COGNITIVE EFFECTIVENESS OF DIGITAL TOOLS IN THE PROCESS OF INDEPENDENT EDUCATION

Saloxiddinova Risolat Nizomiddin kizi
Student of the Department of Primary Education,
Renaissance University of Education
Scientific Supervisor;
Rakhimov Zokir Toshtemirovich,
Doctor of Pedagogical Sciences (DSc), Professor,
Academician of the Turan Academy of Sciences,
Professor, Renaissance University of Education

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Abstract. *The article analyzes the cognitive effectiveness of using digital tools in the process of independent learning, optimization of learning activities in a digital environment, formation of individual learning trajectories and development of students' self-management competencies, effective forms, methods and pedagogical conditions for organizing independent learning through digital tools, cognitive effectiveness of using digital tools, identification of real mechanisms of influence in the learning process, use of digital technologies only as a means of information transmission, their development of deep thinking, analysis and creative activity of students, full implementation of the pedagogical potential of digital tools from a scientific, theoretical and practical perspective.*

Key words: *independent learning, digital tools, cognitive effectiveness, information technologies, educational process, independent learning, pedagogical technologies.*

The modern education system is undergoing a radical transformation in the context of globalization and the development of a digital society. The rapid

development of information and communication technologies requires a qualitative update of the content, form and methods of the educational process. In particular, the independent learning process is now recognized as one of the most important components of education, which plays a decisive role in the formation of students' skills for self-development, independent acquisition, analysis and practical application of knowledge. As a result of the integration of digital technologies into the educational process, the traditional model of independent learning has significantly expanded and new didactic opportunities have emerged. Electronic learning platforms, digital resources, artificial intelligence-based learning systems, virtual laboratories and multimedia tools allow students to organize their learning process in an individual, flexible and interactive way. In this regard, digital tools are not only a means of transmitting information, but also a pedagogical tool that activates cognitive processes, develops thinking and serves for deep assimilation of knowledge.

According to the theory of the cognitive approach, the learning process is directly related to the human ability to perceive, remember, analyze, synthesize, and think creatively. Therefore, the extent to which the use of digital tools in the process of independent learning activates the cognitive activity of students, how it affects the process of processing and consolidating knowledge is emerging as a pressing scientific problem. The cognitive effectiveness of digital tools is determined not only by technological capabilities, but also by their didactic basis, methodological correctness of their use, and their suitability for the individual psychological characteristics of the student.

Although the use of digital tools in educational practice is expanding today, the scientific substantiation of their cognitive effectiveness and the identification of real mechanisms of influence in the learning process remain an urgent issue. In some cases, digital technologies are used only as a means of conveying information, and their potential for developing students' deep

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thinking, analysis, and creative activity is not sufficiently revealed. This creates the need to fully realize the pedagogical potential of digital tools [2].

At the same time, the expansion of the digital environment in the process of independent learning creates new conditions for the formation of cognitive competencies in students, such as self-management, time planning, information flow analysis, and critical thinking. This process strengthens the person-centered model of education and allows the formation of an individual educational trajectory of the student.

The relevance of this topic is that by scientifically substantiating the cognitive effectiveness of digital tools in the process of independent learning, the quality of education will increase, the intellectual potential of students will develop, and the opportunities for training personnel with modern competencies will expand. Therefore, scientific research in this area will serve to deepen the integration of pedagogy and digital didactics.

The modern education system is undergoing a process of digital transformation [5]. In the context of global informatization, the main task of education is not only to impart knowledge, but also to develop in students the skills of independent thinking, analysis of information, its processing, and application in practice. Independent learning plays a central role in this process.

Digital tools (e-learning platforms, virtual laboratories, multimedia resources, artificial intelligence-based systems) are becoming an important factor in increasing the effectiveness of the independent learning process. They allow individualizing the learning process, presenting knowledge in a visual and interactive form, and activating the cognitive activity of students. In this regard, studying the cognitive effectiveness of digital tools is one of the current scientific problems of pedagogical science.

Independent learning is the process of a student independently acquiring his or her own knowledge, deepening it, and applying it in practice. According

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to the constructivist approach, knowledge is not given in a ready-made state, but is formed by the student on the basis of active cognitive processes [1].

Independent learning relies on the following cognitive processes: perception; analysis; synthesis; generalization; reflection. Digital tools serve as a means of activating these processes.

Digital learning tools have the following didactic capabilities [3, 4]:

- visualization capabilities – explaining complex processes through graphics, animations and simulations;
- interactivity – two-way interaction between the learner and the system;
- individualization – adapting to the level of knowledge of each learner;
- instant feedback – immediate analysis of results;
- unlimited resources – access to global knowledge bases.

These capabilities optimize the cognitive load and serve to deeply assimilate knowledge.

Cognitive efficiency is the level of efficiency of receiving, processing and applying information in the learning process. It is assessed by the following indicators: the level of knowledge retention; the development of analytical thinking; the ability to solve problem situations; the formation of a creative approach. Digital tools optimize the cognitive load and activate the mental activity of the student.

Digital tools directly affect the following cognitive processes [6, 7]:

- perception: fast and efficient reception of information through multimedia resources;
- concentration: activation of attention through interactive elements;
- memory: strengthening long-term memory through visual and audio integration;
- thinking: development of analytical thinking through problem tasks and simulations.

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The following problems are observed in the process of using digital tools:

- insufficient digital competence of teachers;
- weakness of technical infrastructure;
- insufficient formation of a culture of independent learning among students;
- incomplete didactically substantiated digital resources;
- information overload.

The following areas are important for increasing cognitive efficiency: development of digital pedagogy; increasing IT competence of teachers; introduction of adaptive learning systems; expansion of the blended learning model; methodological improvement of electronic resources.

The use of digital tools in the process of independent learning serves as an important factor in increasing educational efficiency. They activate the cognitive activity of students, help to deeply assimilate knowledge, and form modern competencies.

However, the cognitive efficiency of digital tools is determined not only by their technological capabilities, but also by their didactic basis and methodologically correct application. Therefore, the development of digital pedagogy in the education system and its improvement on a scientific basis remains an urgent task.

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