www.arpnjournals.com

MODELING AND FACTOR ANALYSIS OF EFFICIENT INCREASE OF BACHELORS AND MASTERS' TRAINING CONNECTED WITH APPLIED INFORMATICS

Olga Borisovna Nazarova, Olga Evgenievna Maslennikova, Liliya Zaynitdinovna Davletkireeva and Tatiana Borisovna Novikova
Nosov Magnitogorsk State Technical University, Magnitogorsk, Lenin Avenue, Russia
E-Mail: Ldavletkireeva@mail.ru

ABSTRACT

Training process of bachelors and masters according to educational standards taking into account individual trajectory of professional development defines formation of the high quality IT specialist according to requirements of the IT companies, vendors and employers. Conceptual factors' justification of efficient increase of educational process in the Applied Informatics is provided in this article. Isikava's fishbone diagram is used for modeling of the studied problem. The assessment of results was carried out by methods of ranging and standardization. The analysis of the received ranks has shown that groups of factors – "Succession of disciplines" (26,6%) and "Human resource" (20,7%) are essential to achievement of a goal. The weight of the reasons of the first group's factors were distributed as follows: curriculum (4,9%), working program (4,5%), individual plan (2,8%), automated information system (2,8%), modular and competence-based approach (3,6%), principle of many paradigms (3,3%), intersubject coordination (4,9%). The weight of the reasons of the second group of factors: qualification of the faculty (11,3%), the level of preparation which is trained (9,6%), image (8%). Distribution of scales has allowed defining the directions of the further work on research: academic subjects' harmonization of the studied direction of preparation; reference point based on the modular and competence approach; accounting of intersubject coordination. The expert assessment has allowed to analyze the received results, to define the implementation mechanisms of the principle of succession, and also development and monitoring of teachers and trained people's professionalism. The consistency of working hypothesis has been also confirmed by the results of the assessment of total influence by Pareto's method.

Keywords: model, factors, bachelor, master, Applied Informatics, succession of preparation, IT specialist, individual trajectory, professional development of bachelors and masters, automated information systems.

1. INTRODUCTION

The reforming of the higher education system happens at the time of global economic crisis, difficult demographic situation and continuous changes in labor market through the integration and reorganization of higher education institutions; through the introduction of new educational standards and per capita financing. Modern social and economic conditions in which higher education institutions have to work, result in need of searching new ways and instruments to increase the overall performance of the educational organization in general, and also the to increase efficiency of preparation in the certain directions of bachelor degree and master programs [12]. In this way modeling and the analysis of the factors influencing the level of training of the Russian educational organizations' (EO) graduates is the actual task against the global problem of improvement of education's quality in general.

In the main activities of the Russian Federation's Government for the period till 2018 as the basic in the field of education is the contents and structure's reduction of vocational training of personnel in compliance with modern requirements of labor market, and also the increase of availability of high-quality educational services. It is in the law on education of the Russian Federation (December 29, 2012, No 273-FZ) the levels of professional education which include bachelor degree and

magistracy are established. Their implementation is at formation stage now.

The two-level system of higher education (bachelor degree and magistracy) which has been brought in the Russian Federation since 2011 promotes harmonization of the Russian and European educational systems, development of export of the Russian educational services, allows to set the requirements to quality of education at each level, providing rather broad preparation when training in the directions of bachelor degree and both the narrower and deeper specialization oriented to research or teaching work when training in magistracy.

According to D. Medvedev, the reference point of the state in questions of educational system's upgrade has to consist not so much in implementation of two-level structure but in development of its new forms - applied bachelor degree and technology magistracy within which training of students must be carried out taking into account features of specific production, orders of the particular employer and, of course, corporate standards which are set by this employer ".

The orientation of system of the higher education on perspective of professional demand of future specialist during all life becomes possible only when the foundation of his continuous professional development is already laid in the institute of higher education. Hopelessness of orientation to narrowly professional preparation is obvious as the world promptly changes, and it is difficult to foresee

www.arpnjournals.com

what will be professional structure of society in the next twenty-thirty years. For this reason preparation according to the wide baccalaureate program with the subsequent specialization in magistracy or at work conforms to requirements of labor market and requirements of society. According to the principle of orientation to the consumer [22] important and necessary element in quality management of education is requirements of all interested parties, including employers, to the level of specialists' training in higher education institution. These requirements, first of all, represent set of professional characteristics which the university graduate must possess to correspond to the selected direction of preparation more fully and to execute the professional duties successfully. In this respect Federal state educational standards of the third generation (FSES of the 3rd generation) in development of which representatives of employers were also directly involved, give ample opportunities and reduce a gap between the theory and practice.

Informative sector of economy grows in the modern world and develops much quicker than other industries. It should be noted that the problem of demand of IT graduates, including in the Applied Informatics sphere is aggravated with that if for the majority of the directions of preparation the period of "half-decay" of knowledge makes two-three years, for the IT industry - only some months. Therefore among the criteria defining competitive advantages of the IT university graduate on the first place there are professional IT competences (ITC). As practice shows, requirements of information society to professional and other types of ITC of young specialists are much higher, than that competence which forms during training in higher education institution. Employers note that traditional IT education still lags behind real requirements of science and production, mismatch of the content of education and educational technologies to modern requirements and tasks is observed. One of the main problems facing the higher education in the field of IT is to make educational process timely and corresponding to constantly changing requirements. And training of competent bachelors and masters is possible only at the most active interaction of the higher school and the industry, the government and private institutions.

According to Petelyak V. E.: "… the need of society for the advancing orientation of training of the bachelors and masters ready to solution of professional tasks in the conditions of informatization of all spheres of society, faces insufficient readiness of the main part of higher education institutions for practical implementation of this function. Thus traditional nature of education cannot provide in due measure individual trajectory of continuous professional development of bachelors and masters" [25].

Graduates on educational programs of Applied Informatics 09.03.03 and 09.04.03 as IT specialists in the field of information systems have to be competent while mixing integration of IT solutions with business processes for achievement of strategic objectives of the enterprise (the corporate purposes). According to authors [18]: " …

training of IT specialists has the feature in comparison with vocational training of specialists of other directions that, in our opinion, is defined by the object of their professional activity connected with the use of hardware and software, electronic ADP equipment, computer complexes and systems". In essence, such specialists are link between technicians and managers. The full list of types of work determined by the professional standard for the specialist in information systems has to be updated and serve periodically as reference point for development of different occupations oriented to practice by universities, including laboratory, project and term papers, educational and work practice, etc.

Thus, the research problem consists, on the one hand in search and assessment of the factors promoting increase of bachelors and masters' readiness of Applied Informatics to professional activity, and on the other hand, in definition of efficient and perspective mechanisms of such development taking into account current trends in the IT industry in general [21].

2. METHOD

During implementation of the project the methods, techniques and tools capable to provide necessary study of scientific problem of research at its different levels promoting increase of efficient training of bachelors and masters of Applied Informatics are applied.

At the theoretical level of research the following methods have been used: studying of the best practices, the analysis of philosophical, pedagogical and psychological literature; the systems and structural-functional analysis within consideration of system of bachelors and masters' professional development; synthesis, forecasting, induction and classification. The principle of programming paradigm and the principle of succession are applied in work.

At the modeling level of work on the project the following methods have been used: observation methods (method of expert evaluations; in our case representatives of employers, vendors, the teaching stuff of the faculty and institute act the expert's work); methods of ranging and rationing; chart technicians of different methodological approaches (in particular, the fishbone diagram – Isikava's chart).

3. RESULTS

The observance of the principle of succession in the organization of educational trajectory of bachelors and masters of Applied Informatics is the defining factor of its efficiency. It has been defined as working hypothesis of research situation.

In this regard modeling of relationships of cause and effect of the competence-based oriented training of future and taken place specialists in the IT sphere to professional activity has allowed not only to select the key factors defining the studied process but also to evaluate the positions demanding, first of all, concoction of resources. Key concepts have been studied and analyzed at the theoretical level of research: educational process [5], training technique [4], education quality management [14],

monitoring of educational process [24], information and education environment (IEE) [19], readiness [10] principle of programming paradigm [8], framework of IKT-competence [15], competence-based approach [16], information model of training [2], automated information system [23].

The modeling level of works on problem demanded the observance of creation rules of the fishbone diagram. The following purpose has been formulated for this: efficient increase of bachelors and masters' training connected with Applied Informatics.

According to the rule of "six M" those categories - factors which are subject to influence from participants of the studied process have been consistently selected, namely: "management" – management – succession of disciplines; "method" – method – educational technologies; "measurement" - measurement – monitoring; "men" – people (human resource) – teaching stuff (TS) and trained; "material" – material – the information and education environment (IEE). Let's note that the factor of "mashine" has not been taken in attention as the hardware of educational process is not in competence of its direct participants.

The expert assessment of the developed version of Isikava's chart has been carried out for the initial assessment of right direction of research's working hypothesis. Expert estimates on each factor and the reason received by method of ranging and rationing are given in the chart (Figure-1).
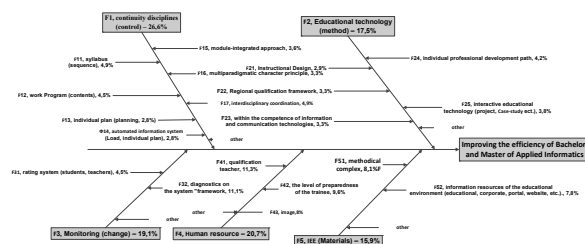
Figure-1. The chart of the reasons and factors of increase of bachelors and masters' efficient training of Applied Informatics with scales on each factor

Let's consider each of the selected factors in detail.

3.1 Group of factors 1 "Succession of disciplines"

In many respects succession of disciplines determines completeness of forming of required competences by the direction of preparation, acting as one of the significant factors to increase the efficiency of educational process. Three main directions of implementation of succession are supposed in the context of our research: through the contents of training material, sequence of statement, and also methods of its studying. We believe that if succession is considered in the narrow specific context, within some one link (in discipline, course), it is shown in the form of any communications (within one subject, intersubject), i.e. continuity takes place in this case. If consider succession in training (the contents, forms, methods), it is shown in the form of the

general didactic or pedagogical principle which provides systematicalness, sequence, availability, durability, scientific character, sensibleness. Thus, considering succession as the didactic principle which is based on the patterns about general communication and continuous development of the personality, we will provide this category as a basic rule which characteristic signs are:

1) progressiveness and coherence of the contents, forms and methods of didactic process at separate educational stage; 2) progressiveness and coherence of training at different stages of educational process that allows to save the reached level of the personality's proficiency as the result of the previous stage and to provide a possibility of its development. The reasons of the factor "Succession of disciplines" are: curriculum, working program, individual plan, automated information system, modular and competence-based approach, principle of programming paradigm, intersubject coordination.

Competently thought sequence of building of studying's order by students who do disciplines of the Applied Informatics during all educational process in the curriculum, will provide succession implementation, whereas the contents, volume, the structure of educational process is defined by the working program for specific discipline. The main document regulating work of the teacher of university on all types of activity within academic year is the individual plan. The use of the automated information systems (AIS) for forming of academic load, for accounting of teachers' individual plans, accounting of students' progress promotes increase of effective management of educational process. In the conditions of modular and competence-based approach complex mastering of abilities and knowledge within forming of specific competence which provides execution of the specific labor function reflecting requirements of labor market is carried out [15, 16]. The modern educational space has to be mobile and combine ideas of different methodological approaches harmoniously. That is provided with the principle of programming paradigm. It is worth also observing intersubject coordination which eliminates duplication of training material when studying different disciplines.

3.2 Group of factors 2 "Educational technologies"

Training of the bachelors and masters of Applied Informatics demanded in the conditions of the market demands the application of new educational technologies [1]).

The reasons of the factor "Educational technologies" are: pedagogical design, regional frame of qualifications, ICT competences frame, individual trajectory of professional development, interactive educational technologies.

Pedagogical design is a function of the teacher of the university not less significant, than organizing, gnostic or communicative. One of results of pedagogical design is the individual trajectory of professional development created on the basis of regional frame of qualifications and IT competences [14]. The efficient mechanism in this

process is interactive educational technologies (interactive boards, projector, teleconferences, e-mail, e-book readers, multimedia).

3.3 Group of factors 3 "Monitoring"

If monitoring must become a real factor of management representing certain system of activity, it needs to be organized according to the reasons presented on a model: rating system and diagnostic system on the basis of "framework". In higher education institution the system of the rating indicators of assessment of students' activity develops in the same way as teachers'. The assessment has to be carried out on competences, according to the selected framework and to have the regular character which transfers diagnostics with the use of modern control and evaluation means to monitoring rank.

3.4 Group of factors 4 "Human resource"

Teachers and students act as human resource, interacting within university. They create its image [11]. In modern conditions of intense competition in the field of the higher education, the concept of effective activity of higher education institution substantially depends on the quality of management of teaching staff. One of the options of optimization of administrative activity of the higher education institution's manual is the information technology implementation in management. Modern operating conditions of the letting-out department are that that the manual is in great need in the mechanism of regular informing on activity of teaching staff on different types of activity for more effective management and increase, eventually, of the quality level of the provided educational services.

Besides, today the higher education institution is faced with the major task connected with competitiveness and demand of future graduate in labor market. The problem of employment became actual especially recently when the competition for workplace happens not only among university graduates, but also among specialists with experience. Therefore the higher education institution has to provide maintenance of the image at the competitive level due to development of the teacher's competences and tracking of results and achievements of the student's activity.

3.5 Group of factors 5 "IOS"

The work with experts has shown that the majority recommends "to design and implement the information and education environment in educational process of higher education institution, using different forms of its practical embodiment (the programs of special courses for bachelors, masters, teachers of higher education institution, employers; series of master classes with vendors and employers; the electronic educational resources created on the basis of LMS Moodle for the purpose of increase implementation's mobility of individual trajectories; the organization of psychological and pedagogical support of professional development of future and taken place bachelors and masters, etc.) [25].

The reasons of this factor are: educational and methodical complex, information resources of the educational environment.

The Educational and Methodical Complex (EMC) is necessary for the qualitative organization of the main and additional educational programs, according to the curriculum. EMC acts as the mechanism integrating the theoretical and applied parts of training of bachelors and masters of Applied Informatics, some kind of accumulator of training material. Thus effective training activity is impossible without information resources: software of general purpose (text and graphics editors, electronic spreadsheets, etc.); the software for activity's automation of different services (for accounting of students and parents, for personnel record, for drawing up the schedule, for the analysis of progress, for automation of library, etc.); program and methodical providing for the organization of teaching and educational process (the training and developing computer programs, electronic reference books, multimedia encyclopedias, etc.); information resources of educational institution (uniform database, educational and methodical databanks, multimedia educational development, storage of documents, Web site, corporate portal, etc.) [4].

4. DISCUSSIONS

Graphically current situation is shown by Pareto's (Figure-2) chart. The application of the rule of Pareto in quality management shows that 20% of the reasons create 80% of problems. This approach allows distributing forces and resources for achievement of the goal rationally [13].
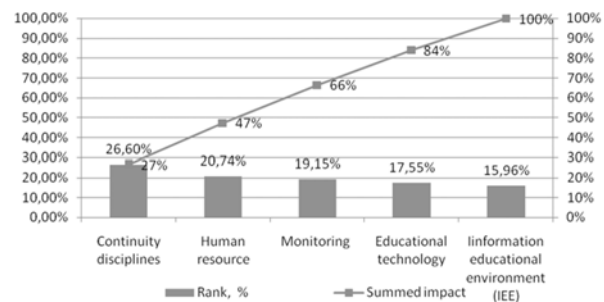
Figure-2. Factors of increase of efficient training of bachelors and masters of Applied Informatics.

The constructed chart on the basis of the exposed ranks shows that the initial solution in the light of the designated problem demands the implementation of the principle of succession and work on the development of human resource (teachers' potential and continuous monitoring of personal and professional growth of bachelors and masters both during training, and after its end).

On the other hand, implementation of algorithm and technique of forming of "the ideal curriculum" with use of frame of qualifications and the principle of succession can act as the mechanisms allowing to come nearer to solution of the put problem; on the other hand, the creation and development of teachers and students'

www.arpnjournals.com

electronic portfolio from Applied Informatics faculty for the purpose of ensuring monitoring of their personal and professional growth.

5. CONCLUSIONS

The results of the conducted research show relevance of search problem of effective mechanisms of increase of readiness of bachelors and masters of Applied Informatics for professional activity. Sufficient potential for its solution is saved up in the theory and practice of pedagogy, the problem causes interest and in employers. Nevertheless, problems which are solved insufficiently still remain: the forming of this or that competence, according to FGOS VPO of the third generation; the organization of educational process with a possibility of creation of chain "competence-discipline- competence" among disciplines within curricula of the selected directions of preparation; the model's developing of individual trajectory of professional development of bachelors and masters of Applied Informatics on different types of activity in the IT sphere.

The expert assessment has allowed to select the following factors promoting the competent organization of educational trajectory of bachelors and masters of Applied Informatics: succession of disciplines (the curriculum, the working program, the individual plan, automated information system, modular and competence-based approach, the principle of programming paradigm, intersubject coordination), educational technologies (pedagogical design, regional frame of qualifications, ICT competences frame, individual trajectory of professional development, interactive educational technologies), monitoring (rating system, diagnostic system on the basis of "framework"), human resource (qualification of the faculty, the level of student's preparation, image), the information and education environment (educational and methodical complex, information resources of the educational environment).

The weight of each of factors has been determined by method of ranging and rationing. The analysis of the received ranks has shown that essential factors to achieve of the goal are: group of factors "Succession" (26, 6%) and "Human resource" (20, 7%). The weight of the reasons of the first group of factors were distributed as follows: curriculum (4, 9%), working program (4, 5%), individual plan (2, 8%), automated information system (2, 8%), modular and competence-based approach (3, 6%), principle of programming paradigm **(**3,3%), intersubject coordination (4,9%). Weight of the reasons of the second group of factors: qualification of the faculty (11, 3%), level of student's preparation (9, 6%), image (8%). The solvency of working hypothesis was also confirmed by results of assessment of total influence on Pareto's method.

From the point of view of methodical maintenance, the following stage of work on problem of research will have technological character. The following methods will be used here and the following principles which are listed below will be observed: interactive methods of the organization of educational process;

diagnostic methods, pedagogical experiment; methods of statistical data processing; the principles of identity, self-updating, subjectivity, success (forming of the I-concept), alternative, trust and support (as, according to the personal oriented approach, they promote planning students' own individual routes and building of educational vital trajectories, including creation of individual trajectories of continuous professional development); the principle of self-education (as one of links of updating of the acquired knowledge, conducting to self-realization of the personality in certain field of activity, acting as a source of professional self-improvement and social adaptation) will find the application at the technological level of work on the project.

The search and the implementation of solution's mechanisms of the following perspective directions are supposed in this way: support of high educational motivation of students; encouragement of their activity and independence, expansion of opportunities of training and self-training; tracking of the individual progress of the student which is reached by him in the course of education; the assessment of his educational achievements. It is possible due to the development of the specialized information support of the educational environment including electronic portfolio of the teacher and the student, electronic educational and methodical complexes with the use of remote educational technologies.

REFERENCES

[1] Bazhenov R.I., Luchaninov D.V. 2014. Use of blended learning elements for formation of a humanitarian student's creative initiative at learning modern information technologies. Life Science Journal. 11(11S): 371-374.

[2] Vexler V. A., Bazhenov R. I. and Bazhenova N. G. 2014. Entity-relationship model of adult education in regional extended education system. Asian Social Science. 10(20): 1-14. DOI: 10.5539/ass.v10n20p1.

[3] Agdavletova A.M. 2015. About technique of teaching discipline. Information systems and technologies. Humanitarian scientific researches, 3 http://human.snauka.ru/2015/03/8954.

[4] Agdavletova A.M., Inashvili S. Ya. 2015. Use of electronic educational resources for training of school students in the field of information science and ICT. Works II of the International conference "Information Technologies in Science, Management, the Social Sphere and Medicine. Part III. under the editorship of O. G. Berestneva, O. M. Gerget (p. 365). Publishing house of Tomsk polytechnic university, Tomsk, Russia.

[5] Belousova I.D. 2010. Information management as concept of management. Collection of scientific works Sworld. 4(9): 5-6.

[6] Belousova I.D. 2014. Information management as new methodology of creation of information management system. Modern scientific researches and innovations. 9-1 (41): 12-15.

[7] Belousova I.D. 2015. Professional standards in the field of training of IT specialists. Modern society, science and education the collection of scientific works on materials of the International scientific and practical conference on March 31, 2015: in 16 parts (pp. 20-21). Tambov, Russia.

[8] Berezhnaya I.F. 2010. Individual trajectory of professional development of the specialist: Monograph. F. Berezhnaya, L. N. Motunova. Voronezh: Nauch. Book.

[9] Berezhnaya I.F. 2012. Interaction of teachers and students in design process of individual trajectory of professional development. Messenger of VGU. Series: Problems of the higher education. 1: 30-34.

[10] Gavrilova I.V. 2012. Uroven of ITK-development of the monoindustrial cities of Ural federal district. Development of the innovation mechanisms of increase of competitiveness of graduates of IT specialties of higher education institution in the conditions of the mono industrial city (under the editorship of L.Z. Davletkireeva, G. N. Chusavitina). pp. 15-25. Magnitogorsk state university, Magnitogorsk, Russia.

[11] Glushchenko T.B. 2009. Model of training of future teachers for use of new information technologies in forming of image of educational institution. Bulletin of the Chelyabinsk state pedagogical university, 3: 54-61.

[12] [12] Zubareva E.V., Sukhomlin V.A. 2012. Taksonomiya of the directions of diversification of programs of training of bachelors and masters in information technology field. Modern information technologies and IT obrazovaniye (under the editorship of the prof. V.A. Sukhomlin). 8: 146-158.

[13] Kurzayeva L.V. 2013. Introduction to the theory of systems and systems analysis: manual. (pp. 63-70). Magnitogorsk, Russia.

[14] Kurzayeva L.V., Ovchinnikova I.G. 2012. The international experience of quality management of education on the basis of frame structures. "Scientific discussion: questions of sociology, political science, philosophy, history": materials VI of the international correspondence scientific and practical conference. Part II (on October 17, 2012). pp. 51-56. Prod. The international center of science and education. Moscow, Russia.

[15] Kurzayeva L.V., Ovchinnikova I.G., Slepukhina G. V. 2013 Adaptive control by quality of professional education on the basis of competence-based approach (on the example of the IT industry): methodological bases, models and basic tools of installation of requirements to results of training: monograph. MAGICIAN, Magnitogorsk, Russia.

[16] Kurzayeva L.V., Ovchinnikova I.G., Zakharova T.V. Development of modular educational programs on the example of the direction of training of 230700.62 Applied information scientists. Modern information technologies and the IT education. Collection of the chosen works IX of the International scientific and practical conference. Under the editorship of the prof. V.A. Sukhomlin. INTUIT.RU, Moscow, Russia.

[17] Makhmutova M. V. The innovation technologies of training of the IT specialist in the educational environment of university in the book: New information technologies in Educations. Materials VII of the international scientific and practical conference. (pp. 247-250). Russian state professional and pedagogical university, Yekaterinburg, Russia.

[18] Makhmutova M. V. 2013. The innovation approach to technology of training of the IT specialist in Universityю Makhmutova M. V., Davletkireeva L.Z. Bulletin of the Moscow University. Series 20: Pedagogical education. 2: 103-116.

[19] Makhmutova M. V. 2007. Modeling of information educational environment of higher education institution in the conditions of remote learning. MGOU Bulletin. Pedagogics series. 2(2): 8-12.

[20] Makhmutova M. V. 2007. Forming of model of educational information environment of preparation of specialist. Collection of scientific works Sworld. 14(4): 85-90.

[21] Nazarova O. B. 2013. Maintenance of enterprise information systems (textbook). O.B. Nazarova, L.Z.

www.arpnjournals.com

Davletkireeva, O. E. Maslennikova, N. O. Prolozov. –
MAGICIAN, Magnitogorsk, Russia.

[22] GOST P ISO 9000. 2008. Quality management
system. Basic provisions and dictionary.

[23] Nazarova O.B., Maslennikova O.E., Davletkireeva
L.Z. 2013. Forming of competences of the specialist
in the field of information systems with involvement
of vendors. Applied Informatics. 2(44): 49-56.

[24] Ovchinnikova I.G. 2009. Monitoring of educational
process of higher education institution. Modern
problems of science and education. 11: 82-85

[25] Petelyak V. E. 2014. Problema of immaturity of
system of professional development of bachelors and
masters for implementation of stages of creation of
automated systems. Modern information technologies
and IT education: Saturday. Chosen works IX
Mezhdunarodn. nauch. - praktich. konf. under the
editorship of the Prof. V.A. Sukhomlin). pp. 664-671.
INTUIT.RU, Moscow, Russia.