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DIDACTIC OPPORTUNITIES OF DIGITAL TECHNOLOGIES IN TEACHING PROGRAMMING LANGUAGES

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Abstract: This article presents the issues of teaching programming languages in the continuous education system. It highlights the didactic opportunities of digital technologies in enhancing the effectiveness of teaching programming languages and provides suggestions and recommendations for using digital technologies in teaching programming to learners.

Keywords: programming, digital technology, information-educational environment, motivation, logical, creative, competence

Efforts to modernize the continuous education system are yielding results in preparing specialists who meet contemporary requirements [1]. Researchers theoretically and practically demonstrate that active integration of digital technologies into the educational process can lead to effective outcomes [2]. Based on scientifically grounded research results, educators are equipping classrooms and auditoriums in general secondary schools, professional education institutions, and higher education institutions with modern educational technologies (equipment) to support teaching various subjects, including programming languages [3]. This underscores the need to expand research on the use of digital technologies in teaching programming languages [4]. The use of technological interactions allows for research at all levels of subjects related to programming languages [5]. However, technology alone is not sufficient. Currently, there is a need for high-quality digital content available through the global network [6].

In this regard, research on the use of distance learning systems, artificial intelligence-based learning tools, educational platforms, and information-educational environments to enhance the effectiveness of teaching subjects and developing students' competencies is conducted by scholars such as A. Abduqodirov, S.L. Atanasyan, L.A. Bachurina, U.SH. Begimqulov, I.G. Zakharova, L.M. Ivkina, A.V. Karmanovskiy, E.S. Matosov, V.I. Snegurova, U.N. Taylakov, J. Elmurodov, L.I. Anikushina, and A.X. Gilmutdinov. Their research theoretically and practically demonstrates that digital technologies, including distance learning systems, open online courses, virtual learning platforms, and information-educational environments, serve as modern educational tools to enhance the effectiveness of teaching subjects, organize students' independent learning efficiently, increase motivation, and develop competencies [7].

Similar ideas are also presented in the works of L.A. Bachurina, I.G. Zakharova, L.M. Ivkina, A.V. Karmanovskiy, E.S. Matosov, A.V. Pisarev, and V.I. Snegurova, who argue that online presentation of information-educational environments increases students' interest in the subject. To achieve these positive outcomes, organizers of educational sessions within information-educational environments should include video lectures, teaching programs, self-assessment and control diagnostic software, as well as tasks for independent completion and laboratory work.

Moreover, L.M. Ivkina, Y.V. Konkov, A.O. Norbekov, M.A. Sukharev, M.R. Fayziyeva, and A.N. Sheremet emphasize the importance of information-educational environments and web-adapted teaching systems in increasing the effectiveness of teaching computer science-related

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subjects and preparing future computer science specialists. M.R. Fayziyeva argues that distance learning systems and educational platforms are effective teaching systems for improving the efficiency of teaching web programming and developing students' logical and algorithmic thinking related to programming, as well as their professional competence [8]. D.R. Ruziyeva also highlights the importance of information-educational environments as essential pedagogical software tools for increasing the effectiveness of teaching object-oriented programming languages [9].

Analyzing the work of the aforementioned scholars, it can be concluded that information-educational environments and distance learning systems provide the following opportunities in the continuous education system for teaching computer science and information technologies, including programming languages: conducting online lectures, practical and laboratory sessions on computer science and programming languages; discussing programming-related projects and group work through the network; receiving and submitting programming assignments online; obtaining online consultation from professors; self-assessment; conducting intermediate and final assessments online; asynchronous teaching; multi-functional and comprehensive capabilities; the possibility of learning at any place and time; comprehensive digital educational resources aimed at mastering the subject; implementing feedback between professors and students; and providing opportunities for students to independently assess themselves.

According to the analysis of the work of the aforementioned scholars on the capabilities of information-educational environments, it can be concluded that information-educational environments play an essential role in enhancing the effectiveness of teaching subjects, including programming languages, in the continuous education system. They also contribute to the development of students' logical, algorithmic, creative, and cognitive thinking related to programming and the formation and improvement of their competencies [3].

In developed countries, distance learning systems, educational platforms, information-educational environments, and websites aimed at increasing the efficiency of teaching modern programming languages and teaching students programming are being effectively utilized. Similar information-educational environments also exist in our country, such as the dr.rtm.uz and eduportal.uz information-educational environments of the Ministry of Public Education of the Republic of Uzbekistan, the Ziyonet information-educational network containing educational materials related to programming languages, and the rabota.uz website designed for analyzing programmed examples and tasks.

However, it can be said that these information-educational environments are not sufficient for teaching students programming today. These environments primarily serve to introduce students to basic courses. Therefore, there is a need to create an information-educational environment in the continuous education system that ensures the continuity and coherence of teaching programming languages. This environment should include educational tools, sets of problem-based tasks, control and diagnostic systems, and methodological developments for teachers [7].

One of the research tasks is to create an information-educational environment aimed at teaching programming languages in the continuous education system. To achieve this, it is necessary to rely on the requirements and principles developed by scholars for creating information-educational environments and, if necessary, improve them.

In this regard, the theory and practice of creating distance learning systems, the issues of

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creating information-educational environments and educational platforms, the requirements and principles for their creation have been analyzed based on the works of scholars such as Y.A. Vinnitskiy, A.O. Norbekov, S.Q. Tursunov, M. Fayziyeva, J. Elmurodov, U. Lidwell, S. Wenschek, R. Hamdamov, U. Begimkulov, N. Taylakov, K. Holden, D.J. Butler, Henderson Steven, and Feiner Steven. They emphasize that the following principles should be adhered to when creating an information-educational environment:

1. Design Principle: The information-educational environment and its educational tools should consist of attractive colors, fonts, and small animation effects.

2. Hierarchical Structure Principle: This principle implies that the content of the studied material and the actions in studying it should be carried out in a hierarchical order. This allows for the creation of multi-level educational technologies and the use of the interactive operating mode of information-educational environments, providing sufficiently flexible educational complexes.

3. Scientific Principle: The information-educational environment should be created based on scientific evidence.

4. Continuity Principle: The information-educational environment should be a whole, consisting of educational resources aimed at fully mastering the subject.

5. Educational Content Principle: The main tasks of this principle include ensuring that the placed educational tools meet modern requirements, increasing student motivation and developing creative thinking, high interactivity, the possibility of editing and updating when necessary, quick updating of information, being filled with high-quality topic materials both in content and form, being accurately transmitted, having explanatory dictionaries for programming, and the ease of downloading educational tools.

6. Principle of Student Knowledge Assessment and Control: This principle involves transferring test assignments to the pedagogical diagnostic software tools of computers and presenting them in the educational process.

7. Usability Principle: The created information-educational environment should correspond to the technical level of computers and devices, consider the age characteristics of students in terms of usage, support widely used browsers, and use advanced and modern tools in creating the system page, including relevant educational manuals and popular HTML editors.

Based on the analysis of the researcher's and scholars' scientific works mentioned above, the following pedagogical and psychological requirements should be adhered to in the development of web-based educational tools for programming languages:

- The ability to apply voluntary methods of managing learning activities.
- Providing the possibility of making changes and modifications to learning management methods.
- Supplying constant information about the short-term and long-term goals of teaching and the levels of achievement.
- Focusing on high visualization and motivation related to programming for students.
- Being designed for individual learning by students.
- Ensuring that the difficulty of educational tasks matches the individual and age capabilities of students, taking into account their prior knowledge, skills, experience, and competencies.

Thus, based on the above principles and requirements, an information-educational environment was created on the global network at uz-das.uz.

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The information-educational environment created within the scope of this research provides the following opportunities:

- Open access at any convenient place and time. That is, the created information-educational environment is aimed at open use of educational tools related to programming languages such as Scratch, Python, S++, Java, Delphi, Borland Builder C++. In this case, students learn programming languages according to their individual abilities. As a result, education proceeds in a free and flexible manner, allowing students to complete the given tasks in a convenient order. Students independently determine the duration of their study sessions. Additionally, there is no set or limited time for students to assess their knowledge, thus eliminating the "time pressure" issue, which positively affects the learning of programming and ensures systematic teaching.

- The ability to download educational tools. The information-educational environment provides the ability to download digital educational tools related to programming languages.

- Availability of information related to the programming languages taught in general secondary schools. The educational tools aimed at teaching programming languages like Scratch, Python, Delphi in school textbooks are provided in a continuous and coherent manner.

- The ability for general secondary school students to independently engage in learning activities related to programming languages.

- Availability of educational tools and task collections for talented students.

- Online open and closed tests for students to check their knowledge related to programming languages.

- Crosswords aimed at developing students' logical thinking in programming.

- Collections of problem-solving tasks related to programming.

- Availability of educational tools related to programming languages taught in higher pedagogical educational institutions. Video lectures, lectures, practical and laboratory work developments related to programming languages such as Scratch, Python, S++, Java, Delphi, Borland Builder C++, PHP are available.

- Crosswords aimed at developing students' thinking related to programming.

- Collections of tasks related to programming.

- A system for analyzing whether the provided program code examples and problems are correct or incorrect.

- A feedback system.

Thus, the information-educational environment developed within the scope of this research serves to improve the effectiveness of teaching modern programming languages in the continuous education system, enhance students' motivation for algorithms and programming, develop their logical and creative thinking, and form and develop their competencies related to programming.

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