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Abstract. The article is devoted to the organization of the educational process of specialists' training by means of the adaptive teaching technologies. We have described the philosophy of instability that underlies such technologies: from chaos to self-organization. By showcasing the concepts of adaptation and adaptability, we define the content and stages of adaptive technology. The article presents the results of monitoring the trends of respondents' awareness of the technologies of using the Bloom's taxonomy in professional activities, which are necessary for the formation of the educational program of specialists' training. Considering that the Bloom's taxonomy strengthens the learning processes of applicants.

1. Research problem.

Educational technologization and digitalization as the main characteristics of modern education, leading to the adoption of an adaptive approach in the educational process' organization. This is due to the fact that, under conditions of instability and uncertainty, non-standard challenges are emerging which determine the emergence of a leading operational skills. These are competences such as life-long learning, critical thinking, setting goals and achieving them, teamwork, communication in a multicultural environment, etc. These can be developed through the usage of the adaptive technologies to train future specialists in general and teaching engineers in particular through the usage of computer equipment. Adaptive technologies activate adaptive processes to achieve a primary objective when conditions, circumstances, situations change [1]. Currently, these technologies are considered to be successful in management.

The aim of the research is to describe the characteristics of adaptive technologies for the preparation of specialists, based on the system of quality assurance of educational services provided by the higher educational institution, and to facilitate the implementation of educational programs.

In writing the article, theoretical methods of analysis, synthesis, classification and systematization were used to define and generalize the results of scientific research and to formulate the essence of the basic definitions of research. Quasimetrical Modeling and Microsoft Excel Spreadsheet Editor were used to assess the development of professional competence of future specialists [4].

2. Approach

Looking at the different perspectives on the management that correspond to the stages of its evolution, one can conclude that there are three basic paradigms of the management. The first points out that the head of the organization (educational institution) CANNOT enjoy the realization of the «target process» neither by his own activity nor through the voluntary organization of the activities of others. The head therefore uses the force of power through the enforcement of the process by others. At the same time, power hangs over him and his subordinates (retrospective view). The second paradigm, based on the fact that the leader himself does not participate in the realization of the «target process», but organizes the activity of others on its realization. Participation, qualifications, efficiency and other qualities of subordinates are decisive and fundamental (modern view of the organization of cooperation, elements of project activities). The third paradigm indicates that the leader realizes the «target process" by his own activity. The participation of others is not principled and determinant (perspective). At the same time, we believe that, in the context of decentralized management, a constructive view is relevant, which stands between the second and third paradigms and uses the technology of a project-based approach to the organization of activities. This paradigm emphasizes the priority of organizing joint activities between the head and the employees. By creating so-called project teams, which are rotational and have to perform certain tasks, the common goal is achieved. The driving force behind the development of such a management system is the balance of interests of all its participants and sub-structures. This approach takes into account the environmental self-organization of the entity and its object. At the same time, the targeted functions of the management structures and objects are combined through dialogue adaptation processes, which are implemented as a result of the regulation (interlocking) of these functions during marketing and monitoring.

The methodological basis of such a management structure in general and the adaptive technology for the training of specialists is the philosophy of instability, which unites two opposite sides of existence: the logos (order) and the chaos where the logos emerge from chaos. This arbitrary emergence of an ordered structure from chaos (self-organization) is common to all phenomena of existence. Steel structures can disintegrate into chaos, from which more highly organized steel structures can again emerge. In nature, progress always exceeds regression. The processes of self-organization and self-development are carried out through the interaction of two opposing forces: the one that forms and the other that destroys. As the processes of self-development continue, it is necessary to be able to determine in time when the underlying force is going beyond its limits and becoming destructive, and ensure that appropriate adjustments are made in the direction of development of the facility. We believe that randomness, instability and fragility from a synergistic perspective are seen as important factors of development. The task of development, directed from the outside, with synergistic views, is shifting into the problem of self-development. It is the synergistic construction of adaptive technologies for the training of professionals that ensures successful learning materials and the development of both integrative competences and common and specialized competencies. We emphasize that adaptive technologies are based on a philosophy that development under conditions of instability cannot be guided by the regularities of deterministic theory explaining linear processes. The conditions of instability create a multi-factor and disparate influence, and therefore the processes occurring in these conditions are non-linear and can be explained on the basis of chaos theory (or the philosophy of instability). In connection with this, we emphasize that the timely acquisition of new competencies by the applicant takes place certain non-linear processes that can lead to chaos. The driver of making the chaos into order is the teacher. Using adaptive technologies, the teacher, in order to achieve the goal of learning, helps the learner to become aware of his or her abilities, to feel his or her dignity, to gain the recognition of others, further develop their abilities in the interactive process of interaction in the execution of training tasks or in the creation and implementation of certain projects. Adaptive technologies are based on the essence of adaptation and adaptability [3]. Under adaptation in education (from. Lat. Adaptatio - adaptation, from adaptare - adaptation) we get the process and the result of the applicant acquiring certain changes and acquiring skills for successfully adapting to the educational process in order to better understanding the education content [2]. And by adaptability, we mean an

individual's ability to adapt to external requirements (in particular, to the conditions or standards of the educational process). It may be noted, however, that the use of adaptive training technologies is led by three factors: the philosophical basis (we note the theory of synergy), the method for determining the common goal and personal objectives of the joint activities of teachers and educational applicants and their transformation (adaptation and adaptability) and the determination of mechanisms for monitoring the learning status of educational material (marketing and monitoring support). Besides, considering the essence of adaptive technologies for the specialists' training it is necessary to pay attention to the disclosure of concepts such as technology, such as Greek origin words, in the original translation means "knowledge of mastery". Although skill is intuitive, it is based on the regularities of scientific knowledge and takes into account certain laws of events and tasks. This knowledge is systemic and provides a sense of continuity and sequencing to achieve the intended result. We see technological efficiency in education as defining the sequence of actions, defining conditions, optimum expenditure of resources of the institution, the time is ripe for teachers to be properly trained to use modern teaching tools and to succeed in the educational process. That is, technology in education is defined as a step-by-step activity with appropriate management effects, which is presented in the form of the collection, processing, analysis of information and certain corrective actions for the educational achievement of applicants [2;4].

Thus, by revealing the essence of the concepts of adaptation and adaptability, technology, we define the content of the technology of adaptive management of training of specialists. Specifically: these are technologies that are based on process and mutual influence, which causes mutual adaptation of the participants' behaviour in the educational process to dia(poli)logical framework, which is provided by a common definition of a realistic objective followed by a combination of efforts and self-direction to achieve it. The leading signs of such technology are the mutual adaptation and organic combination of the teacher's and the applicant's goal and the making it through flexible models of activity, to succeed in acquiring integral competence [2]. The technology consists of the following steps:

- On the basis of an analysis of educational standards and the requirements of the labour market and the market of educational services, the development of educational programs for the training of specialists;
- Study of the external influences on the functioning of the educational institution in general and the educational process in particular;
- Investigation of the internal influences (resources) of the educational institution;
- Continuous research and analysis of the educational services market and the labour market with a view to adapting educational programs to modern requirements;
- Definition of the real purpose of the training according to the resulting three forces of influence on the person (I should, I want, I can) within the agreed requirements of the person, society, the state and the real circumstances of the educational process;
- Quality assurance of educational services (implementation of the educational program) through factor and criterion modelling (creation of a standard of activity and learning outcomes);
- Self-monitoring and external outcome monitoring of the process;
- Reflexion and forward-looking self-regulation.

It is these stages that make it possible to present the procedural characteristics of the adaptive technology for the training of specialists and the step-by-step achievement of the educational activity of the institution.

This approach to the organization of the educational process justifies the need to create conditions for ensuring the quality of the educational services provided by the institution through the development of the participants' potential in the educational process; the study, formation, meeting their educational needs and the customers of the services provided by the institution. It is the construction of a flexible system for the creation of relevant products of higher educational institutions and a system for monitoring the quality of educational services that will contribute to the formation of integral competence of the educational applicants. Let's emphasize that under.

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of the potential of the participants in the educational process; the study, formation, meeting their educational needs and the customers of the services provided by the institution. Building a flexible system for the creation of relevant products of the higher educational institution and a quality monitoring system of the provision of educational services. By the quality of the educational services provided by the higher educational institution for the training of future specialists, i.e. teaching engineers, we understand the extent to which the results of the educational process are in conformity with the orders of the State (compliance with the standard), and with the needs of society (regional educational needs) and individual needs. Educational institutions provide a range of educational services that meet the needs of consumers to change their educational level or vocational training and are resourced by the institution. This package of services is referred to as the educational programme, which is also the product of education. The content of the educational programme is the only educational components' set (subjects of study, disciplines, individual tasks, control measures, etc.) planned and organized to achieve certain learning outcomes (Law of Ukraine «On education») [5]. Its formation is based on certain educational needs and orders.

3. Outcomes

An educational program (as a package of educational services) is developed by an educational institution in order to meet the needs of a certain target audience for education, vocational training, training or retraining, further training etc. The effect of such an educational program is to achieve some social effect: a changes in a person's educational or professional level. It is with this educational product that the educational institution comes to the market. Some research has been carried out in the creation of an educational program for the training of the specialists. Its purpose was to determine the professional competence of teachers in the process of providing educational services for the training of specialists. In particular, a survey was conducted on the teachers' knowledge of the planning, projecting, and simulation of the educational process based on the Bloom's educational objectives' taxonomy of. More than 70 respondents from different regions of Ukraine took part in the research. Four questions were posed that determine the respondent's level of awareness of the nature of the Bloom's taxonomy goals and the status of its usage in the educational modelling. For example, it was necessary to choose a level: remembering, understanding, applying, analizing, creating, evaluating, on which verbs are used in problem formulation "remember", "repeat", "list up", "name". Distribution of respondents: 55.7% remembering; 17.1% understanding; 14.3% applying (https://forms.gle/kJsfBxWknZdNdRNF8). In the analysis of the obtained results was identified the need to include the module that are specifically concerned with the formulation of the objectives of the educational process and how to achieve them during the design of the educational process in the curriculum of the training of the specialists (see Figure 1, Table 1).
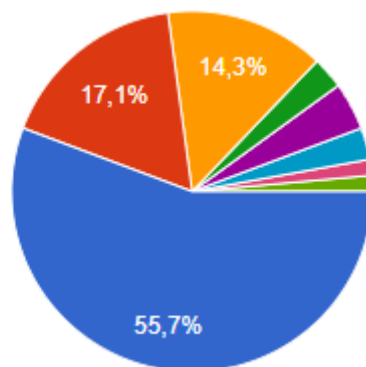

Figure 1 Respondents' replies
(55,7% - knowledge/remembering; 17,1% - understanding; 14,3% - applying).

Table 1. Trends in respondents' awareness of technologies for the usage of Bloom's taxonomy in professional activities (4 questions).

Before the learning of the usage of the Bloom's taxonomy (in unit shares)	After the learning of the usage of the Bloom's taxonomy (in unit shares)
0,8	1
0,45	0,89
0,55	1
0,87	0,96

To harmonize the objectives of teaching and learning, in other words, in order to ensure the quality of the educational services provided by the educational institution, we have chosen to measure the level of respondents' awareness of the technologies used by the Bloom's taxonomy in their professional activities. This is due to the fact that the formulation of the general purpose, as one of the stages of the adaptive technology for the training of specialists, takes into account the logic of the learning and the teaching material and is based on "Management lattice" as suggested by Robert Blake and Jane Muton, Houston University researchers in the United States. The lattice is based on two extremes of the manager's behavior. The first is the prioritization of the organization's tasks. The second is to give priority to the needs of the actors. The vertical axis ranks the care of the person from 1 to 9 (10 - do not care about the organization, which cannot be). The horizontal axis ranks the concerns of the organization from 1 to 9 (10 does not care at all for the person, which also should not be). We will not consider all types, they are well described in the well-known research of Mescon H., Albert M., Khedouri F. "Management". Note that there are five main behaviors that are the basis for classifying the types of managers. But, the best management result is at the position 9.9. when a team is formed that provides group control. In this position there is a «perfect manager», who is equally well-cared for people and the interests of the organization. This results is directing their activities towards the achievement of the organization's purpose, taking personal responsibility. This approach that we place in the foundation of adaptive training technology and propose, through the development of the idea, to examine the relationship between management and self-management in order to enhance the motivational aspect of learning. It should be emphasized that the process of target-setting is fundamental to learning [6]. The goal can be ideal, that is, the one that is in our imagination and that we dream to achieve, and real - the one that we can achieve in specific conditions. Using the above-mentioned approach, it is possible to create study teams for both educational tasks and translation of these tasks into project activities. This will help to define the real purpose of the training activities and ensure the quality of the educational services [7].

Consider the use of factor and criterion (qualimetric) modelling to assess the state of provision of educational services and the level of training of professionals. We note that for this process to be effective, it is necessary to develop factor and criterion (qualimetric) models of the activities of educational subjects), which must be periodically changed) the evaluation apparatus, which includes the specified development parameters of the controlled object, criteria for assessing these parameters and the way in which they are measured (statistical, expert, etc.); a monitoring technology that integrates external assessment and self-assessment processes with ongoing external adjustment (outcome) and self-correction (outcome process).

To create a qualimetric model, first- and second-order parameters, factors and criteria are selected. The parameters correspond to the global objectives of the facility. Factors reveal each global goal. First-order criteria detail each factor at the level of the region's challenges. The second-order criteria are at the level of localized tasks (tasks of a particular institution, teacher, students, etc.). Thus, the activity model is based on the target tree. The basis for the creation of variation models can be the system of information support for the management of the educational process in general and the educational activities of the applicants in particular. In order to establish objective results of activities, each parameter, factor, first-order criterion is given a significance, which reflects the priorities of the team

activity. The mechanism for constructing such models is developed on the basis of qualimetric principles. An example of this is the structure of a qualimetric model for assessing the educational performance of applicants. Thus, the model consists of six parameters: motivation, purpose, training, control, self-control, correction, self-correction, evaluation, self-evaluation. Each of these parameters is explained by factors, which in turn are disclosed by the criteria. All of 18 factors and 37 criteria have been identified. We emphasize that in the creation of a qualimetric model of educational activity of applicants it is necessary to determine the significance of parameters, factors and criteria. This is done by the expert estimation. Each criterion is based on an appropriate document - a requirement that establishes what the applicant's integral competence component should correspond to. We stress that a qualimetric approach is used to measure the status of educational activities and the level of the educational services provision, which ensures the quantitative assessment of the quality of the activities of the subjects of the educational process in general and the state of the educational services of the educational institution in particular (the state of implementation of the educational program).

In a mathematical form the qualitative and quantitative qualimetric model provides for a description of the real state of the educational program, and using Microsoft Excel editor to assess the development of the professional competence of future educational engineers, it is possible to track the dynamics of the formation of both integral competence of specialists and the formation of general and specialized skills, which are defined in the curriculum (https://goo.su/2Heh). It is also possible to predict the further development of both the professional development of future specialists and the educational institution.

4. Conclusions

Thus, we have considered the essential characteristics of adaptive technologies for training of the educational engineers. Philosophical approaches are disclosed and the essence and stages of adaptive technology for the training of specialists are indicated. The use of certain research on educational needs and needs for the development of educational services at a higher educational institution has been substantiated; that will facilitate the provision of quality educational services the necessity of using the Bloom's taxonomy to harmonize the learning goals based on the «management lattice» of Blake and Muton. We have also noted the results of a research and analysed its results, which are the basis for the development of an appropriate curriculum for the training of educational engineers. It should be emphasized that the educational program is based on the principle of adaptability, which will contribute to the development of professional competence by organizing and reflecting the results of self-monitoring and self-evaluation.

References

[1] Yelnikova G, Borova T, Ryabova Z et al 2017 *Adaptive management: intersectoral links, scientific and applied aspect: Monograph*

[2] Yelnikova G 2002 *Basics of adaptive management* (M.: TSIPPO NAES Ukraine)

[3] Taras Lendyuk, Oksana Bodnar, Sergey Rippa and Anatoliy Sachenko 2018 Ontology application in context of mastering the knowledge for students *In: IEEE 13th international scientific and technical conference on computer sciences and information technologies (CSIT)* vol **2**

[4] Bondarenko T, Kupriyanov O 2018 Implementation of Mobile Testing System for Control of Students' Educational Outcomes ed Auer M, Guralnick D, Simonics I *Teaching and Learning in a Digital World ICL 2017 Advances in Intelligent Systems and Computing* vol **715** (Springer, Cham) pp 760-765 https://doi.org/10.1007%2F978-3-319-73210-7_88

[5] Law of Ukraine «On Education» https://zakon.rada.gov.ua/laws/show/2145-19

[6] Nemchenko S 2014 Creating a reflexive environment of master course as a condition of effective training of a future head of an educational institution *French Journal of Scientific and Educational Research* **2** (12) pp 436-442

[7] Ryabova Z, Ermolenko A, Mahinya T et al 2017 Project management for the innovative development of educational institutions in Ukraine: study manual for the training of masters (M.: NAES of Ukraine, SHEI «University of education management», Kultur Kontakt Austria)