

## QUALITY MANAGEMENT OF THE DEVELOPMENT PROCESS OF ADAPTIVE EDUCATIONAL SYSTEMS

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### ABSTRACT

This article analyzes the problems of the system taking responsibility for guiding the student in the learning process and assessing the quality of the adaptation mechanism, summarizing the information on the tactics and strategy of learning in the adaptive education system.

**Keywords:** TO-BE model, interface, cognitive, adaptive education.

### INTRODUCTION

Today, in the field of development of electronic learning systems, there is a tendency to personalize the learning process. These systems are adaptive, where the training course is formed individually for each user. In an adaptive learning system, the tactics and strategy of learning are determined by the system itself. Summarizing this information, we can say that the system takes responsibility for guiding the student in the learning process. It follows that the problem of assessing the quality of the adaptive mechanism is relevant.

As a result of the quality assessment, the developer receives the information necessary to repeat the system development cycle.

The two most common life cycle models used in the design of automated systems today are cascade and spiral.

1) Analysis of the AS-IS model of the adaptive systems design process based on the cascade model shows that, along with its obvious advantages, the cascade model corresponds to such a rigid scheme, which has a number of disadvantages associated with the fact that the actual process of creating software is never fully implemented. Also, when using the waterfall model to assess system quality, the so-called "holistic" approach is used. In this approach, the process of assessing system quality is carried out by determining the values of common quality criteria, such as performance, security, user feedback analysis, statistical analysis of work results, based on the verification or certification of the system and its compliance with standards. The information provided is often insufficient to improve the system.

2) The spiral life cycle model focuses on the initial stages: analysis and design, evaluation of the developed system, and quality control are especially important. Incomplete work at each stage leads to the fact that system defects can be identified at any level. Using a "holistic" approach to assessing the quality of a system is of little help in developing a system based on the spiral life cycle model, therefore, an approach is needed that allows assessing the quality of individual components of the system at its development stage and identifying defects at the conceptual level. This is of great importance in the development of flexible educational systems.

The effectiveness of training is determined by many factors, such as the interface, information content, and how the training course is adapted to the learner.

Researchers P.N. Vorobkalov and O.A. Shabalina are also studying this issue, in particular, in their work “Quality management of the process of developing adaptive educational systems using a multi-layered approach” they propose a multi-layered approach, which is also aimed at assessing the quality of adaptive educational systems. The essence of this approach, described by scientists, is as follows: in a multi-layered approach, the adaptation process is divided into several stages or layers, which are considered separately. As a result of analyzing the multi-layered approach, the researchers identified the following advantages: methods based on this approach provide information about the functioning of individual components of the system. The approach can be used at the initial stages of system development. The researchers highlight the following as disadvantages of the multi-layered approach: the requirement for knowledge of the internal structure of the system, the calculations obtained are usually useful only for developers.

Applying this approach requires defining a set of layers for evaluation and formulating quality assessment criteria for each layer. To define the set of layers, an analysis was conducted and a TO-BE model of the adaptive education system design process was constructed. As a result, the following set of layers was identified: “Interface” layer, “Building adaptation models” layer, “Structure of educational materials and subject area”, “Adaptation decision-making” layer, and a set of quality assessment criteria was formulated for each layer.

According to researchers, the quality of the interface of adaptive educational systems can be assessed based on expert opinions and/or using the results of user work in the system.

There are projects that combine the knowledge of specialists in the field of interface construction and formulate guidelines for building a practical interface. The ease of use of the interface is a complex characteristic that implies the ease of use and learning, and the overall attractiveness of the interface.

In the “interface” layer, it is proposed to express the knowledge accumulated in the field of building a practical interface in the form of rules to quantitatively assess the quality of the system. Then, it is necessary to find the level of confidence in the development of the rule to assess the quality. The higher the level of confidence in the conclusions of the rule, the higher the quality of the system interface.

At the stage of developing an adaptive educational system, scientists propose an adequacy criterion for assessing the learner model, in which the adequacy of the learner model is understood as the degree of correspondence between the information about it in the model and its real characteristics, which plays an important role in learning. The adequacy of the learner model is determined both by the set of features it takes into account and by the method of determining these features.

The sensitivity property of the learner model can be used to analyze the degree of influence of learner behavior on changes in the properties of the model. Correctly separating users by behavior increases the adequacy of adaptation models.

The quality of the “structure of educational materials and subject area” layer is determined by the following factors: the correspondence of the hyperspace structure to the structure of the subject area, the completeness of the content of educational materials and the integrity of all links (absence of “empty” links). System assessment based on the first two factors is difficult

to automate and should be carried out by specialists. The integrity of the connections can be assessed using software after the system is implemented.

Assessment by the learning system at the “Adaptation decision” level is carried out at the final stage of system development. Usually it is based on data on the process of system operation obtained during testing by user groups. The existing criteria for a comprehensive assessment of adaptive solutions are insufficient. Despite the variety of interaction tactics between an adaptive educational system and the user, a situation may arise during the operation of the system when most tactics are not used at all or are used very rarely.

The next layer, “Building adaptation models,” is crucial in adaptive learning systems. Modern approaches to developing adaptive learning systems are based on the use of the following models: a subject area model, a learner model, and an adaptation model. Various criteria are used to assess the quality of adaptation models: the proportion of correctly classified users; the deviation of the values of user characteristics in the learner model from those determined by the expert; the accuracy of determining learning objectives<sup>1</sup>.

The psychological foundations of the development of an adaptive automated learning system are of great importance in the development of an adaptive automated learning system.

O.A.Artemenko, K.A.Amelicheva attribute the following components to the technological foundations of the development of an adaptive automated learning system:

- 1) a subsystem for presenting information with search functions, i.e. containing theoretical material;
- 2) a subsystem of training and test tasks - the main component of the automated learning system;
- 3) a control subsystem, i.e. a set of teacher tools that allows you to create various types of training and test tasks, including components of the information presentation subsystem;
- 4) an adaptation subsystem, which includes a set of algorithms that provide for the creation of an individual learning trajectory based on the analysis of the interrelationship of the individual characteristics of users and the student model contained in the system database;
- 5) communication subsystem (within the study group, as well as with the teacher);
- 6) registration subsystem - creates an account for each user. The account takes into account the implementation of the individual study plan and the group study plan<sup>2</sup>.

These researchers also emphasize that when designing an automated learning system, it is necessary to take into account the principles of behaviorism, which is necessary for the assimilation of theoretical material, cognitive, which is designed for the practical application of educational material, and the principles of constructivism. which is necessary for the practical application of educational material, is also important. The combination of these principles, according to scientists, ensures maximum learning efficiency<sup>3</sup>.

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<sup>1</sup> Воробкалов П.Н., Шабалина О.А. Управление качеством процесса разработки адаптивных обучающих систем с использованием многослойного подхода // Известия Вологодского государственного технического университета. – 2007. – № 2. – С. 76 – 78.

<sup>2</sup> Артеменко О.А., Амеличева К.А. Психологические основы разработки адаптивной автоматизированной обучающей системы // Высшее образование сегодня. – 2013. – № 10. – С. 47.

<sup>3</sup> Артеменко О.А., Амеличева К.А. Психологические основы разработки адаптивной автоматизированной обучающей системы // Высшее образование сегодня. – 2013. – № 10. – С. 47.

It should be noted that the individual learning trajectory created by the automated training system based on Skinner's linear algorithm, despite its complex adaptive nature, and its components are replaced depending on the individual characteristics of the individual. Each variant of constructing a linear algorithm from a limited set of tasks included in the database of the automated training system is implemented on the basis of the system's internal software algorithms.

The features of the linear algorithm in accordance with the principles of behaviorism include:

- 1) the presence of specific goals that are the criterion for completing a session of work with the system;
- 2) the presence of tools that allow assessing the achievement of set goals, i.e. a complex system of test tasks;
- 3) the sequence of training materials, which should help increase the effectiveness of training;
- 4) the consolidation of the results of completing training and test tasks with a feedback system.

As for the cognitive principle of organizing education, this approach draws the attention of scientists and developers of educational resources to the individual characteristics of mental processes:

- perception;
- memorization;
- thinking;
- problem solving and decision-making.

In accordance with this approach, when developing the components of the educational system, it is important to take into account and use appropriate strategies that will allow students to most effectively perceive the educational material and store it in long-term memory.

These strategies include:

- 1) appropriate placement of information on the screen;
- 2) screen attributes, i.e. color scheme, graphics, text size, etc. Here it is important to take into account that you cannot overload the text with too many different colors. It should be noted that highlighting the most important information in red, green and yellow colors helps perception.
- 3) the ability to perceive information in all channels<sup>4</sup>. If the perception channel refers to the ability to perceive information primarily through one or another sense organ, then different methods of presenting educational information that allow for increased learning efficiency for students with different perception channels are needed.<sup>5</sup>
- 4) a set of hyperlinks for a step-by-step presentation of the educational material, which should be divided into small parts (from five to nine), a graphic representation of the logical structure of the theoretical material.
- 5) it is also important to orient complex educational materials, educational tasks, their types to the current level of acceleration of the target competence of the individual and replace them with simpler or, conversely, more complex options in this regard. the presence of alternative links or automatic redirection.

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<sup>4</sup> Артеменко О.А., Амеличева К.А. Психологические основы разработки адаптивной автоматизированной обучающей системы // Высшее образование сегодня. – 2013. – № 10. – С. 48.

<sup>5</sup> Ливер Б.Л. Методика индивидуализированного обучения иностранному языку с учетом влияния когнитивных стилей на процесс его усвоения: дис. ... канд. пед. наук / Гос. ин-т ру. яз. им. А.С. Пушкина. М., 2000. – С. 20.

6) an important strategy also includes the formation of connections between new material and information that is in the long-term memory of the individual during training with an adapted automated educational system. This strategy is determined by the placement of questions aimed at establishing such connections before starting to study new material, as well as a consistent and systematic comparison of the language being studied with a previously studied foreign or Russian language<sup>6</sup>.

When using a cognitive approach, educational resources should have appropriate mechanisms that simultaneously diagnose the characteristics of the user's cognitive and learning styles and, based on them, create an individual educational path that allows students to choose the learning path that suits them. However, the construction of individual educational trajectories should be aimed not only at the current level of development of cognitive processes, but also "... at complicating all forms of his mental experience, enriching the repertoire of stylistic behaviors ..."<sup>7</sup>.

In this regard, an important place in the design of adaptive automated learning systems is occupied by the following requirements:

- 1) independent regulation of the speed of information presentation in combination with saving time for completing the task in the user profile;
- 2) regulation of the volume and nature of feedback;
- 3) the presence of various types of training exercises, test tasks, which can be open and closed for identifying and correcting errors, which also implies searching for details, identifying the main points in the text, etc.;
- 4) orientation of this system to students with voluntary and involuntary attention, as well as high and low levels of learning efficiency, different levels of motivation: internal, which implies the diversity and quality of educational materials; external, aimed at implementing the plan, accounting for the implementation and the presence of negative reinforcement;
- 5) a combination of individual and collective forms of learning;
- 6) encouraging students to use their metacognitive abilities<sup>8</sup>.

Thus, the quality management of the process of developing an adaptive educational system is very important today, since modern education is moving towards personalization. These educational systems that lead to individualization are adaptive educational systems. The performance indicators of the educational process largely depend on the quality of their development. The method proposed by the authors (based on the use of a multi-layer approach) for assessing the quality of adaptive educational systems is, in our opinion, effective, since an analysis of existing criteria and new criteria was carried out for each layer. quality assessment was introduced for each layer. The use of this method allows you to increase the quality of the developed adaptive educational systems by identifying and correcting shortcomings at the conceptual level of development. It is also not uncommon for researchers to pay attention to the psychological characteristics of students when developing adaptive educational systems.

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<sup>6</sup> Артеменко О.А., Амеличева К.А. Психологические основы разработки адаптивной автоматизированной обучающей системы // Высшее образование сегодня. – 2013. – № 10. – С. 48.

<sup>7</sup> Холодная М.А. Когнитивные стили. О природе индивидуального ума. 2-е изд. СПб.: Питер, 2004. – С. 348.

<sup>8</sup> Артеменко О.А., Амеличева К.А. Психологические основы разработки адаптивной автоматизированной обучающей системы // Высшее образование сегодня. – 2013. – № 10. – С. 49.

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