

Vocational Education Modular Technology for Bachelors of Science

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Abstract: The objective of the study is to present the practically-oriented concept of forming autonomy of Bachelors of Science in the process of vocationally-oriented language learning. The tasks of the study are to give the analysis of the engineers professional activity peculiarities and Bachelors of Science vocational education process problems; to determine an integrative professionally important characteristic-Bachelors of Science autonomy; to consider its definition, structure, formation mechanism; to present vocational education modular technology for Bachelors of Science by means of vocationally-oriented foreign language learning; to find out the advantages of vocational education modular technology in the process of foreign language learning and the way its functions form autonomy. The results of the research described in the study enrich scientific notation of Bachelors of Science vocational education; enlarge scientific notation of foreign language means creating professional activity context in class; there appears a possibility of a new look on the process of Bachelors of Science professionally important characteristics forming. From the practical standpoint, the results of the research improve the process of Bachelors of Science vocational education; determine the means of Bachelors of Science autonomy forming. The methodic support of the process of Bachelors of Science' autonomy forming worked out may be applied in a technical higher education institution in the course of vocational education.

Key words: Module, modular approach, teaching technology, language learning, vocational education

INTRODUCTION

In the modern world characterized by changes in productive-economic spheres there appear new demands to the vocational education of Bachelors of Science which is caused by the necessity to make responsible technical decisions in the situation of uncertainty. Higher vocational education system is supposed to be differentiated by variative plans and programs to give students the opportunity to choose educational trajectory framed by Russian state educational standards autonomously and independently. The necessity to change Russian educational paradigm is caused by the fact that there is a contradiction between the progress in science and technology and recent educational systems. Technical higher educational institutions have to eradicate defects in the existing vocational education system: the gap between general educational, general vocational and specialized subjects; usage of mainly conservative teaching methods; insufficient level of development of engineer's communicative abilities necessary for successful professional activity; low level of vocationally-oriented foreign language speaking which causes difficulties in job finding for young engineers.

Traditional approaches to the vocational education process do not take into account specifics and

professional activity peculiarities in the modern world. Thus, innovation personally-oriented technologies of vocational education should be worked out. Theoretical groundings of vocational education are represented in pedagogics by various aspects: peculiarities of vocational education process, contradictions and tendencies of modern vocational education are found out; characteristics important for work in the "person-technology" sphere are determined; engineer's professional activity specifics is highlighted and its innovation character is grounded.

Specific character of engineer's professional activity is in the leading role of designing linked with the necessity to make technical decisions in the situation of uncertainty, when the subject of decision must be ruled by the regulatory standard having qualities influencing on making individual decisions: autonomous thinking, responsibility, readiness to scientific-research activity (Ivkina, 2015).

The success of educational and productive activity of an engineer as a subject of independent decision-making is defined by self-regulation which represents a person as an ideal, self-educated, self-advancing and self-regulated system (Rudneva, 2012). In the technical sphere such systems are called autonomous and autonomy is the most important characteristic of an individual as the November

26, 2016 subject of self-regulation and autonomous work which is essential to make technical decisions in the situation of uncertainty. Vocationally-oriented learning contributes to engineering thinking development. Such learning uses the subjects creating the context of engineer's professional activity. One of such subjects is a foreign language and vocationally-oriented language learning based on the context approach may provides conditions suitable for autonomy formation.

The analysis of scientific literature and research results showed that modular technology is used in vocational education to allow students independently, autonomously, individually study educational trajectories framed by Russian state educational standards (Merkulova and Merkulov, 2011). There exist researches revealing possibilities to choose an individual way of learning taking into account personal characteristics; various methods and forms of learning are integrated; the content of vocational education is chosen on the basis of modular approach; means of achieving high level of readiness to the professional activity and ways to systemize professional skills in the course of studying are determined. Philosophical understanding of modular education and its usage peculiarities is given; controlling-educative modules are developed.

Though, the possibilities to apply modular technology in vocational education of Bachelors of Science in the process of foreign language learning to form professionally important characteristics is not investigated enough. There should be resolved a set of objective contradictions between:

- Existing vocational education systems of Bachelors of Science and their disability to make technical decisions in the situation of uncertainty in the course of professional activity
- Possibilities of vocationally-oriented language learning to form professionally important characteristics for making technical decisions in the situation of uncertainty and its insufficient usage to solve this problem
- Demands of the modern society in technical specialists capable to independently make technical decisions in the situation of uncertainty in the sphere of modern industry development and insufficiency of the pedagogical technologies stimulating Bachelors of Science autonomy forming as their professionally important characteristic (Kamakhina and Lkhotskaya, 2015).

Scientists mark the importance of autonomy and independence development during vocational education

of Bachelors of Science, although there is no unified point of view on the autonomy definition and structure. Researches of are devoted to the process of foreign language learning at technical higher education institutions and prove its significance in forming professionally important characteristics of Bachelors of Science. Researches of vocational education language learning (Borozenets, 2013; Galskova, 2006; Martynova, 2014; Merkulova and Merkulov, 2011) prove its role in forming Bachelors of Science professionally important characteristics. The main contradiction between existing practice of vocational education of Bachelors of Science and insufficient status of pedagogical conditions for forming autonomy of Bachelors of Science should be resolved.

The urge to find ways of solution of the contradictions mentioned above determined the problem of our research. In the theoretical field it is a problem of grounding approaches to organizing the process of vocational education of Bachelors of Science. In the practical field it is a problem of developing means of forming autonomy of Bachelors of Science as their professionally important characteristic. The object of our research is vocational education of Bachelors of Science. The subject of our research is the modular technology as a component of vocational education of Bachelors of Science.

The objective of our research was the development and theoretical-methodological grounding of the practically-oriented concept of forming autonomy of Bachelors of Science in the process of vocationally-oriented language learning. The hypothesis of our research is the following. Bachelors of Science autonomy is an important condition of successful professional activity as the ability to act independently, to take responsibility for the professional activity results helps to effectively make technical decisions in the situations of uncertainty. The existing vocational education system does not provide the full development of professionally important characteristics necessary to carry out professional and research-and-development activity. Bachelors of Science autonomy forming in the vocational education process by means of a foreign language learning becomes possible if:

- Scientific notation of Bachelors of Science vocational education is concretized
- The essence and structure of Bachelors of Science autonomy is revealed and grounded
- The role of the vocationally-oriented foreign language learning in Bachelors of Science autonomy forming as their professionally important characteristic is proved

- Vocationally-oriented foreign language learning technologies are analyzed
- Means of Bachelors of Science autonomy forming in the course of vocationally-oriented foreign language learning are determined
- Vocational education modular technology for Bachelors of Science by means of vocationally-oriented foreign language learning is worked out

The tasks of our research were the following:

- To concretize scientific notation of Bachelors of Science vocational education
- To reveal and ground the essence and structure of Bachelors of Science autonomy
- To prove the role of the vocationally-oriented foreign language learning in Bachelors of Science autonomy forming as their professionally important characteristic
- To analyze vocationally-oriented foreign language learning technologies
- To determine the means of Bachelors of Science autonomy forming in the course of vocationally-oriented foreign language learning
- To work out vocational education modular technology for Bachelors of Science by means of vocationally-oriented foreign language learning

We aimed to prove the following suppositions: The social demand for Bachelors of Science preparations is preconditioned by dynamic changes in socio-cultural and industrial-economic spheres and high pace of scientific technological progress. Bachelors of Science professional activity specifics is in the prior role of the designing process preconditioned by multifactor tasks which requires Bachelors of Science to be capable of making technical decisions in the situations of uncertainty. This causes a demand in forming autonomy as a professionally important characteristic. Modular approach to the Bachelors of Science vocational education process will help to resolve a contradiction between the existing practice of the Bachelors of Science vocational education and a demand for engineers capable of individual independent making technical decisions of various levels of difficulty in the situations of uncertainty. Interconnections between such notions as self-regulation, self-regulating system and autonomy, presence of a similar essence in their structure (self-sufficiency, independence, thinking individuality) are the basis of determining the essence of Bachelors of Science autonomy which forming provides professional activity

effectiveness. Bachelors of Science autonomy as an individual's integrative characteristic comprises in its structure the components which indexes show that readiness to make technical decisions in the situations of uncertainty is formed. This readiness is represented by the demand to independently get professionally important information; knowledge of individual professional abilities; an ability to solve problems logically and orientate in the unexpected situations; an ability to evaluate a situation finding out problems and finding alternative ways of their solving (Cattell *et al.*, 1988). The process of globalization and multinational integration in the spheres of vocational education and engineering activity causes the necessity create such a system of Bachelors of Science autonomy forming which contributes to the process of their integration in the world professional and educational society.

Bachelors of Science vocational education reaches its goal-Bachelors of Science autonomy forming-when vocationally-oriented foreign language learning creates engineer's professional activity context putting them in their professional specifics. Studying this specifics forms natural and independent behavior and initiates students to study more. A vocationally-oriented foreign language teacher's strategy should be represented by vocational education modular technology for Bachelors of Science by means of vocationally-oriented foreign language learning development and realization as the part of the whole vocational education process. This becomes possible when the content element of the vocational education modular technology includes vocationally-oriented foreign language and its thesaurus is chosen on the basis of the context approach and constructed by autonomous structural elements modules. Studying these modules contributes to the autonomy components development. Vocational education modular technology effectiveness is represented by the quantitative growth of Bachelors of Science autonomy components indexes. The academic novelty of our research is the following:

Scientific notation of Bachelors of Science vocational education is concretized (the engineer's prior professional activity is the designing activity in the course of which multifactor production tasks are solved which requires Bachelors of Science readiness to make technical decisions in the situations of uncertainty (Troitskaya, 2015); an engineer's activity takes place in a self-regulating, independently functioning system which presupposes thinking independency; multifactor production tasks solving requires autonomy professionally important characteristic) forming which is Bachelors of Science' vocational education peculiarity).

The essence and structure of Bachelors of Science autonomy is revealed and grounded (it comprises axiological-motivational, cognitive, pragmatist and reflexive-regulating components and their indexes' growth proves the presence of possibilities to make technical decisions in the situations of uncertainty in the course of professional activity); the role of the vocationally oriented foreign language learning in Bachelors of Science autonomy forming as their professionally important characteristic is proved (vocationally-oriented foreign language learning creates engineer's professional activity context using situation putting them in their professional specifics and creating conditions for natural and independent behavior in the modeled professional activity to find independent solutions of professional tasks).

Vocationally-oriented foreign language learning technologies are analyzed (collaborative learning, student-centered learning, distance learning, project technologies, modular technology) and the advantage of the modular technology which principles are adequate to the autonomy components (modularity principle axiological-motivational component, flexibility principle cognitive component, problematization principle-pragmatist component, reflexivity principle-reflexive-regulating component) is proved; means of Bachelors of Science autonomy forming in the course of vocationally-oriented foreign language learning are determined the vocational education content includes structural elements (modules) providing autonomy components development (axiological-motivational component-an introductory module, cognitive component-a learning module, pragmatist component-a practical module, reflexive regulating component-a controlling module) which helps to integrate Bachelors of Science into the world professional and educational society; vocational education modular technology for Bachelors of Science by means of vocationally-oriented foreign language learning is worked out (on the basis of the context approach thematic topics reflecting professional specifics are determined and linguistic means providing speech activity mastering are chosen (Yassin *et al.*, 2014). Reading and listening provide axiological-motivational and cognitive components development, speaking and writing provide pragmatist and reflexive-regulating components development). The procedural element of the vocational education modular technology comprises active learning methods (role-play, business play, problem analysis and solving method) which help to develop Bachelors of Science autonomy component's indexes.

The theoretical importance of our research is in the fact that it enriches scientific notation of Bachelors of Science' vocational education; introduction of such

definitions as "vocational education modular technology" and "Bachelors of Science autonomy" enlarges scientific notation of foreign language means creating professional activity context in class; there appears a possibility of a new look on the process of Bachelors of Science professionally important characteristics forming.

The practical importance of our research is in orientation of its results on improving the process of Bachelors of Science vocational education; in determining the means of Bachelors of Science autonomy forming; in creating and approbation of vocational education modular technology for Bachelors of Science. The methodic support of the process of Bachelors of Science' autonomy forming worked out may be applied in a technical higher education institution in the course of vocational education.

The methodological basis of our research are philosophical, pedagogical, psychological theories and concepts of an individual's autonomy; modern pedagogical and psychological theories of vocational education. The base of our research is the experience of Bachelors of Science vocational education at Samara State Aerospace University (Russia) and the personal experience of vocationally-oriented foreign language learning at the university. The representative sample included 193 persons (students and foreign language teachers). The our research comprised 3 stages. At the first stage philosophical, sociological, pedagogical, psychological, methodic studies on various aspects of Bachelors of Science vocational education and professional activity was analyzed. Pilot study aimed at proving the necessity of Bachelors of Science autonomy forming was carried out. It allowed to ground the starting positions, the problem; to determine the object, the subject, the objective of our research and to formulate its hypothesis and tasks. The result of this stage was determining the methodology and method of our research.

At the second stage in the course of experimental work, analysis and interpretation of the experience of Bachelors of Science' vocational education we further defined the research hypothesis, determined the essence and structure of the key notions and revealed the means of Bachelors of Science autonomy forming. The result of this stage was the development of vocational education modular technology for Bachelors of Science by means of vocationally-oriented foreign language learning.

At the third stage the theoretic interpretation of the experimental work results served the ground to check vocational education modular technology for Bachelors of Science effectiveness. The empiric knowledge got in course of comparative analysis of the ascertaining and formative experiments results was subjected to the

theoretical analysis. The accuracy of our research results is provided by the research methodology, its correspondence to the problem set; by carrying out the research at the theoretical and practical levels; by applying the method adequate to the research subject; by the possibility to repeat the experiment; by the sample representativeness and statistical importance of the experimental data; by the researchers personal participation in the process of Bachelors of Science' vocational education by means of vocationally-oriented foreign language learning.

MATERIALS AND METHODS

For solving the set out problems and checking our hypothetical suppositions we have used a complex of mutually reinforcing research methods adequate to the research subject: philosophy, sociology, psychology literature analysis; empiric methods (pedagogical experience studying and generalization, pedagogical observation, questionnaire surveys, expert judge method and self-estimation, testing, educational programs and vocational education concepts content-analysis, the ascertaining experiment and the formative experiment); mathematical statistics methods (correlation analysis).

RESULTS AND DISCUSSION

The main part: Global changes influencing all the spheres of a modern society first of all touch upon the technical sphere rapid development and thus greatly influence engineer's activity which provides for technical objects creation and servicing. The increase of modern society's research and technology and engineering manufacturing demands, the growth of the production level and research in the aerospace and other highly technological branches, high responsibility of engineering activity, carrying it out in conditions of competition and the necessity to solve global problems of the modern society caused increased requirements to the quality of Bachelors of Science vocational education. The scientific literature analysis allowed to define engineers professional activity specific character. That is the primary role of designing which requires making numerous technical decisions in the situations of uncertainty. So, there is a demand on changes in Bachelors of Science vocational education.

In the course of our research it was found out that the problem of vocational education in the modern stage is not worked out adequately: its individual aspect requires further investigation. It was defined that to make technical decisions in the situation of uncertainty Bachelors of

Science should have autonomy but there is no clear definition for autonomy in pedagogical literature. The absence of a unified point of view on the essence and structure of this key definition caused the necessity to specify it. It was defined that vocational education efficiency improvement is possible in case autonomy of Bachelors of Science is formed which we understand as an integrated professionally important quality of an engineer containing axiological-motivational, cognitive, pragmatist and reflexive-regulating components (Ivkina, 2009). These component's indexes prove the readiness to make individual decisions in the situations of uncertainty in professional activity.

The autonomy structure was worked out on the ground of philosophical theory by (Kagan, 1974) and psychological activity theory. The indexes of Bachelors of Science autonomy components were defined in the course of analyzing qualification characteristics of the Russian State educational standard for Physics, Applied Information Technologies, Information Technology specializations.

Researches devoted to studying various aspects of autonomy showed that its forming may be effective in the course of a foreign language learning because its purpose in a technical higher education institution is to form communicative competence. Communicative competence provides for the readiness of Bachelors of Science to the successful professional activity in the labor market conditions, because its components (socio-cultural, social, linguistic, pragmatist, discursive, socio-linguistic, self-controlling) influence the autonomy components development.

Meanwhile, a contradiction between the employer's requirements to the level of a foreign language knowledge of Bachelors of Science and vocationally-oriented foreign language learning methods was discovered. This can be explained by not taking into account their professional activity specifics. The advantage of vocational education modular technology by means of a foreign language learning was revealed. In the course of the ascertaining experiment low level of Bachelors of Science autonomy components forming was revealed which proved the necessity of changing Bachelors of Science vocational education process. While creating vocational education modular technology for Bachelors of Science we investigated modern pedagogical technologies and according to the target-setting criterion (Bloom's taxonomy) chose the following: collaborative learning, student-centered learning, distance learning, project technologies. Collaborative learning provides for professional activity abilities development; student centered learning influences self-organization ability development; distance learning helps self-reflection and independent learning skills; project technologies create

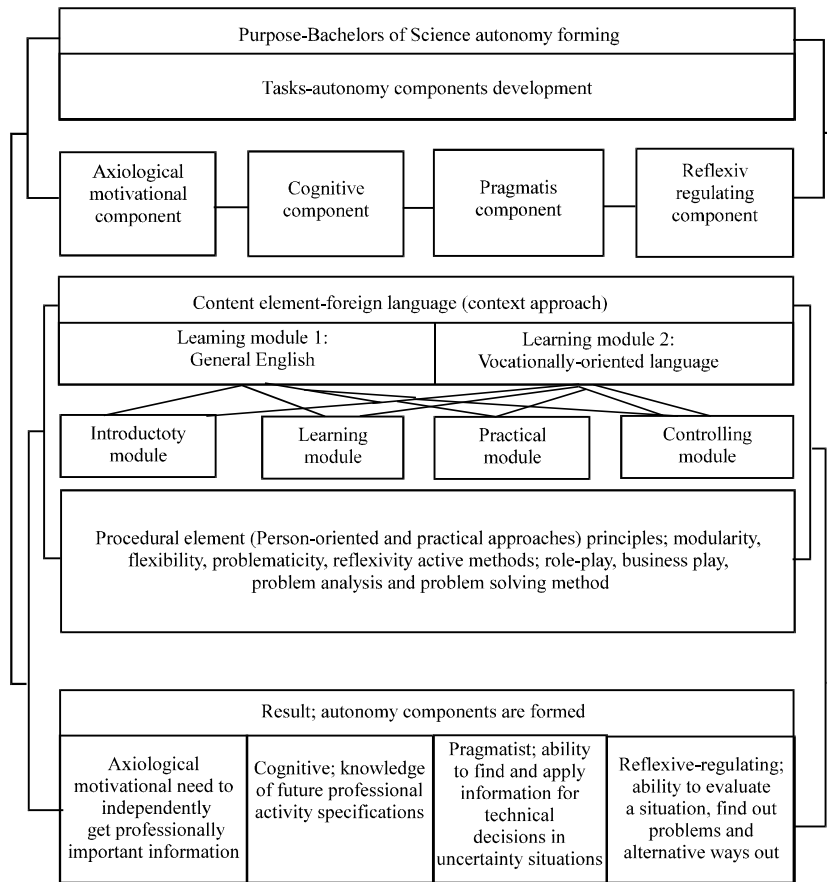


Fig. 1: Vocational education modular technology for Bachelors of Science

professional context and develop designing skills. Modular technology integrates all these technologie's definitions; that is why its aim is Bachelors of Science autonomy forming.

Vocational education modular technology for Bachelors of Science is constructed on the autonomy structure basis. According to the main methodological principles of the system approach (organic integrity of the objective and the subjective notions, system structural properties, system dynamism) vocational education modular technology for Bachelors of Science structure contains the purpose, the tasks, the content, learning forms and methods, activity principles and algorithms.

Vocational education modular technology for Bachelors of Science created is a kind of a pedagogical system and includes the content element and the procedural element. The content element based on the methodological ideas of the context approach includes content units created on the ground of the Russian State educational standard for the higher vocational education and the typical foreign language learning program for technical higher education institutions; linguistic means

providing mastering types of speech necessary to develop autonomy components indexes (Fig.1). The foreign language learning syllabus was constructed on the basis of studying modules, autonomous and logically complete blocks of information. According to the modular technology principles modules allow to differentiate the syllabus and provide mastering a foreign language course on an elementary, intermediate or advanced level depending on the Bachelors of Science needs. In such a process the student-teacher interaction is brought into action on a principally different basis, because modules help students to autonomously achieve a certain level of preliminary readiness to each meeting with a teacher. The essence of the modular technology itself requires unavoidable abidance of prior subject-subject relations between a teacher and students in the studying process.

Besides, using modules allows to fully take into account Bachelors of Science individual characteristics and their level of language knowledge. A student may study any module autonomously, at a convenient pace and if necessary, to pay more attention to the most

difficult for him or her professional knowledge and learning skills. This allows to reach learning technologization and to make it less dependent on the teacher's pedagogical skills. A teacher in this case stops being an information holder becoming a consultant.

The aim of the vocational education modular technology is Bachelors of Science autonomy forming; that is why each module contains smaller structural elements reflecting the component structure of the key definition: an introductory module, a learning module, a practical module and a controlling module. All these elements have certain objectives and contain theoretical information. As a rule, to present this information the deductive method is used (from definitions to examples and practical activities); exercises-tasks which require applying information from the module to analyze student's particular practical activity; brief conclusions on the content of each module's part are presented; the ways of student's work self-evaluation are suggested; the references for further studying are given.

So, according to the modular technology principles (modularity, flexibility, problematicity, reflexivity) the content element was constructed by autonomous functional units-modules (introductory module, learning module, practical module, controlling module); each of them included active learning methods (role play, business play, problem situations analysis and solution method) which provided for Bachelors of Science' autonomy components indexes development, because all the modules were constructed taking into account structural-content characteristics of the main notion and each of them helped for the prior development of separate autonomy components (Fig. 2).

To prove the effectiveness of the vocational education modular technology for students-future engineers created we compared the results of the ascertaining experiment and the formative experiment. The our sample group was represented by the control group (70 students) and the experimental group (98 students). The empirical data analysis using Student t-test proved the sample group accuracy: statistically meaningful ($p = 0.05$) differences between the average balls in the control group and the experimental group were not found.

Self-rating of Bachelors of Science autonomy axiological-motivation component index got in the course of the ascertaining experiment was 3.24 in the experimental group and 3.19 in the control group (5-grade scale). Low level of autonomy pragmatist component forming (2.73 on average for both groups) can be explained by the insufficient experience of students self-organization activity. The level of reflexive-regulative autonomy component forming (3.2 on average in both groups) is

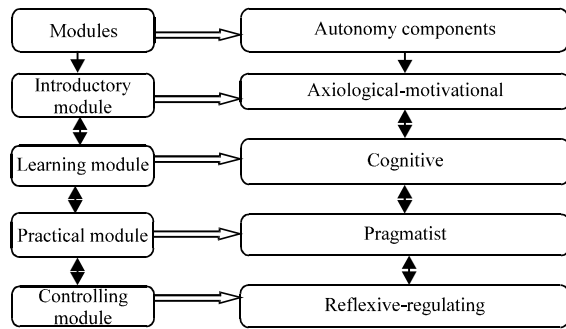


Fig. 2: Module's influence on the autonomy components development

also not enough for effective activity self-regulation. Using R. Cattell's multi-factor personal study method it was stated that 32% of students showed mobility and constriction features and 68% showed constriction features, the result of which can be difficulties in the activity self-correction.

The formative experiment, the aim of which was to appropriate the vocational education modular technology for the Bachelors of Science was carried out on the basis of Samara State Aerospace University (Samara, Russia) for 2 years. The hypothetical position of the formative experiment was based on the supposition that using vocational education modular technology in the course of vocationally-oriented language learning provides for autonomy forming which is reflected by the positive changes in the axiological-motivation, cognitive, pragmatist and reflexive-regulative components.

Statistically significant positive dynamics of Bachelors of Science autonomy components indexes in the control group and the experimental group was stated. However, Student's test criterion values prove statistical significance (at the level $p = 0.0001$) of index's average values differences between the two groups. Therefore, targeted Bachelors of Science' autonomy components formation (Table 1) allows to significantly increase the values in comparison with the implicit slight formation in the process of learning and social adaptation in the control group.

In course of the ascertaining experiment (Pearson correlation coefficient was counted) slight links between the autonomy components were found in both control and experimental groups which proved the necessity of its forming in the process of vocationally-oriented language learning. The results of the formative experiment show that the reflexive-regulative autonomy component is dominating: the most significant correlation links were found between the axiological-motivation and the reflexive-regulative components ($r = -0.6748$ in the

Table 1: Bachelors of science' autonomy components formation

Components	Ascertaining experiment		Formative experiment	
	Control group	Experimental group	Control group	Experimental group
Axiological-motivational	63.7	64.8	68.3	88.6
Cognitive	62.2	62.6	66.0	86.3
Pragmatist	54.6	64.6	58.8	86.2
Reflexive-regulating	64.3	64.4	67.5	90.5

ascertaining experiment; $r = 0.8710$ in the formative experiment); the reflexive-regulative and the cognitive components ($r = 0.1007$ in the ascertaining experiment; $r = 0.6957$ in the formative experiment); the reflexive regulative and the pragmatist components ($r = 0.0643$ in the ascertaining experiment; $r = 0.3095$ in the formative experiment). These results prove self-reflection's influence increase on the process of individual learning and getting professionally important information. The interconnection increase between the axiological motivation and the cognitive components ($r = 0.0776$ in the ascertaining experiment; $r = 0.7297$ in the formative experiment) proves awareness of future professional activity specific character, a need for self-improvement in this field.

CONCLUSION

As a result of analyzing empirical materials got in course of our research and their theoretical interpretation we made the following conclusions: Dynamically changing social-economical situation in the modern society requires to change the Bachelors of Science vocational education character. Their learning process should ensure forming the ability to make technical decisions in the situations of uncertainty; this causes the aim of vocational education- forming autonomy as an integrative professionally significant characteristic. Therefore, the contradiction between requirements of the modern society to engineers and Bachelors of Science' real competences may be solved in the process of vocational education ensuring Bachelors of Science' autonomy forming. Bachelors of Science' autonomy (integrative professionally significant characteristic) presupposes them to have an integral comprehension about their professional abilities, a skill of modeling and programming their own individual activity, to evaluate the results of professional tasks solving and find adequate ways of making technical decisions in the situations of uncertainty. Modern pedagogical language learning technologies (collaborative learning, distance learning, project technologies) are directed on separate autonomy components forming. Modular technology integrates all

these technologies' definitions; therefore, it corresponds the vocational education aim-Bachelors of Science autonomy forming. Vocational education modular technology for Bachelors of Science individualizes the learning process stimulating the need for individual independent getting professionally significant information and intellectual activity; develops the ability to analyze individual activity and correct it. The effectiveness of vocational education modular technology for students future engineers is proved by numerical increase in autonomy components indexes values, increase of its components interconnection which shows the readiness to make technical decisions in the situations of uncertainty.

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