

THE POTENTIAL OF DIGITAL LEARNING PLATFORMS IN TRAINING FUTURE TEACHERS TO IMPLEMENT ADAPTIVE TEACHING

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Abstract

The humanization of social relations, the introduction of digital technologies, and the formation of a new paradigm of modern education set increasing demands on the creation of a comfortable educational environment. An essential attribute and a key condition of it is the organization of adaptive teaching, which involves implementing an individualized approach within a group of students, allowing the alignment of educational outcomes through the algorithms of the digital environment.

Currently, digital platforms providing adaptive teaching environments are becoming increasingly widespread. The teacher has the prospect of using interactive educational technologies as effectively as possible, intensifying research and independent work, and using various types of control and evaluation of teaching effectiveness. Given these opportunities, they set entirely new demands on the professional competence of specialists in the field of education. Based on that, the relevant objective is to prepare future teachers to work with various categories of students on the basis of adaptive teaching in the digital environment. The purpose of this study is to identify the capabilities of digital learning platforms for preparing future teachers to implement adaptive teaching.

Based on the methodology of the systematic approach, the authors summarized data on the impact of the adaptive approach on the effectiveness of learning in general as well as the potential of digital platforms that offer an adaptive teaching environment.

In accordance with the identified potential of digital platforms, the educational standard of the teaching major of a bachelor degree was analyzed, and general professional competencies were outlined. The authors suggested that they include the skills to create an adaptive environment: to set goals, choose content and results of group and individual educational activities, apply technologies for organizing group and individual educational and extracurricular activities of students, and apply psychological, pedagogical, and information technologies necessary for individualizing learning. In this paper, the stages of technology for training a future teacher for the implementation of adaptive teaching have been determined, including getting acquainted with concepts of adaptive pedagogy, realizing the need for professional self-improvement, creating a vision of an adaptive school, and mastering the technologies of activities in an adaptive school, including innovative ones.

The paper offers a fragment of the authors' methodology for preparing students to implement adaptive teaching using digital learning platforms as part of the "Adaptive Pedagogy" subject. The authors systematically compared: key concepts of adaptive pedagogy; digital platforms containing the potential for adaptive teaching; topics from the curriculum of the discipline "Adaptive Pedagogy", allowing the use of a digital resource; results of students' activities that are significant for mastering adaptive teaching skills.

The practical output of the research consists of the collected data from a reflective assessment of students to identify their opinions regarding the possibilities of using digital learning platforms to master adaptive teaching skills. In most cases, positive responses are observed. In this paper, the authors provide recommendations for training students for the implementation of adaptive teaching in a digital environment.

Keywords: adaptive teaching, digital learning platforms, future teacher training.

1 INTRODUCTION

The problem of improving the quality of education remains relevant, and hopes for its resolution are increasingly linked to the digital transformation of education. Its essence lies in achieving the necessary

learning outcomes through personalizing the learning process based on the use of digital technologies. Currently, there is a growing trend associated with the development and use of digital adaptive educational systems and learning models. Attempts to create them began at the end of the last century, and currently, interest in them has significantly increased. This is due, on the one hand, to the increasing role of computer technology in society as a whole and the development of artificial intelligence. On the other hand, it is due to the realization that only the learner is best able to determine their comfortable learning conditions. Modern students mostly independently take different educational courses using digital learning systems and technologies. Various digital learning platforms have been developed: special programs and applications for mastering academic disciplines, various learning management systems (LMS), online platforms where one can watch video lectures, read e-books, etc.

Digital learning technologies now allow to adapt educational content and curriculum to the individual level of students' skill development and personalizing their learning through the use of algorithms, artificial intelligence, and machine learning. Their main anticipated advantage and, accordingly, goal is to increase the effectiveness of learning primarily in terms of "results/time." This can be achieved in two main ways: achieving maximum learning outcomes in a certain time or achieving set learning outcomes within a limited time.

In Russia, several projects in the field of digital transformation of education are planned, including the "Digital Student Assistant." This service allows to build an individual learning plan based on a selection of verified digital educational content according to the student's interests and abilities, as well as managing the educational trajectory according to the level of preparation and interests [1].

Unfortunately, despite the large number of scientific and methodological works dedicated to adaptive teaching problems, there is currently no unified view on the process of designing and implementing a comprehensive approach to it. However, modern educators need to understand the pros and cons of adaptive learning models and technologies and learn to work in innovative educational environments. Universities face an even more complex task - not only developing adaptive content for mastering academic disciplines but also preparing students - future teachers to work in the conditions of an adaptive digital learning environment of modern schools.

Considering the abovementioned, the research aim was to identify the possibilities of digital educational platforms for preparing pre-service teachers for implementing adaptive teaching.

2 METHODOLOGY

The theoretical and methodological framework of the research is based on works of Russian and foreign specialists dedicated to the following issues:

- The study of the scope of computer-based learning and its most effective implementation (Cheung, A. C. K., and Slavin, R. E. (2012); Tamim, R. M., Bernard, R. M., Borokhovski, E., Abrami, P. C., and Schmid, R. F. (2011));
- The historical development of adaptive teaching (Snow R., Yalow E. (1982); Natriello G. (2017));
- Various approaches to the concept of "individualization of learning" and its changes in relation to the development of educational technologies (Gavriush, N. & Reypolska, O. (2019));
- The role of adaptive teaching as a growing trend in computer-based learning (Xie, H., Chu, H.-C., Hwang, G.-J., and Wang, C.-C. (2019));
- The functions and role of teachers in personalized learning (Hughey, J. (2020));
- The use of modern approaches to create and apply models and tools for organizing an effective adaptive teaching process (Tsibulsky G.M., Vainshtein Yu.V., Esin R.B. (2018); Tagirova L.F. (2022); Krechetov I. A. (2022); Chupin N.A. (2023));

To achieve the set aim, the following research methods were applied: theoretical - literature review, analysis of key concepts, systematization; and empirical - analysis of activity products, surveys.

The concept of "adaptive teaching" was introduced by the English researcher G. Pask in the 1960s, referring to education that continuously and operatively adapts to individual information acquisition processes [2]. It is characterized by mandatory prior knowledge assessment, thorough course detailing, and establishing dependencies between course parts.

Currently, there is no established terminology in the professional community to denote all aspects of adaptive teaching. For instance, in modern research, adaptive teaching is understood also as a technology. According to Kerr, adaptive teaching is an educational technology which aim is to design "automatic, dynamic and interactive" content [3].

Adaptive teaching is also defined as an educational model that uses new technologies to enhance students' knowledge taking their individual characteristics into account. This is a modern automated version of realizing personalized learning in which adaptive technologies hold a significant role.

The term "adaptive learning model" is also used as an independent concept. Generally, three main adaptive learning models are identified [4]:

- The student model (provides information about the student necessary for adaptive systems: about the student's progress, topics and tests that he has already studied and completed, about watching videos, reading additional materials and grades).
- The instructional or teaching model (helps to adapt teaching based on the student model and provides the basis for making decisions about what content should be provided to the student (speed, format, sequence of delivery of materials, etc.).
- The content model (characteristics of the content and searches for suitable educational resources that match users' needs and preferences).

The forementioned models of adaptive teaching can be implemented using various algorithms and data analysis methods. The analysis and reproduction of different learning models are provided through the use of artificial intelligence and digital technologies.

In connection with the development of digitization and the increasing role of information technologies, which have significantly expanded the possibilities of adapting educational resources, the terms "adaptive learning systems" and often, as a synonym, "adaptive digital learning platforms" are more frequently used at present.

Adaptive systems are online learning systems that provide personalized adjustment of the educational process to the specific characteristics of each learner (personal learning strategy, dominant channels of information perception, program logic, sequence of skills and knowledge formation, optimal pace of course completion, necessary revisions and practice, consideration of self-assessment and learner's confidence, etc.) [5].

The most well-known adaptive platforms include: 2U, Wiley, Canvas, Loud Cloud, Blackboard, Knewton, RealizeIT, Adaptcourseware, Anewspring, Geekie, Smart Sparrow etc.

The idea of adaptive teaching has gained the most popularity in the USA. Currently, there is a large number of studies that consider the advantages and disadvantages of existing models for building and functioning of adaptive educational systems.

It is no longer in doubt that adaptive teaching is capable of performing numerous functions such as tutoring, various types of monitoring and evaluating learning effectiveness, feedback, course detailing, predictive analytics, and etc. Researchers note its educational potential and positive aspects by mentioning the ability to take into account the following student characteristics [6],[7],[8]:

- 1 Foundational knowledge;
- 2 Cognitive styles;
- 3 Learning styles;
- 4 Metacognitive knowledge or knowledge about personal cognitive processes in comparison with others' capabilities;
- 5 Student preferences;
- 6 Student behavior (viewing materials or videos, responses to test tasks, etc.);
- 7 Student profile - personal data (gender, age, etc.), etc.

Research from the University of Central Florida has shown that adaptive teaching based on digital platforms can reduce student attrition, improve outcomes, and provide more accurate measures of learning. It was noted that students can complete traditional courses at an accelerated or advanced pace, and also have repeat, rewind, and replay capabilities that help them learn the content [9].

However, students' attitudes towards adaptive teaching were positive due to its ability to provide more personalized learning, allowing them to correct mistakes or learn course material more effectively. On the other hand, the very complexity and multitasking of the development and use of adaptive systems and digital adaptive platforms gives rise to many problems. For example, adaptive teaching offers many possibilities, but it may not be equally effective in all disciplines, namely in those subject areas where there is little or no hierarchical structure [10].

Each implementation must meet the requirements of courses, instructors, academic standards, and individual institutional goals. Anyone implementing adaptive teaching must be persistent in their efforts. Adaptive teaching is not an overnight solution [11]. Researchers warn of the need to study adaptive teaching from different perspectives, engaging partners with different assumptions, perspectives, opportunities and challenges [12].

Johanes and Lagerstrom made an attempt, firstly, to explain what adaptive systems are and what data they require; secondly, to classify the main cases where they can be used and capabilities of adaptive systems; thirdly, to outline the current limitations and challenges associated with adaptive systems. At the same time, the authors say that the US National Academy of Engineering has named adaptive teaching as one of the "big challenges" which the educational system has faced [13].

In addition to the difficulties that accompany learning based on adaptive digital learning platforms, there are many concerns about its effectiveness and impact on teachers and students.

Thus, researchers warn that the use of digital learning tools can lead to a lack of communication with the teacher, problems controlling students' independence when completing tasks, and an increase in the load on both students and the teacher [14].

Some authors call the main, in their opinion, advantage of adaptive teaching: "its spread does not lead to an increase in subjectivity and student-centeredness of the educational process. We are transferring control to artificial systems, which, based on an increasing number of data, are going to manage student behavior more targeted and effectively [15]."

Researchers (Knight and Buckingham Shum, 2017) also warn that adaptive teaching technologies that use algorithms based on the analysis of big student data may ignore and mask key elements of the learning. Therefore, they "...have therefore raised concerns that LA and data-driven teaching and learning could potentially marginalize learners and educators by transforming education into a technocratic system, wherein learning is limited to concepts for which we can create analytics and excludes alternative learning engagement activities that may be difficult to computationally track, to the detriment of learners [16]".

So far, unfortunately, there is no clear attitude towards the effectiveness of adaptive teaching. The reason for this may be both the ambiguous results of the studies conducted and the difficulties that adaptive teaching has in general.

Currently, most systems relate to: STEM (Science, Technology, Engineering, Math) and medical subjects such as anatomy and physiology. These systems use affects to a greater extent only science areas (profiles) of student training. The problem of training pre-service teachers for secondary schools remains somewhat aside.

Researchers note that the level of training pre-service teachers and the qualifications of teachers do not meet the requirements of a modern adaptive educational environment. P. McMillan and M. Jess (2021) say that the modern lesson is a complex adaptive practice and transformation of the educational environment and note that currently professional development of teachers reduces their work in the classroom to a simple and predictable process [17].

Moltudal, Krumsvik and Høydal (2022) demonstrate some of the integration challenges associated with automated and data-driven adaptive teaching and computer-assisted learning systems that exceed teachers' ability to use certain real and perceived technological capabilities beyond their digital competence [18].

It is no secret that the majority of modern school students are already quite successfully learning independently using digital learning systems and technologies. Therefore, it is true that not only the training of pre-service teachers itself should be adaptive [19], but a theoretical and methodological basis is also necessary for the special preparation for the use of digital adaptive learning systems and platforms in future professional activities.

3 RESULTS

In practical part of this research at the first stage, we analyzed the educational standard for the teaching major at the bachelor's level and identified general professional competencies (GPC), the structure of which, as we believe, includes skills in creating an adaptive environment [20] (table 1).

Table 1. Competencies and indicators of its achieving

Competency and its code	Competency Achievement Indicator and its code
GPC-3. Can organize joint and individual educational activities of students, including those with special educational needs, in accordance with the requirements of federal state educational standards.	GPCI-3.1. Formulates the goals, content, results of joint and individual educational activities of students in accordance with the requirements of federal state educational standards.
	GPCI -3.2. Applies technologies for organizing joint and individual educational and extracurricular activities of students.
GPC-6. Can use psychological and pedagogical technologies necessary for the individualization of training, development, including students with special educational needs in professional activities.	GPCI-6.1. Considers the individual, psychophysiological characteristics of students in professional activities.
	GPCI-6.2. Applies psychological and pedagogical technologies necessary for the individualization of training, development, including students with special educational needs in professional activities.
GPC-9. Can understand the operating principles of modern information technologies and use them to solve professional tasks.	GPCI-9.1. Knows the modern technical base and digital technologies used in professional activities, their capabilities, types, functions.
	GPCI-9.2. Implements modern digital devices, platforms and software to solve professional problems

Next, the stages of technology for preparing a pre-service teacher for the implementation of adaptive teaching were determined. The first stage involves the formation of an initial idea of adaptive school and teaching in it. Its content includes:

- 1 Familiarizing students with the concepts “adaptive school”, “adaptive educational environment”, “adaptive educational model”, “adaptive education system”, “personalized learning”, “adaptive learning technologies”;
- 2 Familiarization with the requirements for an adaptive school teacher and awareness of the need for professional self-improvement.

At the second stage, an understanding of the concept of an adaptive school and ideas about the variability of its models is formed, and knowledge is acquired about the specifics of the educational process in it.

The third stage involves mastering the technologies of activities in an adaptive school, including innovative ones, and drawing up notes on student-oriented lessons.

Further, in accordance with the aim of the study, the possibilities of adaptive digital learning platforms for training pre-service teachers to implement adaptive teaching were identified. For this purpose, we have developed a methodology for preparing students to implement adaptive teaching using digital learning platforms as part of the course “Adaptive Pedagogy”. In a systematic form, it compares: key categories of adaptive pedagogy; digital platforms containing the potential for adaptive learning; topics from the curriculum program for “Adaptive Pedagogy”, allowing the use of a digital resource; results of students’ activities that are significant for mastering adaptive learning skills. Here is a fragment of this technique (Table 2).

Table 2. Fragment of a methodology for preparing students to implement adaptive teaching using digital learning platforms as part of the course "Adaptive Pedagogy"

№	Elements of adaptive pedagogy	Digital learning platforms for adaptive teaching	Topic according to the curriculum	Learner outcomes significant for adaptive teaching skills
1.	Main concept of adaptive pedagogy	Knewton, Sberclass	The essence of the concepts "adaptive school", "adaptive educational environment", "adaptive educational model", "adaptive teaching", "adaptive technologies".	<ul style="list-style-type: none"> • Systematisation of key concepts of adaptive pedagogy, defining the objectives of professional activity in an adaptive school; • comparative analysis of traditional and adaptive school with regard to the quality of formation of key competences.
2.	Adaptive content, forms and methods	Knewton, Smart Sparrow, Plario	<ul style="list-style-type: none"> • Methods of designing programmes in adaptive teaching: linear, concentric, combined; • independent work in adaptive teaching; • variability of forms and methods of adaptive teaching. 	<ul style="list-style-type: none"> • Designing the study of a particular topic as a consistently complex process: from productive to problem-seeking; • designing different types of independent work of students, allowing to vary the duration and sequence of learning stages.
2.	Adaptive technologies	Stepic, Uchi.ru, AR TUTOR, iSMART	<ul style="list-style-type: none"> • Level differentiation of learning; • microlearning; • flexible learning; • technologies of rehabilitation, teaching and social adaptation for students with special educational needs. 	<ul style="list-style-type: none"> • Designing learning tasks taking into account individual characteristics of students and their cognitive interests; • presentation of a learning topic on the basis of microlearning with the use of didactic materials of the learning platform; • designing a lesson using flexible learning technology; • development of criteria for assessing the dynamics of development of students with special educational needs using the electronic platform Ar-Tutor.
3.	Individualisation of the educational route	Knewton, Smart, Sparrow, Foxford, Sberclass	The concept and algorithm of designing an individual educational route.	Development of an individual educational route of a student on the basis of inter- and intra-subject links
4.	Motivation to learning	Stepic, Uchi.ru, YaClass, Canvas, Edstories, Yarnit	<ul style="list-style-type: none"> • Learning motivation in adaptive teaching; • Formation of positive self-concept in school students. 	<ul style="list-style-type: none"> • Designing tasks to motivate students' cognitive activity based on the interactive capabilities of the learning platform; • designing a class using digital storytelling technology.
5.	Adaptive assessment	Knewton, Smart Sparrow, Intellipath, Uchi.ru	Designing a system of control and correction of students' knowledge of a topic or section of the course.	<ul style="list-style-type: none"> • Development of adaptive assessment criteria for the class topic; • development of a system of questions and tasks on the topic of the class taking into account the different levels of complexity depending on the accuracy of the student's answer with the use of graphic material and video.

At the final stage of the study, using the "word cloud" technique, a reflective assessment of students was carried out to identify their opinions regarding the use of digital learning platforms for mastering adaptive teaching skills.

The questions were formulated as follows:

- I learned that digital learning platforms allow...
- Digital learning platforms can be used for...
- The use of digital platforms and Internet services significantly increases the general professional competencies of a teacher and allows, in terms of adaptive skills, to learn...

The overwhelming majority of students positively assessed the influence of digital learning platforms in relation to the formation of adaptive teaching skills and quite fully characterized their potential in this direction.

4 CONCLUSIONS

Based on the conducted research, we have formulated guidelines on training pre-service teachers to implement adaptive teaching in the digital environment:

- 1 Inclusion of didactic units such as: adaptive school, adaptive educational environment, and adaptive mechanisms of the lesson in the teaching content.
- 2 Formation of ideas about the didactic possibilities of modern digital technologies for adaptive teaching, analysis of one's difficulties and needs.
- 3 Usage of digital platforms, internet services for developing educational content and assessment materials, organizing the learning process, including the use of active teaching methods.
- 4 Integration of learning through digital resources and traditional education.
- 5 Learning in a digital environment should be accompanied by the analysis of pedagogical situations, formulation of pedagogical problems, reflection on one's own activities, contributing to the formation of the teacher's professional consciousness.
- 6 The content of education should be relevant to students and be in the context of their future professional activities.
- 7 Adaptive learning in a digital environment should create opportunities for self-awareness, self-development, self-improvement, and self-realization of the pre-service teacher in educational and professional activities.

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