

The Peculiarities of Some Modern Pedagogical Technologies That Can Be Implemented in The Educational Process in Higher Educational Institutions

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Abstract

This article defines some modern educational technologies that can be used in the process of teaching programming languages in higher educational institutions and outlines the benefits of implementation of them. It also explains the concepts of teaching, education, and upbringing based on the opinions of leading scientists. The author's interpretation of the term "educational technologies" is proposed. The article is devoted to modern educational technologies, including cloud education technologies that can be used in the language of process of teaching programming.

Keywords: teaching, education, upbringing, technology, educational technologies, programming, project, augmented reality, cloud, analysis, 5G, adaptive learning.

INTRODUCTION

Today, the IT industry is rapidly developing in the world's programming practice. Therefore, the process of teaching modern programming languages is widely deployed in higher educational institutions. Naturally, higher level of learning efficiency cannot be achieved if the learning process is organized in a traditional, that is in a theory based teacher centred method. Therefore, various modern educational and information, and communication technologies, modern achievements of world pedagogy, printed and electronic resources are widely introduced into the education system. In such conditions, a natural question arises: what technologies can be used to increase the effectiveness of the educational process? Scientists such as G. K. Selevko, M. Bond, N. Subramani, and others have conducted

scientific research on general education technologies that can be used in the educational process. The problems of using specific educational technologies in the educational process were investigated by N. Nguyen, R. Benner, A. Zammit, R. Renz, A. Dimitriado, E. Wang, A. Guzman-Valenzuela, and other teacher-researchers.

In the field of teaching subject-oriented programming languages and computer science, several problems arise:

- improvement of methods of teaching computer science and information technology, including programming languages, in various educational areas;
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- development of students' system of algorithmic, and logical thinking skills in teaching computer

science and information technology, including programming languages;

- formation of students' various programming-related competencies;
- improving the efficiency of the educational process based on various technologies.

METHODOLOGY

In the literature review stage of the research, the author collected materials on the research topic from the existing scientific and methodological, pedagogical, and psychological literature, as well as from open sources. In the further stage, the information received was processed based on methods of study, analysis, synthesis, comparison, pedagogical observation, clarification, and scientific research. In turn, the most suitable educational technologies that could improve the quality of the process of teaching programming languages have been selected and recommendations on the use of modern educational technologies in teaching subject-oriented programming languages have been developed.

RESULTS

The education system is one of the most important and integral parts of any society and characterizes such aspects as teaching, directing and upbringing.

Teaching is a controlled process aimed at forming and developing an exemplary person by the education system (nature, society, parents, teacher, etc.) the programs necessary for his life (knowledge, skills). In a narrow sense, this concept is interpreted as a purposeful process aimed at forming individuals' ways of consciously performing operations.

Education is a socially directed and controlled process of transferring cultural values to people. Although it is more logical to interpret this concept as the result of the educational process, the world of the pedagogical community often interprets them in the same sense.

The term "upbringing" is defined in different ways. In particular:

- 1) upbringing is the influence of society and the social environment on a person;
- 2) upbringing is a purposeful activity aimed at forming certain moral and aesthetic qualities in a person.

The educational system of each era is based on its educational paradigms.

An educational paradigm is a set of basic phrases, rules, and ideas recognized by the pedagogical community and supported by scientific research in a certain period [1, p-11].

In a simple expression, educational paradigms are understood as leading ideas denoting methods of approach to the process of choosing an education system, content, organizational forms, methods of education, and training. They change in connection with corresponding changes in nature, society, science, and technology.

The introduction of a large number of technologies (including "smart technologies") has radically changed the standard of living of the population. This situation is also reflected in the education system. Therefore, traditional methods and paradigms are considered insufficient for modern education. In the modern education system, instead of them, new forms, approaches, methods, techniques, tools, and technologies for organizing training have appeared.

The term technology can be interpreted from the greek words "techne" - art, craftsmanship and "logos" - science.

Today, many scientists have tried to describe this term. In particular, G.K. Selevko writes [1, 10-b]:

Technology is a scientifically or practically substantiated system of activities for the use of knowledge gained by a person to change the environment, the production of material goods, or spiritual values.

The term technology is usually applied to a production process (including software development) or activity that can guarantee the expected outcome of a given problem for a given set of resources. In the programming industry, this concept is interpreted as a scientifically (or practically) proven sequence of operations that can guarantee the generation of required or expected output data for given input data. Technologies are based on five principles: conceptuality, consistency, manageability, efficiency, and publicity. Programming also becomes a technology if conceptuality is interpreted as a paradigm.

The term "technology" applies to all aspects of life. In particular, it is used in the educational process in the form of "educational technologies" and "pedagogical technologies". I think that applying the term technology in its purest form to the educational process is not logical. But, since this word is widely used in the practice of world pedagogy, we will try to interpret it from different perspectives.

Educational technologies - are a set of actions aimed at determining the order of using a sequence of teaching methods, organizational forms, and technical and didactic tools in the educational process. Also, this technology is interpreted as a

set of measures that ensure the highest efficiency in achieving educational goals.

An analysis of open sources showed that there are different views on the concept of pedagogical technologies. In particular, scientists such as De Kieffer, and M. Meyer defined educational technologies in the sense of the practical use of equipment, devices, teaching aids or technical devices, and other means intended for the educational process. Others interpret pedagogical technologies as ways of describing the process of achieving planned educational outcomes. Pedagogical technologies, in addition to having such characteristics as scientific, visual, simplicity, and practicality, fully comply with all the principles that apply to other technologies.

The famous teacher G.K. Selevko in his book "Modern Educational Technologies" exemplifies definitions given by leading scientists and teachers to the concept of pedagogical technology [1, p. 13].

Pedagogical technology - is a set of pedagogical and psychological instructions, which includes special forms of education, methods, and means of education, and is an organizational and methodological tool of the pedagogical process. (B. T. Likhachev).

Pedagogical technology - is a way of expressing the process of achieving the intended goals of education. (I. P. Volkov).

Pedagogical technology - is a) pedagogical skill; b) expressing the process of personality formation; c) content technique for the implementation of the educational process. (V.P. Bepalko).

Pedagogical technology - is a systematic method of identifying, creating, and applying educational forms, taking into

account the technical and human resources of the learning and learning process. (UNESCO).

Pedagogical technology - is a meaningful (informative) generalization that includes all the definitions of different authors (sources). (G.K. Selevko)

Pedagogical technology - is the construction of an educational process that guarantees the achievement of educational goals (M. V. Klarin).

Also, G. K. Selevko gives the following definitions of other famous teachers of the world in their work [1, p-4].

Pedagogical technology - is a system of all components used in the pedagogical process, programmed in time and space, which allows you to achieve the expected result. (P. Mitchell).

Pedagogical technology - is a process of interaction (communication) or solving educational problems, involving the use of behavioural and system analysis aimed at improving education (T. Sakamoto).

Considering educational and pedagogical technologies as a single concept is more suitable for teachers working in Western-style teaching. If we recall that the purpose of the science of pedagogy is to study the problems of education and upbringing, then it follows that educational technologies include pedagogical technologies and, therefore, are a broader concept. There are too many views like the above and they are one-sided, and it is not mentioned that pedagogy is a humanitarian science and that it operates with philosophical views and paradigms prevailing in a particular society and a certain historical period. Therefore, in our opinion, it is advisable to define the concept of educational technologies as follows.

Educational technology is a complex of human factors, legal, regulatory, pedagogical, technical, and software tools, and a systematic set of actions performed on them based on a certain paradigm that can guarantee the expected educational results with high probability (The author).

If the information described above is interpreted as teaching programming languages, educational technologies provide the following opportunities:

- opens up opportunities for planning and more accurate forecasting of educational outcomes of teaching programming languages;
- with a high probability increases the efficiency of the training process;
- helps to solve the issue of teaching programming languages and the formation of personal qualities of students in general;
- develops new recommendations for use in the real educational process with the help of scientific justification, analysis, and systematization of the results of pedagogical experiments in the field of teaching programming languages;
- provides favourable conditions for the comprehensive development of a person;
- allows efficient use of available educational resources;
- paves the way for the development of new educational technologies.

G.K. Selevko in the interpretation of the term "technology" emphasizes the following: the concept of "technology" is involved in pedagogy in the form of three main qualities: theory, normative (algorithmic) activity, and pedagogical practice.

The introduction of digital technologies has affected not only other areas but also the education system. New educational technologies have been developed and implemented that can be used in higher education. According to the forecast of Serosift Academy (the leading software development company for education in the USA), in 2022 several educational technologies will change the perception of modern education in the world [3]. These technologies include:

1. Augmented Reality & Virtual Reality;
2. Adaptive learning;
3. educational technologies based on artificial intelligence;
4. use of 5G technologies in education;
5. automated learning;
6. competence-based education;
7. learning analytics.

I. Augmented reality (AR) - involves enriching students' ideas about the universe with additional visual information. Although augmented world and virtual reality technologies are not new technologies, they are recognized as technologies that have received momentum due to their constantly evolving nature and the influence of modern technologies, as a result of which they will acquire a new meaning. As a rule, this technology involves the transfer of knowledge that is difficult to express in words, in a visual form, while students use a virtual world designed to use as many sensory organs as possible.

Virtual reality (also called simulation) is a program that simulates the world of existence and can interact with the human mind, intellect, and imagination.

The possibilities, advantages, and ways of applying the technology of the enriched

world are revealed in the scientific research of such scientists as N. Nguyen [5], A. Hajirasuli [6], and others.

Augmented reality and simulation technologies can be used by the teacher to enhance student learning methods. Our experiments have shown that at the initial stages of learning the basics of programming, many students do not have enough abstract ideas, and several problems arise when studying the tasks of programming language commands. Examples include the following training materials:

- address of variables and constants in memory;
- representation and storage of data in computer memory;
- fulfilment of the order for adding value;
- repeat commands
- work with functions, etc.

The formation of students' imagination by modeling and demonstrating situations such as the procedure of processing data using a computer, simulating the execution of commands, memory, presentation, and storage of information in the classroom on these topics, contributes to the deep assimilation of educational information. This knowledge serves as a solid foundation for the assimilation of the following educational information.

II. Adaptive technology. The purpose of adaptive educational technologies is to teach methods of independent work, self-control, and research methods; It involves the development of the mental abilities of students based on independent work, the development, and improvement of knowledge acquisition skills, and the maximum adaptation of the educational

process to their characteristics. This technology is not considered new, but thanks to the introduction of digital education technologies, it has begun to acquire a modern tone and significance. The introduction of pedagogical programs in the educational process has allowed the use of adaptive learning with high efficiency in distance learning, independent learning, or traditional learning.

The problems of using adaptive educational technologies in the educational process were studied by such scientists as V. Mirata [7], and C. and Helm [8].

Adaptive educational technology makes it possible to improve the educational process, taking into account the individual characteristics of students (emotional state, age, gender, abilities, perception of various types of information, level of training, knowledge, skills, and abilities). Its success is determined by the involvement of each student in the educational process. In this method, the educational process is organized with the help of a special educational trajectory, developed based on studying the level of knowledge and individual characteristics of students. The essence of this technology lies in the organization, control, and management of self-training of students based on individual learning. Its advantages are determined by the following circumstances:

- management of independent work of all students;
- individual work with students;
- taking into account individual (age-related psychological and pedagogical) characteristics and capabilities of students and their use in the educational process;

- maximum involvement of each student in individual independent work.

Adaptive learning is seen as a technology that adapts to the needs, interests, and abilities of each student in a short period. Studies have shown that flexible technologies will play an important role in the global education system in 2022. Due to their availability, the system can be modified as it uses computer algorithms to regulate student interaction. Although adaptive learning is based on artificial intelligence, it still provides learning resources that actively adapt as well as the best learning activities to meet the specific needs of the learner.

III. Educational technologies based on artificial intelligence (ETBAI). Today, artificial intelligence is recognized as one of the most recognized educational technologies in the world. The introduction of smart technologies in the educational process, as in all areas of management, serves to increase its efficiency. In Uzbekistan, too, a lot of work is being done in this area of technology, which is believed to have a great future.

The problems associated with the use of artificial intelligence technologies in the education system have been widely studied by scientists and teachers (including, A.Renz [9], E. Dimitriadou [10], etc.).

“According to experts, shortly, the use of artificial intelligence and machine learning technologies will become the main factor in the evolution of the education system. According to Markets, the global market share of artificial intelligence for education will grow to \$3.68 billion by 2023. The need for distance learning has accelerated the integration of artificial intelligence

technologies into the education sector. According to experts of the e-Learning Industry platform, more than 47% of learning management tools will be equipped with ETBAI capabilities in the next few years” [11].

The use of ETBAI in the educational process helps to solve the following nutritional problems:

a) impartial and honest assessment - assessment of students' knowledge without taking into account the existing objective and subjective conditions. Monitoring and evaluation of student progress are usually carried out by teachers and may not always be objective and fair. In addition to being an impartial, real, and honest assessment tool for this process, ETBAI frees teachers from the monotonous, tedious, and boring practice of testing and assessing students' knowledge, giving teachers more time to work on themselves, to increase the effectiveness of teaching. educational process or more to interact with students. allows separation.

b) assistance to teachers - automation of the same sequence of actions that teachers must perform regularly, including automation of administrative tasks, interactive dialogues between students and teachers, analysis of online learning results, selection of topics and materials for new classes, development of educational programs in which individual characteristics, capabilities, and needs of each student are taken into account.

c) helping students – enhancing student learning opportunities with programmable educational applications. Programmable educational applications are developed taking into account the individual characteristics, capabilities, needs, and speed of obtaining knowledge from

students. This provision improves the efficiency of the educational process, reinforces their knowledge, and opens up opportunities for developing their skills and competencies.

d) increase the motivation for learning - enrich the form, method, and content of training and increase the level of students' working capacity. The use of educational game elements in ETBAI makes the learning process more active, interactive, and interesting.

Adaptive learning technology can also be very effective in teaching programming languages. Since the level of development of students, individual characteristics, skills of logical and algorithmic thinking, and areas of interest are different, it is advisable to use flexible technologies in teaching. At the same time, the teacher of natural sciences requires complete information about the individual pedagogical and psychological capabilities of each student.

IV. The use of 5G technologies in education. It is no secret that mobile communications are widely used in education today. 5G wireless technologies will reduce the likelihood of interception and provide high-speed communication for each user to work with Internet resources (including educational ones). The 5G standard will allow all applications, services, objects, and devices to integrate big data processing, cloud computing, ETBAI, and other innovative technologies within the concept of "everything is mobile" in reliable and secure wireless networks. The digital part of the education industry market is predicted to reach \$240 billion by 2023, and this process is directly related to 5G technologies.

It is reported in open sources that research works on the methodology of using mobile educational technologies in the educational process were studied by J. Zammit [12], D. Sun [13], and other scientists.

5G technologies can be used in higher education in the following areas:

1. marketing technologies for general management;
2. ETBAI, which is activated on demand;
3. an expanded world for immersive learning (imposing on students through several senses at the same time);
4. more online tools for smart educational institutions;
5. online programs to expand the audience of students.

V. Automated learning. An automated educational system is an automated complex that includes didactic and educational materials and a system for processing educational data. This system is designed to organize the processes of education, training, knowledge control, and certification.

Learning automation is understood as the solution to several educational tasks with the help of technical means. As a result of automation, the working time of the teacher is reduced. Here it is necessary to distinguish between the concepts of “automated learning” and “automated machine learning”. Automated machine learning is organized with the help of technical means and is carried out without outside interference. And in automated learning, the learning process is carried out with the help of technical means, and, if necessary, the intervention of teachers is allowed.

Scientific research on automated learning tasks was carried out by Lo F. Hutter [14], E.Y. Levina [15], and other

scientists. As a rule, with automated learning, students have access to educational resources (for example, lectures) directly at the scheduled (or convenient) time. These resources can be expressed in electronic, digital, audio, video, and other forms, and learning can be organized remotely, online, or offline.

Online courses for learning the Python programming language are available at GeekBreins.kg, codecademy.com, udemy.com, beonmax.com, and other sites.

VI. Competency-based education.

Competence is understood as the ability to apply theoretical knowledge, skills, and abilities acquired in academic subjects in the process of solving problems of various forms and content encountered in practical activities.

Competency-based learning provides students with the means to acquire a skill based on their abilities and capabilities. This allows students to learn new knowledge at their own pace of learning.

Any type of professional activity requires the acquisition of various competencies that are characteristic of the process of performing functions and tasks within this type of activity. You can point to different types of competencies that are considered important for the activities of a specialist. This situation is typical for programmers as well. Often, competence units can be used interchangeably and applied in different settings.

Typically, competency units are formalized as qualification levels and mastered as separate modules. Students pass the specified levels of language proficiency. Competency mastery allows learners to help with the most common problems they may encounter while

ensuring they have the knowledge they need to advance to the next level.

Units of competence consist of specific, measurable, transferable learning objectives that enable learners to learn. Students will have a choice in the learning process. In this process, the teacher works with students to determine what they need to know, and what they want to know. Students receive timely and differentiated instruction based on individual learning needs. Students are assigned a flexible schedule so that they receive additional support in their studies and quickly eliminate misconceptions. In this case, students who fail the course are more likely to focus on the specific skills they need to develop, rather than reread the entire course.

An electronic journal "Competence Education" dedicated to the problems of competence education has been created on the Internet. This journal helps students to achieve better results more effectively and measure competence in a particular area based on completely objective indicators. Wang [16], R. Brenner [17], and many other well-known scientists and teachers were engaged in scientific research related to the methodology of competency-based education.

VII. Learning analytics technologies.

Analytical learning (or learning based on analysis) means the collection, evaluation, presentation, and analysis of data about students and the educational environment to understand the features of obtaining new knowledge and optimize the educational process.

It is known that the process of acquiring new knowledge is large-scale and to further increase its effectiveness, it is necessary to control the environment,

form, method, and means of education. Today, pedagogical analysis as an emerging technology is being used by teachers to study student behaviour to provide fast, deep, and quality education. Learning analytics technology, officially launched in 2010, is predicted to become one of the most popular technologies after 2020.

Analysing the rate of learning of students and their behaviour in this process provides teachers with the following opportunities:

- definition of an educational roadmap;
- ensuring appropriate conditions for learning;
- determination of the forms of organization of the educational process;
- selection of equipment and tools for training;
- introduction of appropriate methods and techniques for the student audience;
- optimization of the content of education, etc.

Organizational and methodological problems of using this technology in the educational process were studied by Guzmán-Valenzuela [18] and other scientists.

The study of analysis as one of the new technologies embodies the following directions, designed to achieve a common educational goal:

- education - development of methods of pedagogical research, training, assimilation, and evaluation of educational results;
- analysis - observation of the educational process, recording and processing of statistical data related to the educational process, comparison,

summing up, visualization, decision making, forecasting the academic success of students;

- student-centred design - ease of implementation, construction of projects for participants in the educational process, identification of poorly digestible students, etc.

The main educational goals of studying analytics are:

- support strategies for the development of knowledge, skills, and abilities of students;
- Provide students with timely conclusions about the dynamics of their learning;
- promote the improvement of important personal qualities, such as cooperation, critical thinking, communication skills, and creativity;
- development of self-awareness of students through self-assessment;
- promote quality learning and teaching by providing empirical (based on practical activities or experience) evidence of the success of pedagogical innovations.

The analyses are mainly carried out in the following areas:

- descriptive analysis (comprehension of the history of the educational process) - refers to the analysis of all statistical data collected from the moment of admission to graduation of students based on the level of satisfaction of students with the educational process, questionnaires, and personal conclusions of students and graduates;
- diagnostic analysis - “why did this happen?” in the educational process. collects, searches, processes, corrects, and

examines the essence of the door to answer the question. This analysis covers the following questions:

- a) presentation of the main indicators of the quality of education to the management of the educational institution and analysis of data for its improvement;
 - b) defining guidelines for achieving relevant quality indicators;
 - c) analysis and definition of high-quality educational strategies;
 - d) study the impact of the management system on quality indicators.
- predictive analysis - forecasting the prospects for the development of education based on the combination of historical and traditional data. This analysis uses statistical models and algorithms to draw appropriate conclusions about the relationships between participants in the educational process.

In addition to the advanced educational technologies of the world described above, cloud and project educational technologies are widely included in the modern educational process.

VIII. Cloud technologies. The concept of cloud technologies (or cloud computing), which was first used in 1996 to describe a computing model where all applications are hosted in the cloud, is rapidly entering all aspects of today's digital society. In the process of cloud computing, the user communicates with a server designed to provide cloud computing services over the Internet and creates personal backups of the applications and data stored on it that are necessary for processing. The processed (edited) data is again sent to the server for storage.

Since the storage of information on the Internet provides great convenience for its

users, the circle of cloud technology supporters is expanding and gradually entering the education system. Cloud technologies provide the following opportunities for participants in the educational process:

- openness to participants in the process;
- sharing of educational resources;
- individuality and mobility in the use of resources;
- lack of importance of time and space;
- cooperation and mutual communication;
- individual education and independence.

To date, international servers such as Coursera, Google Classroom, Blackboard, Microsoft Education Centre, and Knowledge Matters have gained a great reputation in the field of cloud technology services among the participants in the educational system. Cloud technologies for education provide its users with the following conveniences:

- improvement of educational process management;
- openness and mobility of information;
- online and offline educational courses;
- competitiveness;
- reduction of time and costs;
- arbitrariness of place, time, and speed of learning;
- reliability and safety.

Research work related to the methodology of using cloud technologies in the education system was carried out by scientists such as Guanming Bao &

Ping Guo [19], Tzavidas, E. [20], and others.

A virtual machine in a cloud learning environment might not have the programming language IDE installed. In such cases, sites such as online-ide.com, codechef.com, replit.com, jdoody.com, codingrooms.org, and programiz.com may allow you to work online with modern programming languages, including Python. All of these sites allow registered users to select one of the online programming languages on their computer and run their programs written in that language.

IX. Project educational technologies.

Today, in the field of teaching the basics of programming, project-based learning technologies are being reformed as one of the effective ways to solve many educational problems. Although the method is considered one of the "old" ones, it has taken on a new meaning in today's educational environment. At the heart of this technology, which many teachers recommend put into practice as one of the main educational technologies of the XXI century [21] and "a technique that every teacher should know" [22], is a method based on project development.

A project is a plan for solving a particular problem. When designing a software tool for solving a practical problem, it is supposed to express a chain of logical connections between its components in a form convenient for developing a program. Projects for the software can be built in one of the individual and template ways.

The project method was proposed by the American philosopher-educator John Dewey (1859-1952) and his student W.H. Killpatrick at the beginning of the 20th century, which puts forward the idea of

organizing the educational process based on the interest and active desire of students to acquire vital knowledge. According to J. Dewey, "learning by doing means organizing the activities of students aimed at solving problems independently. The project method should remain one of those methods." These ideas are reflected in the teaching of domain-specific programming languages. Typically, the project method is used in teaching to solve multifaceted specific life problems. Such tasks are practical in nature and involve the joint application of skills, abilities, and creativity in various fields of science and technology. The results (or decisions taken) of the developed project will be suitable for practical application. According to this aspect, it is believed that the use of project technologies in teaching students programming languages in higher educational institutions gives the best effect. The problems of using this method in the educational process were studied in the scientific research of Lipes-Markula & Aksela [23], Author [24, 25], and other scientists.

The stages of project development can be expressed using the following algorithm:

- 1) in-depth analysis of the content of the main task (setting a task or setting a goal);
- 2) division of the main task into subtasks (parts);
- 3) Continue step 2 until the subtasks are solved using one of the domain-specific programming methods or its operators;
- 4) logically link the main task and the subtasks arising from it to achieve the goal (project development);
- 5) registration and analysis of the results of the project;
- 6) conclude.

Projects offered to students can be short-term (for one pair) or long-term (for a specific module of educational material, term paper, qualifying work, master's thesis, etc.). Naturally, such projects are carried out by students on their own and are quite practical in nature. If necessary, the teacher provides examples of tasks and participates in the project development process with methodological recommendations.

Also, in addition to the educational technologies described above, in the process of teaching domain-specific programming languages, other technologies can be used by the educational goals and possibilities of use.

CONCLUSION

In the modern digital society, scientists and teachers have developed a large number of new (or modernized) educational technologies, studied their effects, and recommended them for practical use. However, no educational technology is recommended as the most efficient and effective technology unless the following situations serve as the basis for teachers to choose one or another educational technology for current training sessions:

- educational goals and objectives;
- the content of the topic;
- characteristics of the student audience, including the level of readiness to master the educational material;
- students have the incentive to develop the subject;
- methodology explanation of educational material;
- pedagogical conditions;
- technical and didactic means.

The article and research findings also serve as an important basis for educators to decide on the combined available use of the above educational technologies.

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