

## Adaptive Education Technologies to Train Russian Teachers to Use E-learning

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### ABSTRACT

Rough development paces of modern society, its dynamism and variability necessitate training teachers with the double advancing. In this respect there is a problem of searching for pedagogical innovations that intensify the process of their high-quality professional training. Process approach is one of advanced versions to solve this problem. It is based on the optimization of management of students' educational activities using learning technologies, interrelation of self-organization and adaptation concepts through synergetics being at the bottom of their development. It is shown that these technologies should be oriented to make knowledge gained by students an extender of their activity capabilities, and also a basis for personal and professional implementation through three types of technologies: information, activity and organizational. In case of synthesis they are considered as social technologies. It is proved that their use in training is the most reasonable inclusive of multiple-factor specifics of the educational process. The results of the survey are of interest for a wide range of specialists in education, as they expand possibilities of using adaptive education technologies by pedagogical community in the electronic information educational environment.

### KEYWORDS

adaptation, adaptive education technologies, self-organization, synergetics, e-learning

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## Introduction

Information technology industry is one of the most intensively developing industries in the world. Undoubtedly, it exerts influence on dynamics of these technologies application in education. E-learning accumulates in itself advanced scientific and technical achievements and best pedagogical practice, promotes innovative development of educational systems. It is manifested in the following: 1) principles of system interaction of educational process subjects with emphasis on adaptability, collaboration, dynamism change; 2) infrastructure requirements of educational institutions and the electronic information educational

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environment which shall provide mobility, activity, availability, flexibility of education in case of simultaneous adaptive students management change; 3) demand for teachers with new professional visions and qualities increases; 4) active mechanisms of pedagogical innovations promotion regarding e-learning including corporate preparation of the teachers are required.

Researchers show interest in a problem of development and deployment of adaptive technologies for specialists training including teachers (Skoulikari, 2015; Chen, 2016). These studies cover implementation issues of the e-learning systems that support personal oriented and adaptive learning, including courses that are available through mobile environments and devices.

A range of works deal with the discussion of various aspects of teachers training for professional activity in distribution terms of inverse and all-permeating training (Chen, 2016), changing nature of pedagogical need in innovative electronic information educational environments (Schulz, 2014), when the economic, market factor strengthening in motivation of educational activities (Clark, 2016) and taking into account evolution of interactions between teachers and students (Mohammad, 2013). Authors of the articles give examples of valuation techniques of higher educational institutions teachers' readiness for the solution of professional tasks by means of e-learning technologies (Akaslan and Law, 2011).

Nevertheless, it should be noted that in the analyzed works the problem of using adaptive technologies in training of teachers of general education institution does not find sufficiently complete reflection for application of e-learning technologies in their professional activity.

### **Goals and Hypothesis**

The research goal is to develop theoretical bases and practice of applying adaptive educational technologies in professional training of teachers for e-learning use in their professional activity. The research is executed by a collective of authors who are representatives of various regions of Russia (St. Petersburg and Sakha (Yakutia)). It allows comprehending more deeply the problems and tasks of effective training of educational specialists in the field of e-learning, determining more accurately general, specific and urgent educational models and technologies that are necessary for this purpose, and revealing possible risks

### **Methodological Framework**

The research is executed within the system approach to the analysis of the phenomena, synergic ideas of complex and education systems development (Kapitsa et al., 1997). Educational adaptive technologies are worked out that provide effective training of teachers to use e-learning and employ nonlinear techniques for educational process organization and management.

### **Results and Discussion**

Active cooperation of two research teams (the Herzen State Pedagogical University of Russia and the Ammosov North-Eastern Federal University) made relevant the research on the application of adaptive training technologies when training teachers to use e-learning. It was carried out under joint implementation of the network master educational program "Corporate e-

learning" developed by the authors. The choice of this program is caused by the fact that development and implementation of corporate training programs that are focused on requirements of specific educational institution is the most effective form of training, retraining, advanced trainings of teachers in the current context. It gives an opportunity to increase not only teachers' quality of work, but also quality of management. Efficiency of the intra group, intra command relations increases due to improvement in skills of teachers of a specific educational institution, single internal language, mutual understanding and coordination in work is created. Considering geographical features of Russia, its scale and distribution of educational institutions as about the country, and in certain regions, pedagogical personnel training not only in the meaning of corporativity, but also in the meaning of a new training type using – e-learning is reasonable, actual and modern. Solution of this problem requires qualified specialists in the field of corporate e-learning. The master's programs have a multifunctional focus and provides training as a future leader, organizer of e-learning in educational institution, and a specialist who directly performs corporate e-learning of the teachers. Adaptive content and applied adaptive training technologies allow undergraduates to take methods of management that are actual for e-learning; to develop skills of independent search and decision making on the basis of integration of the cross-disciplinary and systematized professional knowledge. The program is oriented on persons who directly participate or are going to contribute to e-learning development in Russia.

The research was conducted to optimize management of educational and cognitive activity of students on the basis of training technologies using focusing on a learner the master's program-based. These technologies are focused on his personality structures, to formation of capabilities to independent orientation in the world of knowledge and abilities at a student. They, on the one hand, shall be adapted for a person, and with another, promote his readiness for adaptation according to needs of a fast-paced world. Adaptation is an essential characteristic of a person. It influences his mainstreaming into social relations including training. The key condition of the successful adaptation is the optimum combination of adaptive and adapting activities that are varied depending on specific situations.

The results of the studies showed that it is possible due to the use of adaptive training technologies based on adaptive interaction of training process subjects, and also pedagogical resources and means employed by them. When elaborating adaptive training technologies, the key factor is the idea of educational process management from the standpoint of synergetics, implying that control parameters do not strictly manage the system (student) behavior, and consider tendencies of its development and use them to "start" internal mechanisms of system self-organization. Use of the concepts of the adaptive management theory is reasonable in view of the following reasons. First, the adaptive behavior is peculiar to a person as to the training subject. Secondly, the adaptive behavior of any system, including a training system, is multialternative, which allows speaking about effective organization of cognitive activity of students during the educational process. Thirdly, information on the managed process – the process of professional training of students and external environment – training environment differs in a plurality



of uncertainties. This leads to various corrective educational actions and, as a result, to emergence of a set of variative training ways.

Development of the adaptive training technologies based on the synergetics principles, and used to improve professional training of students in terms of management optimization of their training was carried out based on the adaptation understanding as process of parameter and system structure changes, and also control actions on the basis of the current information to achieve the system optimum state in case of initial uncertainty and changing operating conditions (Barakhsanova et al., 2010; Vlasova, 2001.). Such adaptation understanding enabled to make studies into quality changes of students' parameters that characterize a level of their professional training, structure of acquired knowledges and abilities from a line item of purposeful and organized corrective educational actions.

The studies showed that the synergy principles of training allow providing a non-standard approach to cooperation procedures of the educational process parties and to choose content, forms and training methods that are connected with this cooperation. The specified approach, on the one hand, shall provide completeness and high quality of cross-disciplinary knowledge in the e-learning, and with another – professional formation of a future specialist – the e-learning organizer. For this purpose, content, methods, forms, and teaching techniques to e-learning shall: first, make active, making for a main objective – to forming of professionally competent, intellectual specialist who is capable to self-organization, self-determination and adaptation taking into account tendencies of information society developing and its practical requirements; secondly, adapt taking into account students professional orientation. These provisions were used as fundamental when adaptive training technologies developing. When adaptation is oriented to professional training of future specialists, training is used for information gaining on a training level and characteristics of a student. It is necessary to organize a certain type of cooperation based on the optimal control under uncertainty that is incomplete apriori information on the student capability to perform the types of activity characteristic of his future activities in e-learning terms. In terms of the adaptive management theory in this case bespeaks an efficiency criterion. Possibility of this approach can be proved by the fact when initial uncertainty (an insufficient level of the professional oriented knowledge, abilities, skills) the only reasonable way is or in its elimination by means of training or self-training in management process; or in use of accumulated current information to find the most effective impact, and, therefore, organization of a special cooperation type. Because of insufficient apriori information to optimize the set indicator, representatives of the Russian school of adaptive management systems consider that accumulating and immediate usage of the current information to eliminate uncertainty is the main distinctive feature of adaptation.

From the existing adaptation algorithms, when training technologies developing it is reasonable to use multistep algorithms of adaptation and to consider them as a special method of the cooperation organization of the educational process subjects. To reduce number of iterations it is offered to use the synergy principles of information choosing to form nonlinear training management methods. In particular, this provision will be approved with synergy approach to systems developing which is that the development provides stability at higher level through instability. This management result optimality

should be estimated using quality indicators. In relation to students training this is qualities, significant for their future professional activity. Main focus should be concentrated on these qualities forming and active technologies with required adaptation should be used for this purpose. Principles that are approved with synergetics are offered to be at the heart of adaptive training technologies. These are inter-disciplinarity, nonlinearity, self-organization, openness. It is caused by the fact that selection and structuring are carried out from general-methodological line items where the most reasonable results can be received using nonlinear control mechanisms. These synergic mechanisms better reflect the essence of the process and make necessary the choice of professionally significant qualities as key control parameters in case of professional training of future specialists and their list when designing different types and forms of cooperation. Also a model of a teacher's adapting activities that forms a complex of resonant control actions on a student of a higher education institution in his training is important. The task is in finding these control mechanisms and means that can realize them. As synergy conception of training is offered control action should be estimated not from energy line items but from line items of its structural topological organization.

Designing of such educational resonant impacts that transfer a student to a new high-quality level of the structural organization of professional knowledge is one of the main objectives of the modern training process. The system organization process is the controlled process. System organization can be increased both due to self-organization processes and due to external control actions. Study of cooperation of these two directions in process and professional formation of future specialists in e-learning requires researching. For this purpose, the student of a modern higher education institution is considered as the developing system that is capable to self-organization. Self-organization is shown in the self-approved system functioning (in our case it is a student as subject of training) due to its internal communications with the external environment. The external environment (society) develops itself and can be characterized by such categories as dynamism, interdisciplinarity, computerisation, high technologies in recent times. Changes that happen in society in general are naturally projected on an educational system and on activities of its main subjects – a teacher and a student. The higher school task is in training of a specialist who is professionally responsive, capable to adapt to changes of the external environment; who is capability to purposeful search, decision making and self-organization. When researching process of future specialist self-organization, you should assume that the structure of his professional knowledge and types of activity are closely interconnected in this developing system. It is expressed in executing set types of activities in external environment changed. And in order that change of this structure led the system to a steady condition, we should consider external collection actions and organize them by means of content, methods, forms and teaching means. All complex of these control actions shall constitute a basis of active training, the active training environment where a student studies. The importance of the environment amplifies when we use the electronic information educational environment that is necessary to implement e-learning and we train specialists of education to work in this environment because much more complex organizational structure, than in case of traditional training is required.



Conceptual basis of adaptive training technologies is adaptive cooperation of subjects of the educational process focused on cooperative implementation of synergetics including openness, nonlinearity, self-organization, and also accounting of personal educational professional education of students and public needs. Substantial part of the adaptive training technologies is characterized: implementation of unity of education content and the adaptive training technologies; adaptation of training goals to modern society needs and personal orientation of students; knowledge-intensive and profession-oriented content of training materials; implementation of inter-disciplinarity and integrity in training; transferability of the adaptive training technologies, that means they may be applied in other same educational institutions and by other teachers.

Procedural part of the adaptive training technologies is characterized: interdependent multiple and adaptive activities of a teacher and a student where they are respectively as a producer and a recipient of educational information; implementation of dialogic conception of training; open and active information exchange between students and various sources of information; set of the methods, means and forms of education focused on activation of student self-organization mechanisms; use teaching methods that are directed to reduce dynamic adaptation of the student to future professional activity.

Generalizing the stated theoretical material we will formulate provisions that determine conditions under which we may obtain effective results of the adaptive training technologies using in the educational process of teacher professional training in case of simultaneous cost optimality and warranty of achievement of the education standard. This is:

- content of training is characterized by science intensity;
- a teacher includes educational tasks in a context of professional problems;
- training management assumes forming of the complex of resonant control actions on a student taking into account his need and motivational sphere;
- students aim at self-developing educational activities;
- variety of methods and forms of education that correspond to content and logic of the educational process is used;
- innovative information technologies are used;
- methods of updating knowledge and types of activity in the context of solvable tasks are used.

Complex of the dedicated conditions serves as a prerequisite to achieve planned results of training, that is, intense training of a future specialist. As indicators of effectiveness of the training adaptive technologies using in case of professional training of students to use e-learning it is offered to apply such indicators as development of the ability to form new knowledge in the conditions of the electronic information educational environment, to reflection, to multiple solution of educational tasks applying e-learning technologies, to develop of the professional activity and ability to cooperate with the electronic professional environment. The formation of the listed qualities shall differ in complexity at students. Within the educational process indicators can be fixed thanks to monitoring.

The provided description of adaptive training technologies shows multidimensionality and constructive complexity of the offered pedagogical innovation, and also its originality that is caused by the fact that one of its

conceptual basis is cooperative use of such ideas of synergetics as openness, nonlinearity and self-organization.

The long authors experience (Vlasova, 2001; Mikhaylova et al., 2015) in e-learning using during work with students confirmed noted provisions and enabled to mark out the most significant results for the innovative educational process. Both teachers and students state that the e-learning is a perspective view of training that provides quick access to resources and educational services, exchange with them and joint productive activity of participants of educational process. It allows increasing efficiency and to save learning time; focuses teachers and researchers to implementation of innovative methods, technologies, instruments of development and e-Learning-decisions applying. It promotes individualization of learning, opportunity of online content updating, release of learning time due to lecture hours reducing. It is especially actual in conditions of the Federal State Educational Standards of new generation that orient teachers to reduce in-class work, to increase and expand forms of students' individual work for which organization the e-learning opens principally new opportunities.

Under the undertaken study the e-learning system that makes possible to manage in general the training process, to exercise adaptive process control of new knowledge acquisition by students, and also to manage by mobile creation of the actual educational content (modified, adaptive, social and interactive) is developed.

The system includes a repository of actual training materials and metadata connecting them. Work with it assumes application of techniques of the active electronic tools of collective communication using that provides interactivity and activity in material studying that were created by teachers. The system is a component of the interactive electronic information educational environment of the department created using cloudy computing. During operation with students, teachers make active use of a wide range of e-learning technologies and instruments; synchronous and asynchronous methods of e-learning communications; collaborative technologies; actual and constantly updated educational content that is stored in the repository. Repository data are used to form training courses that are adapted under needs of students and to organize their individual trajectories of new knowledge receiving. Content, structure and organization of the courses such is that provides control over attention, dialoguing with subjects of the educational process on the basis of the intellectual concept of dialogue, organization of dynamic feedback with students at the expense of the issue system. Teachers pay special attention to e-learning models designing for the purpose of their further using for adaptive training of students according to modules and disciplines of the educational program.

We consider the e-learning as learning in the electronic information educational environment. It means that all possible options of pedagogical interaction under the training process are performed or can be performed by means of the environment components. In this regard it is logical to consider that any model of the e-learning is determined by preferential methods and technologies of interaction in the environment and represents result of information pedagogical designing in specific conditions. In other words, there is no the predetermined finite set of models, there is only one set of initial components that are recombined and adapted taking into account needs of



students. Monitoring is performed to determine importance of factors affecting the choice or models designing.

The monitoring of undergraduates (more than 50 people) that study using the e-learning showed that it is valuable to them as the modern innovative instrument of learning, increase in their personal and professional efficiency. Students emphasize that it is focused on their self-development and self-improvement. A student and teacher's active operation with him is in the heart of this type of learning and it is first of all advantage of it. Over the years the experiment having the purpose to find out how the master's program "Corporate E-learning" promotes innovative training of future teachers and how exactly was made.

Handling of its results was carried out using of a method of principal components. Contribution nature of principal components in general dispersion was analyzed; and the most significant components influencing the researched process are allocated. It turned out that the first principle component gives the most essential contribution. It characterizes students' capability to form new knowledge (knowledge generation) and multiple solution of tasks on the basis of cross-disciplinary knowledge and ability to organize and manage the educational activities. The second principle component bespeaks an interaction capability in electronic professional community. The third principle component emphasizes students' capability to reflect their activities using the e-learning technologies, and the fourth one characterizes students' capability to design their professional activity in the conditions of the e-learning. Results received by mathematical simulation point up significant professional qualities that are urgent for the modern teacher who works using the e-learning technologies. It is reasonable to use them for adaptive control action on students, teachers, other staff of the higher education system who have corporate training in the field of the e-learning for the purpose of innovative development of himself and the educational institution.

## Conclusion

Training of specialists for operation in the modern information world assumes formation and development of their capabilities for nonlinear (multiple, alternative) mentality, directed search, non-standard decision-making, constant self-improvement and self-organization. It is reasonable to base the mechanism of practical implementation of these tasks on the adaptive interaction of subjects of the educational process and synergetics which are the key ideas of the adaptive teaching technology.

The research resulted in a conclusion about the advisability to develop the adaptive teaching technologies that are considered among social technologies and can be applied for active and intense training of teachers to work in the conditions of the e-learning.

Their importance for the teacher's professional training is determined by the fact that the period of a person's professional development in the higher education institution is characterised by the beginning of his/her professional adaptation, development of professional direction and active formation of professional suitability, which demands the learners to constantly adapt to the specifics of future profession through the specifics of higher education institution and the educational environment created in it including the electronic information educational environment. Adaptive training technologies are

considered as a reasonable external pedagogical impact that transfers the students to the qualitatively new level of the structural organization of their professional knowledge, in particular in the e-learning. The system organization process (including a student) is a controlled process. In addition to external control actions the orderliness of the system can be increased also by means of self-organization processes. Study of the interaction of these two directions in the course of development and professional formation of future teachers was a basis of the work which further progress can be connected with elaboration of adaptive e-learning technologies for the representatives of different age groups and individuals with disabilities.

### Disclosure statement

No potential conflict of interest was reported by the authors.

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### References

- Akaslan, D., & Law, E.L.-C. (2011). Measuring teachers' readiness for e-learning in higher education institutions associated with the subject of electricity in Turkey. *Proceedings of 2011 IEEE Global Engineering Education Conference (EDUCON)*. IEEE. <http://dx.doi.org/10.1109/EDUCON.2011.5773180>
- Barakhsanova, E.A., Mordovskaya, A.V., Panina, S.V. (2010). Scientific and methodical maintenance of students and graduate students researches by means of case technology implementation: monograph. Moscow: MSRU Press.166 p.
- Clark, R.C., & Mayer R.E. (2016). *E-learning and the science of instruction: Proven guidelines for consumers and designers of multimedia learning*. John Wiley & Sons. 507 P. <http://dx.doi.org/10.1002/9781119239086>
- Kapitsa, S.P., Kurdyumov, S.P., Malinetsky, G.G. (1997). *Synergetics and future prognoses*. Moscow: Nauka. 285 p.
- Mikhaylova, E.I., Barakhsanova, E.A. Golikov, I.A., Nikolaeva, A.D., et al., (2015). The concept and technologies of life-long pedagogical education in modern higher education institution: monograph higher education institution. Yakutsk. 226 p.
- Min Ch., Chiang, F.K., Jiang, Ya N., Yu, Sh.Q. (2016). A context-adaptive teacher training model in a ubiquitous learning environment. *Interactive Learning Environments*: 1-14. <http://dx.doi.org/10.1080/10494820.2016.1143845>



- Schulz, R., Isabwe, G.,M., Reichert, F. (2014). Supporting teachers' needs within and through E-learning systems. Proceedings of 2014 International Conference on *Web and Open Access to Learning (ICWOAL)*. IEEE. <http://dx.doi.org/10.1109/ICWOAL.2014.7009228>
- Skoulikari, A.I., Tsakalidis, A., Tsohis, D. (2015). Personalized and adaptive mobile e-learning for cultural education. Proceedings of 2015 6th International Conference on. "*Information, Intelligence, Systems and Applications (IISA)*", IEEE. <http://dx.doi.org/10.1109/IISA.2015.7387968>
- Vlasova, E., Gossoudarev, I., Aksytin, P. (2014). E-learning is the next stage of the innovative development of a university.- *Innovative Information Technologies*. 1, 276-278. <http://elibrary.ru/item.asp?id=22297207>
- Vlasova, E.Z. (2001). Adaptive technologies as means of control optimization of students educational activities news of the Baltic State Academy of Fishery Fleet: Psychological and Pedagogical Sciences. 4, 6-15. <http://bgarf.ru/science/journal-izvestia/18-2011/upravlenie-i-menedzhment-kachestva-v-obrazovanii.pdf>