research nature reveals itself as key; it allows realising creative self-development contributing to successful professional activity. Therefore, research preparation of students is a condition of competitiveness of Russian engineering education and is considered by the authors as a strategic guideline, in which direction the professional training of students of technical institutes will be realised.


The terminological system of the concept is represented by notions reflecting specifics of the process under study: “research activity”, “research learning”, “research competence”, “developing educational environment of a higher school”, “research training”, competence-oriented engineering education"
The problem of preparation of a technical institute student for research activity is solved by the authors from the position of the competence approach, which, interacting with traditional approaches, introduces fundamental changes in the training process, manifested in the strengthening of practical orientation and instrumental directedness of engineering education, creates optimal opportunities for research preparation of a student.

Methodological principles, allowing one to select the content of preparation for research activity and to organise the competence-oriented training process, were taken into consideration in the concept: the succession principle, the practice-orientation principle, the integration principle, the principle of unity of educational space, the creativity and activity-based principle, the reflexivity principle.

Realisation of the competence approach and methodological principles implies reconsideration of purposes, content, techniques of professional training of students of an engineering higher school, which is possible when changing the system of education quality management aimed at a result, namely the preparation of students for research activity, inextricably connected with the level of formation of common cultural and professional competences.

Comprehension of scientific, pedagogical, methodological foundations of the system of education quality management in a higher school, which provides motivation of participants of the educational process to enhance the education activity quality, contributed to a transition to a programme-based system of education quality management in a higher school, which is characterised by the following features: “focus on the end result; system understanding of the object; a planned quality level; complex analysis of problems; a complex approach to the choice of purposes and means of their achievement; linking together purposes and resources (creation of a goal-oriented programme); aspiration for maximal effectiveness of achieving purposes when using resources rationally; integration of efforts of a higher school and enterprises” [12].

The program-based system of education quality management allowed:
1. establishing attainable goals, namely formation of students’ readiness for research activity;
2. establishing a developing educational environment in a higher school;
3. building a united team (representatives of a higher school, backbone enterprises);
4. developing a training programme for research activity (a functional model);
5. guaranteeing necessary support: personnel, material and technical, informational, methodological, etc.

The research training of students of a technical institute was determined as a programme of ideology of the higher school functioning; hence, a systematic monitoring of the quality of research competence formation is an integral part of the management system.

Having analysed a number of works on organisation of educational environment of a higher school ([15], [27], [7], etc.), the authors concluded that formation of developing educational environment in a higher school is an obligatory condition for solution of the task of establishing innovative didactics of an engineering higher school, aimed at research training of a student; at that, employers’ requirements for training students for research activity, characterized by an individual and productive style of engineering activity and professional standards provisions, are taken into account. The developing educational environment of an engineering higher school can be considered as a competence-oriented space, in which a set of conditions, aimed at provision of optimal parameters of educational activity of a higher school, is created, namely provision of purposeful, informative, operational, effective, resource aspects.
The technology of organisation of developing educational environment of a technical institute consists of several stages:

1. motivation for research training of students of an engineering higher school;
2. interactions and joint activity of all subjects united by the environment space;
3. students’ self-regulation and self-generation during research training.

The developing educational environment of a modern technical institute includes the following structural components, which are provided with personnel, management and informational resources.

A spatial-subject component: architectural and aesthetic organisation of the educational process (architecture of buildings; classrooms, equipment, etc.); a symbolic space (symbolism and traditions of a higher school).

An informative component: a functional model of research training as an informative content of the concept.

An organisational component: a personnel resource, a management resource, a communication field (partnership interrelations between a teacher and students on the basis of accepting common goals; harmonization of interests of all participants of the educational process (higher school management, work group, teachers, students, representatives of enterprises); creation of an atmosphere of productive activity, organisational conditions. The personnel resource provides for creation of a team of like-minded people, united by a single goal owing to coordinating the work of structural subdivisions of a higher school (sub-faculties, an internship department, an academic office), as well as separate teachers; enhancement of professional competence of higher school employees (refresher courses, seminars, consultations, round-table discussions, etc.).

An information component provides for network interaction with representatives of backbone enterprises, use of network educational resources, introduction of the electronic system of support of the educational process aimed at solution of relevant tasks of education informatization, including development of infrastructure of a united educational informational space, development of electronic educational resources.

Educational environment (Figure 2) is characterised by a structure, in which elements are interconnected and are in the indissoluble unity.

![Figure 2 Structure of developing educational environment of technical institute](image-url)

The authors of the paper proved that establishment of developing educational environment requires: 1. organisation of interaction and joint activity of all subjects united by the space of environment during training; 2. integration of training and research at all stages of the educational process; 3. transformation of the content of
education, development of new and improvement of existing methodological support; change of organisational-technological foundations of the educational process;

- formation of the system of partnership with higher schools, scientific organisations, enterprises; realisation of the network form of interaction (agreements on complex collaboration were concluded with backbone enterprises). This allows conducting purposeful distribution of graduates, attracting representatives of enterprises to the process of research training (development and correction of main educational programmes; internship programmes, a fund of evaluating means, research tasks (connected with real problems of production), participation in control events (presentation of research papers, term projects (papers), graduation theses); conducting internships, field laboratory and practical works; organising probations for teachers; monitoring of current and prospect demands for graduates, consideration and analysis of successful activity of higher school graduates, etc.);

- extension of the set of competences of FSES of HE owing to special competences;

- providing personal and professional development of students, involvement in the process of co-management of education quality with their self-organisation during research training (increasing the share of independent work, rejection of reproductive methods). Students master their role in the educational process, as well as culture of self-organisation in learning activity, self-regulation of the process of research training, which contributes to change of the attitude to training results and more competent evaluation of one’s own preparation quality.

Thus, the following principles are core for realisation of the concept: the programme-based approach to management – systematic monitoring of readiness of students for research activity; organisation of developing educational environment in a higher school providing for motivation, interaction and joint activity of all subjects, united by the environment space; integration of training and research at all stages of the educational process; transformation of the content of engineering education, development of practice-oriented methods, special forms and means of students’ activity; taking into account requirements of employers and provisions of professional standards based on formation of the system of partnership with backbone enterprises; involvement of students in the process of co-management of education quality with their self-organisation in the course of research training; criterion nature and diagnosability of results.

The content of the concept is realised in the functional model of students’ preparation for research activity being a basis of innovative didactics of an engineering higher school. The concept is of interdisciplinary nature, being a part of the holistic content of professional training, is represented as a basis of organising the process of students preparation for research activity. The represented structure of preparing students of engineering higher schools for research activity is invariant and can be used in the educational process of other higher schools.

The assessment of effectiveness of realising the research training concept, expressed in the assessment of formation of research competence of students of technical institutes, was made by means of criteria, indicators. Cognitive, personality, activity-based components, which are also used as criteria, were identified as components of research competence. The cognitive one determines the degree of mastery of the conceptual framework, ability to use the formed theoretical basis during research activity. The personality one is motives and value attitudes of the personality, student’s reflection during research activity. The activity-based one determines the degree of mastery of ways of performing research acts, possibility of applying mastered ways of action and accumulated knowledge in practice [28].
Experimental work on realisation and verification of the concept has confirmed the effectiveness of its basic provisions. The total number of people, involved in the experimental work, was 1520; among them, there were 1390 students and 130 teachers.

The experiment on realisation of the concept underwent 3 stages. At the ascertaining stage, it was defined that at the beginning of the experiment, research competence of the first-year students had not been formed; among the graduates (before the beginning of the experiment), the students with a low level of research competence prevail, which reflects the results of the process of traditional professional training in the technical institute. At the forming stage, pedagogical expediency of introducing the concept of research training of students of technical institutes was proved experimentally. The generalizing stage was aimed at assessment of the concept effectiveness, by means of revealing the resulting dynamics of research competence formation of students of technical institutes. Results of control assessment are presented in Table 1 [11].

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<th>Personality component</th>
<th>2012-2013 academic year</th>
<th>2013-2014 academic year</th>
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<td>62</td>
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<td>30</td>
</tr>
<tr>
<td>Activity component</td>
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</tr>
<tr>
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<td>3</td>
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<tr>
<td>High</td>
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<td>0</td>
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<tr>
<td>Average</td>
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<td>2</td>
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<tr>
<td>Low</td>
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<td>28</td>
<td>29</td>
<td>39</td>
</tr>
<tr>
<td>Zero</td>
<td>40</td>
<td>70</td>
<td>15</td>
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Comparison of the data of initial and final assessments showed a stable growth of indicators by all components of research competence of students of experimental groups versus the compared results of control groups and results of graduates before the beginning of the experiment. The credibility of the results was confirmed by the verification on the basis of statistical analysis using criteria of mathematical statistics. The results of the experimental work show effectiveness of the developed concept realised through the functional model of research training of students of technical institutes.
Conclusion

The concept of the research training of students in the context of the competence-oriented technical education determines research training as a basis of building innovative didactics of an engineering higher school, which allows realising requirements of FSES of HE on formation of the complex of professional, special, common cultural competences. The following principles are basic for realisation of the concept: the programme-based approach to management – systematic monitoring of formation of research competence of students; organisation of developing educational environment in a higher school, providing for motivation, interaction and joint activity of all subjects, united by the environment space; integration of training and research at all stages of the educational process; transformation of education content, development of practice-oriented methods, special forms and means of students’ activity; taking into account requirements of employers and professional standards based on formation of the system of partnership with backbone enterprises; involvement of students in the process of co-management of education quality along with their self-organisation during research training; criterion character and diagnosability of the results.

The results, obtained during the experimental work on approbation of the main provisions of the concept, showed that its introduction contributes to development of student’s creativity, motivation, value attitude to research, readiness for active participation in innovative engineering processes, ability to develop new ideas, solution of research production tasks and making unusual decisions.

References


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