

# Digital technologies as an adaptive learning tool in higher education

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**Abstract.** Education in the modern society is in need for new and more efficient pedagogical technologies. The development of individual qualities becomes the most important mission of education. However, graduates of educational institutions for the most part do not have sufficiently formed personal qualities. It is necessary to create due conditions for the development of individual personality traits, such as: adaptation to life situations, acquiring knowledge independently, the ability to apply it in practice; being able to think critically, to identify problems and select the necessary solution rationally and competently; working competently with information; sociability, being able to work in a team. The relevance of the issue under investigation in the conditions of digital education becomes an important tool for extensive access to adaptive learning at higher educational establishments. The trends in adaptive learning systems will make it possible to transform the educational system, helping students to learn more efficiently. In order to achieve this goal, the following tasks need to be addressed: to make analysis of scholarly pedagogical literature focused on the adaptive learning model; to select and analyse the material for the realisation of the adaptive learning model.

**Keywords:** digital technologies, adaptive learning, adaptive technologies, educational system, information systems

## 1. Introduction

The introduction and use of digital learning adaptive technologies encourages higher educational institutions to shift to a new qualitative level of educational work. The introduction of adaptive technologies is one of the current goals; the objective is to create the industry of innovative technologies and learning tools meeting the global scientific and technological level, digitalisation of all processes in the higher education system [1].

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The main rules for the organisation of learning include provision of interactive learning content to students, adaptation to individual traits in the learning process, use of electronic tools and services of wide practical relevance. Teaching methods and technologies are facing changes. The teaching staff's functions are transformed from traditional teaching, transfer and control of knowledge to creation and operation of electronic educational environment and its management using digital technologies, as well as active participation of students: self-education, professional development, participation in projects, etc. [2].

Thus, higher education institutions face new demands that aim to prepare the learners for adult life as responsible individuals capable to adapt themselves to living in the modern society. Therefore, one of the main objectives is the creation of due conditions for acquiring a level of education appropriate to the abilities, interests and capabilities of every graduate. In addition to the above-mentioned criteria, the teacher needs to spark interest in the taught subject and to keep to the principle of personalised learning and novelty. This is where adaptive learning technologies are useful.

The scholarly pedagogical literature [3-6] formulates the concept of "adaptive learning" as an aggregate of forms, methods, means, technologies and approaches to learning, which provides an alternative and flexible concept extending students' self-awareness.

Among the scholars revealing the essence of adaptive learning system, the works by Krechetov I.A., T.A. Ligai, V.V. Kruchinin, N.A. Zavalko, M.A. Samofalova, K.L. Polupan are worth mentioning. According to these researchers, the core of adaptive learning is represented by digital content of materials, assistive technologies, educational platforms where students can learn and obtain accessible support through adaptive learning materials.

In Kazakhstan, the adaptive learning problems were covered by the works of A.S. Savchenko, J.J. Omirbekov, E.S. Maulenov, V.A. Serbin and others who explore the main issues of adaptive learning in practical application and the problems connected with the development of learning systems.

The main didactic principles of adaptive learning in a modern information system are as follows:

- **learners' activities** – it should not only develop the ability to solve problems according to the assigned algorithm, but also to design problem algorithms;
- **independence** – the students develop the ability to navigate independently through new sections and topics, to think innovatively and find algorithms for new tasks;
- **individuality** – this provides for individualised ways of interaction between the learner and the teacher, which contributes to the formation of high intellectual development level;
- **systematisation** – this implies logical, sequential development of professional competences within each subject, a logical connection between different topics.

## 2. Materials and methods

In the conditions of digitalisation of education, adaptive learning in higher education is one of the promising technologies. Adaptive learning can be understood as a learning methodology that changes the pedagogical approach to teaching based on learner's input resources. It represents a possibility of individualised learning experience that meets the individual's unique needs through timely feedback, due pathways and digital learning resources.

The following areas of adaptive learning can be distinguished: theoretical framework for designing an adapted educational system realised through direct communication of the learner and the teacher; development of the structure and content of adapted educational systems and resources as elements of electronic information and educational environment. However, new educational opportunities offered by modern digital technologies, as well as

the development and synthesis of the existing approaches to adaptive learning have not yet been realised.

Zweig and Chechik (2017) argue that exchange of information between several teaching agents can accelerate adaptive learning [7]. This can be particularly useful if the learners work in a continually changing environment, because a learner can benefit from another learner's previous experience in order to adapt to some new environment.

Oxman S. and Wong W. [8] note that the adopted teaching plan for a discipline, along with the adapted learning content, not only provides due learning topics and texts presented in different forms, but also offers other options that can be of use for an individual student.

The international smart adaptive platforms include LoudCloud, Blackboard, Knewton, RealiseIT, Geekie, SmartSparrow and others.

The Knewton platform is not focused on training course design, but concentrates on adaptation of educational process to students' individual characteristics. This platform, after obtaining due information, assumes that students know the reasons of their mistakes in particular places, and highlights the topics that require the learner's special attention, prognosticates the probability of the learner's successful completion of assignments, gives recommendations for modifying a particular student's educational process towards more successful completion of the course in the future.

Knewton's algorithms are used by such major educational institutions as the universities of Arizona, Alabama, Nevada, Las Vegas. It should be noted that the University of Arizona has successfully explored and tested 27 educational adaptive platforms and instruments. The university ranks first in the rating of the most innovative universities of the USA.

The research analysis shows that the main requirements for realising the principle of adaptation are flexibility of the educational process in organisations and the learner-centred approach that takes the learners resources into account. Adaptive learning is a training methodology that is designed with a view to organise personalised learning that aims at providing efficient, powerful and individualised training trajectories intending to engage every learner in the educational process.

The technologies that incorporate the principles of adaptive learning take a data-driven approach to changing the trajectory of learning, with consideration of its pace for individual students taking personalised learning.

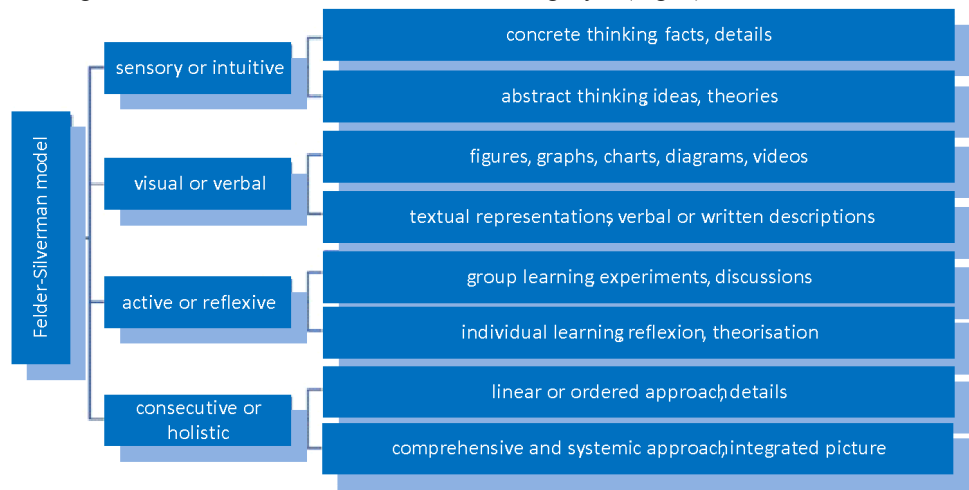
In the conditions of digitalisation of education, it is necessary to develop due methods for managing the learning process in the electronic information/education environment of universities, as well as the methods and techniques of digital control, fixation and prognostication of activities. It is also necessary to develop active management models for training process in the electronic multi-user environment, which would ensure the learning participants' pedagogical interaction based on multidimensionality of students' individual characteristics.

The above-mentioned research makes a significant contribution to the creation of personalised learning process based on adapted learning technologies in e-learning systems; however, the digitalisation of modern education and of distance learning in the conditions of the coronavirus pandemic has revealed new challenges in education. Adaptive learning is not actively practiced today at higher education institutions. This is largely due to the complexity of technical realisation of such-level systems as well as unpreparedness of universities to integrate revolutionary learning methods into the educational process.

Adaptive learning in higher education is a concept that harnesses new technologies for improvement of students' knowledge with regard for their individual characteristics.

Other studies aimed at evaluating the efficiency of adaptive learning are less extensive and focus on analysing the developments of individual companies or researchers themselves. They propose a new framework for adaptive learning that classifies learners on the basis of individual preferences in terms of comprehension and processing of

information; the teaching structure is grounded on the Felder-Silverman model [9]. The teaching content is created on the basis of a learning style (Fig. 1).



**Fig. 1.** Felder-Silverman model.

A set of instructional style characteristics is used to create a model for a learner; some of them are quite easy to measure, like one’s previous learning experience. Thus, the research aimed to explore such a complex construct as students’ learning styles is still on.

With the development of digital learning (speaking of digital learning, the authors mean a wide range of educational services, tools and curricula intended to design personalised learning for students), it has become possible to effectively ensure the learning process adaptability at higher education institutions: the broad range of digital technologies opens up new possibilities for training, for control of educational progress and learnability level of each student. The control of results enables the teacher to analyse any situation and, if necessary, to change the criteria, methods and technologies of teaching.

Today, adaptive learning represents a modern automated version of digital education. Adaptive learning involves the analysis of individual features and background level of students, as well as the process of interactive training, assessment of criteria for successful transition to the next level of schooling.

The adaptive learning system aims to improve the quality of student learning. It includes adaptive planning, adaptive testing or adaptive presentation of educational content, including the same with the use of digital technologies.

Information systems are elements of adaptation and modelling of learner’s activity, since adaptive learning systems are supposed to design the student’s personalised educational strategy. Typically, personalisation involves adaptive interaction, adaptive access to a teaching course, adaptive content of the learning material, adaptive support of collaboration. The origins of adaptive technologies used in adaptive learning systems come from the domain of information coaching systems (adaptive planning, data mining, support of interactive tasks, support of ready tasks, and support of joint work).

The adaptive learning principle is aimed at designing individual learning programmes. The information coaching system for adaptive learning at higher educational establishments should provide due conditions for achieving educational objectives; combine different types of presenting educational materials with regard for students’ individual characteristics, namely, the ability to perceive the material; should be adapted to different forms and methods of training.

3. Results and discussion

The incorporation of information systems into adaptive learning is based on the following models (Fig. 2):

- the information/education model is aimed at acquiring new knowledge, developing due skills, applying innovative pedagogical technologies, self-cognition;
- the controlling-corrective-diagnostic model involves the use of knowledge control tools, expert training systems, dialogue-based solution of practical tasks;
- the research model is related to the development of students’ research skills and aims at gaining research experience;
- the communicative model aims to regulate the selection of communication and interaction methods.

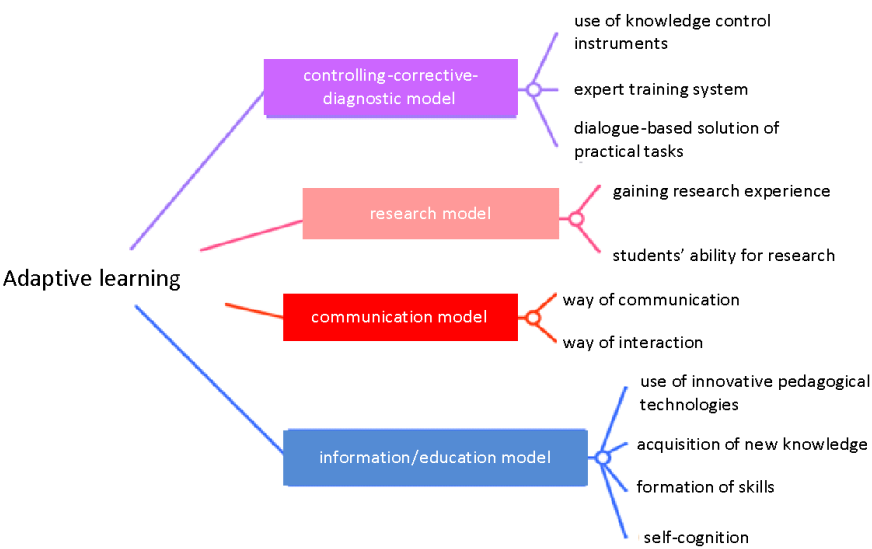


Fig. 2. Adaptive learning model.

These models are interrelated and meet the requirements of adaptive learning.

When organising the educational process based on the person-centred approach, it is recommended to use a set of adaptation criteria taking different aspects of learning into account, namely individual traits of different learner categories.

The present study is based on the works of Russian and foreign scientists, educators and specialists exploring the theoretical and methodological foundations of fundamental and modern provisions of the pedagogical theory dealing with realisation of adaptive learning principles in higher education; those looking into the problems and prospects of digital technologies in education, studying the process of applying innovative tools and learning technologies in the adaptive learning system.

The present research was based on a number of theoretical methods (analysis of scholarly methodological sources, synthesis, comparison), including the method of logical generalisation intended to substantiate theoretically the significance of the set objectives and to clarify the key concepts of research into adaptive learning models.

**Summary.** The main purpose of exploring the methods of adaptive education system at higher education institutions is the use of flexible educational environment providing teachers and students characterised by different individual features and personal preferences

with modern digital tools for improved training of future specialists. An important aspect of this educational system is the students' focus on self-awareness, analysis and comprehension of learning material in the process of their professional training at higher education institutions.

Every learner can work independently in the adaptive learning environment, at a pace that suits his/her psychological profile, when dealing with the learning tasks, asking for advice or assistance, whether needed.

## 4. Conclusion

Thus, the adaptive learning system ensures optimal adaptation of the university educational process to students' individual characteristics and personal preferences, promotes their cognitive activity, enhances motivation for learning, provides an opportunity to control the learning process and adjust the learning content towards achievement of planned individual results.

The adaptive learning system has a potential to fully involve all the learners in the process of designing their own individual learning environment, developing own activities, extending the individualisation of the educational process within the framework of a single educational programme and the entire university curriculum.

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