

PEDAGOGICAL TECHNOLOGIES FOR EFFECTIVE INTERACTION WITH STUDENTS IN THE ERA OF EDUCATION 4.0

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Abstract: *Education 4.0 is a comprehensive concept for the modernization of formal education, which is inspired by the philosophy of Industry 4.0 and its advanced economic model. The parameters of Education 4.0 include distance, blended, personalized and project-based learning, online assessment, robotics, artificial intelligence (AI), database, virtual reality (VR), augmented reality (AR) and virtual environment. These approaches and tools can replace the cumbersome outdated procedures of conventional education with creativity and attention to children and students. The article examines the integration of technology as a learning tool and the possibilities of new pedagogical approaches and practices to provide answers tailored to the specific needs of each student. Among them are the method of learning through practical tasks (case study), VR/AR simulations, the flipped classroom, project-based and problem-based learning. Special attention is paid to gamification as an effective educational technology in the digital school. The presented pedagogical technologies are essential tools that can ensure the transition of the modern school to digital transformation in the educational process.*

Keywords: *Keywords: Education 4.0, Case study, VR/AR simulations, Flipped learning, Project and problem-based learning, gamification*

INTRODUCTION

Digital transformation is an inevitable stage of the renewal of school education, which has been developing in recent years in parallel with the mass penetration of digital technologies into all spheres of public life. It is part of the initiated technological evolution in the sector, which experts call Education 4.0, and its main goal is to prepare children and young people for life in the digital society and the professions of the future.

Education 4.0 is a comprehensive concept for the modernization of formal education, which is inspired by the philosophy of Industry 4.0 and its advanced economic model. For humanity to benefit from these new technological standards, education must enable children from an early age to acquire the knowledge and skills to work with technology that will facilitate their transition to coexistence with intelligent automated systems. New technologies have many applications in the modern education system that can greatly enhance the learning experience.

The parameters of Education 4.0 include distance, blended, personalized and project-based learning, online assessment, robotics, artificial intelligence (AI), database, virtual reality (VR), augmented reality (AR) and virtual environment. These approaches and tools will replace the cumbersome outdated procedures of conventional education with creativity and attention to children and students. Education 4.0 is based on innovation and learning skills of the XXI century, among which are critical thinking, creativity, communication and collaboration (Dimitrova 2023: 9 – 13).



An effective digital transformation in education can occur if such pedagogical technologies are introduced into the learning process that meet the needs of society, the characteristics of individual development and the interests of modern children and students. In this regard, if until recently it was common for technologies to serve as a means of transmitting educational content, today their role is to open new opportunities for adolescents and help the teacher to create a personalized environment for development during training.

On the other hand, modern children are becoming more and more independent in their search for information, in its perception, analysis and application for learning, teamwork or solving non-standard creative tasks. Thus, from passive consumers of educational information, they become active creators of their own knowledge. Digital technologies are one of the supporting components in this new educational situation.

The aim of the present development is to present the integration of technology as a learning tool and the possibilities of new pedagogical approaches and practices for providing answers tailored to the specific needs of each student. Among them are the method of learning through practical tasks (case study), VR/AR simulations, the flipped classroom, project-based and problem-based learning. Special attention has been paid to gamification as an effective educational technology in the digital school.

New technologies and formats in digital education

The dynamic technological development of mankind dictates the current world trends in education. They are related to the need to use new educational technologies and are in accordance not only with the characteristics of the digital generation, but also with the current socio-cultural situation.

The basic minimum of pedagogical technologies, which form the list of new educational solutions and are necessary for building a digital educational process, include technology for network communication, technology for distance and mixed learning, technology for student project activities.

The method of learning through practical tasks (case study) is particularly effective when implementing distance learning. In its application, students are provided with informational educational resources for independent study (case studies), which are then subject to analysis, decision and discussion. Thanks to network connections, students in the class can get the resources they need. In addition, through the network connections, it is possible to realize both the interaction of students with the teacher, and between students themselves.

Case studies can be divided into two main types: teaching and research. The training cases are aimed at reflecting real-life situations and are their detailed description. They can be used in the course of studying a specific subject, the topic of the lesson, and contain a large amount of necessary information (facts) to find an answer to the problem. Students of the knowledge, skills and abilities needed to solve the learning situation can use educational cases at the stage of consolidation. Research cases are necessary to study a certain process (phenomenon) and require a practical analysis of a certain theoretical concept. When solving research cases, students either confirm and complement the existing hypothesis or propose an alternative one.

The basis of *VR/AR simulations* is the use of technologies related to the use of virtual and augmented reality tools. This method is relatively new to pedagogical science, and at this stage, there is still no general information about the effectiveness of using VR/AR simulations in the educational process. (Pellas, N., Fotaris, P., Kazanidis, I. et al., 2019)

Kolykhmatov defines the most common formats for applying virtual reality in the learning process:

- playing with the machine (virtual simulators (trainers), with the help of which the student immerses himself in virtual reality and performs specific actions according to a previously prepared scenario);
- playing with reality (the student performs actions in the virtual space under the guidance (control) of other participants who are in the material reality);
- a game in virtual cooperation (virtual cooperation, when a student in a virtual space performs actions with other learning participants who are also in a virtual space). (Kolykhmatov, 2020: 105)

Very often in the learning process augmented reality (AR) technologies are used together with virtual reality (VR) technologies. In this way, a greater engagement of the students is achieved.

One of the key variants of blended learning is *flipped learning technology*. It is realized according to the formula: independent learning of the new material (including in online format), combined with practical-oriented activities in an on-site format.

When applying this technology, the direct transfer of knowledge is moved from the group educational space to the individual one. At the same time, this collaborative learning environment in which students communicate has been transformed into a dynamic and interactive space. In it, the teacher acts as a facilitator (mentor, trainer, consultant) and helps students to apply the studied theory in practice, to develop skills for further independent work, training and development. The essence of the flipped learning is the flipped classroom.

Another type of blended learning is *mobile learning*, which includes the use of educationally oriented mobile devices and mobile applications by students in the educational process. During the Covid pandemic, mobile learning in Bulgaria took on a wider scale. In 2021, the Ministry of Education and Science purchased and delivered to educational institutions 24,500 tablets and another 15,500 laptops, Windows tablets and Chromebooks for distance learning in an electronic environment.

The „One Device - One Student“ (1:1) model is a variant of mobile learning where each student and teacher has their own electronic device and a personal profile associated with it. They have a personal laptop, Chromebook, tablet or smartphone and constant internet access to study, share information and communicate in groups both inside and outside the classroom. The idea of the model is for students to become active participants in the educational process, to learn to create digital educational content, not just to use it, etc.

The 1:1 model is actively applied in a number of innovative schools around the world - in the USA, the Netherlands, Finland, Sweden, etc. It is still "running" in Bulgaria, having been introduced for the first time in 2019. Now 150 classes in 50 schools are working on this model, and the covered cities in the country are a total of 13.

Project-based learning in a digital educational environment

A number of pedagogues define project-based learning as extremely constructive for the development of a young student's personality (Gyurova 2006). The project method in education supports students "in independent decision-making in a difficult situation, forms educational motivation in children, their reading literacy, readiness for self-education, educational reflection, self-regulation and self-organization" (Dimitrova 2023: 200).

It turns out that the method, which is extremely important for stimulating the cognitive activity of children of the XXI century, is not a discovery of our time. According to some



researchers, the project method in the field of education was applied as early as the end of the 16th century. Over the next two centuries, it was established as a teaching method, and in the late 19th and early 20th centuries, it was introduced into mass schools in America. A real evolution in its application worldwide has been observed since the 1960s, with some even defining it as "one of the symbols of the new education" (Knoll 1997).

The validation of the project method of education is related to the ideas of the humanistic direction in philosophy and education, advocated in the works of the American philosopher and teacher John Dewey and his student V. H. Kilpatrick. The main idea of the method is as follows: active learning through purposeful activity of the student, which is in accordance with his personal interest in the specific knowledge (ibid.).

The term "project", which is widespread in all spheres of public life, comes from the Latin word *projectus* and translated means leading, prominent. Along with this, the concepts "project activity", "creative project activity", "project learning", "project method" are also used in the pedagogical literature.

Learning through projects includes the formulation of a specific problem and its subsequent solution with the mandatory presence of an idea and hypothesis, clear planning of actions, distribution (if it is group work) of roles, i.e. the presence of tasks for each participant, close interaction, responsibility, regular discussion of intermediate steps and results.

Solving a certain educational problem in the course of project activities requires the integration of knowledge and skills from different fields of science and technology, skillfully combined with a huge dose of creativity.

By introducing the project activity into the educational process, students can be trained to:

- to identify and define problems;
- analyze them and find ways to solve them;
- to develop the ability to search and work with information;
- to use the received information to solve the assigned tasks.

Project-based learning is effective in cases where a certain research, creative task is set in the educational process, the solution of which requires integrated knowledge from various fields, as well as the use of research methods.

Based on the studies of a number of authors, we can deduce the following features of the project method in education (Blumenfeld et al. 1991; Chard 2001; Fleming 2000):

1) the basis of project-based learning is not the informational approach focused on the development of students' memory, but the activity approach aimed at forming a complex of various skills and abilities necessary for successful self-realization;

2) the project method provides for the creation of a motivational situation, its maintenance in the work process and improvement of the effectiveness of training and education;

3) project-based learning foresees a solution to a problem that must end with a very real and practically oriented result;

4) the project is a complete development and cannot be stopped halfway, as the final product is being evaluated;

5) this pedagogical technology is tailored to the interests and needs of students and corresponds to the educational content;

6) project-based learning includes various activities (analysis, observation, synthesis, comparison, etc.), requires integration of knowledge and skills from different fields of

science and includes direct application of students' acquired knowledge in the course of practical activities;

7) project work is both a method and a result of the students' training, involving them in social relations, acquiring their own life experience, socially significant knowledge and skills that allow them to successfully realize themselves personally and professionally throughout their lives. Through the project method, we solve a number of current social and pedagogical problems related to increasing the level of the student's speech development, improving his communicative culture, as a basis for his further development as a person (Vasilev 2021: 43).

In the context of the digital economy, the importance of the project method in education follows the logic of modern project management with the relevant stages (identifying a problem/need – searching for an idea – setting a task – designing – testing and correcting a product – presenting and promoting the product – product management). In this way, "performing projects, students gain experience, on the basis of which a set of universal competences sought by the digital age is formed" (Dimitrova 2023: 203).

In addition, the assessment of the progress and the results of the completed project allow to make a complete and objective assessment of the degree of formation of the universal competences of the students participating in the project activities. In this way, we help the modern student to be "active, creative and have the skills of expression and innovation, creativity and adaptability in the dynamically changing environment" (Stefanova 2022: 10).

With the application of digital technologies, project activities acquire new dimensions. Using network technologies and digital communication tools, students, divided into teams, have the opportunity to create so-called network projects. Along with other universal competences, this type of interaction supports the formation of knowledge and skills for digital competence and digital creativity.

Gamification as an effective educational technology in the digital school

The realities of the modern world require new approaches to education, improving its quality and accessibility. That is why one of the main tasks of the modern teacher is to choose and include in the educational process such forms, methods, means of training, which with minimal means will give an effective result. In this regard, the inclusion in the learning process of a person who spends most of his time in the digital world is possible only by creating an environment that is familiar to him. This justifies the efforts in the development of the digital educational environment and the expectations that it will contribute to improving the quality of education.

With the strong presence of digital tools in the learning environment, the change in approaches and methods of learning is connected. Thus, among the current directions in the development of modern education is the "gamification of the learning process, which is based on the deep attachment of the XXI century children to computer games" (Dimitrova 2023: 204).

According to N. Vitanova, "the idea of fun and attractive learning, which would provoke the interests of the students and stimulate their cognitive activity", dates back to Antiquity and developed through the different eras (Vitanova, 2019: 30).

Programmer Nick Pelling while working on the user interface of electronic devices such as mobile phones, ATMs, etc., coined the term "gamification" in 2002. Previously, C. Konrad, known as the "grandfather of gamification", in his book "The Game of Work" in 1984 talked about the application of game principles in business processes (Coonrad,



2012). His rules for employee motivation include frequent feedback, clear goals, personal choice and functions, openness.

As it becomes clear, initially the concept of „gamification“ was used in areas such as the entertainment business and marketing, but today it has already been established in all spheres of human activity. Nowadays, gamification issues are discussed both in pedagogy and in the fields of business, marketing and management. Gamification is seen as a tool in personnel management, as a way to motivate and activate activities, to solve applied problems and even as a tool to maintain health. All this gives reason to talk about gamification not only as part of a new concept in education, but about the presence of a new trend in the educational process.

In pedagogy, there are many definitions of the term „gamification“, but they all boil down to one thing - the use of game technologies in a non-game context (Huotari, Hamari, 2012; Robson et al, 2015). For the purposes of the present study, we will adhere to the broad interpretation of the term – as the use of game technologies in the educational process. This understanding gives reason to consider gamification as a universal pedagogical technology.

A number of researchers are working on the integration of the gamified approach at various levels in the educational process - from early childhood to additional education (Banfield, Wilkerson, 2014; Hartung, 2018; Vitanova, 2019). This is due to the fact that through game technologies it is possible to train people of any age, regardless of the field of activity in which they are engaged.

The ideas of gamification in education have a direct connection with the concept of pedagogical animation, „with the philosophies of education of the future (constructivism and connectivism) and ideas about the parameters of the person-oriented educational paradigm, where the student is at the center of the pedagogical interaction. This new trend in education is due to the inclusion of various computer games and simulations in the learning process. Gamification can be realized both through the fragmentary inclusion in the learning process of individual elements of the games, and through complete game plots“. Thus, despite the fact that gamification includes game elements, the student learns the learning content while having fun (Vitanova, 2019: 31-32).

That thanks to the game, learning becomes more effective, is confirmed by a large-scale study on the benefits of gamification, conducted in 2018 in Germany. Students learn faster and better, and most importantly, without fear, their cognitive and creative abilities are activated. This applies equally to participation in games conducted both in traditional form and with the use of digital devices. However, in the second case, when computers and tablets were used in the classroom, the motivation was even higher (Luig, 2019).

Today, gamification is considered an innovative approach that will help „to bridge the generation gap between teachers and students“ (Kapp, 2007: 28). Another advantage that makes this educational technology highly valued is its versatility. It can be used in various pedagogical aspects in the classroom - as part of homework, in tests or as a main learning activity to motivate students, improve their skills or improve the quality of learning.

This technology should not be equated with such gaming practices as role playing and business games for example. The game takes the participants to a different space, while gamification involves dwelling in the existing reality. The role-playing game by its properties has a different form of organization. When introducing gamification, the educational goal comes to the fore, and the tools can be digital media, computer games, as well as analog devices.

Another advantage of gamification over other teaching methods is that the game helps students overcome their biggest fear in the classroom – making mistakes. In the game, he can go through the corresponding level again and again while working on his mistakes, and if he does it flawlessly - to completely master the game space. In addition, the task can be complicated and, as in a regular game, after completing a level, the student can move on to the next, higher one.

Among the advantages of the considered approach are opportunities to develop teamwork abilities, which allows participants to come together to solve common problems. In addition, the game can offer tasks that allow students to take initiative and take responsibility for decision-making. In some cases, individual game elements can be used to solve specific educational tasks, in others the integration of a full-fledged game with an educational purpose is fully justified.

The scientific literature on gamification often emphasizes that the judicious, strategic and appropriate use of game elements can create a learning situation driven by high levels of active participation and motivation, which in turn leads to positive cognitive, emotional and social outcomes. However, there are scientists who talk about the limitations of gamification: «it can contribute to the devaluation of the studied subject; study work can become simply a game; some games are better suited to encourage the learner to work only with concepts and concepts rather than learning their meaning; games alone are not enough to ensure the effectiveness of learning; learning difficult moments cannot be overcome only with the help of games“ (Apostol, 2013).

Like any other technology, gamification has both advantages and disadvantages. Game rules include rewards for successful work. It should be borne in mind that receiving a reward for the work that was interesting to students in itself could lead to the fact that in the future such tasks are solved only to receive a reward, and thus the interest in learning is lost. Thus, a change in motivation is likely to occur as well. In order to avoid this, it is necessary to maintain interest in learning in every possible way, without resorting to grades and other rewards.

When organizing the games, we must keep in mind that in the case of improper organization, one of the advantages - the opportunities to develop initiative and independence, can lead to a deterioration of interpersonal relations. In addition, competition and the competitive element can reduce the interest of weak students in the educational process.

In order to get the expected result, the teacher must be aware that gamification is unthinkable without rules, and the goal is realized in the real world, not in a game situation. Furthermore, „it is not spontaneous, all the player's moves are registered and structured. The structuring of gamified educational activities is mandatory. It is necessary to divide the entire learning content into certain steps/stages, each of which has its own goal, work is done on each step, and the achievement of the intermediate goals leads to the realization of the general goal“ (Vitanova, 2019: 41).

In this regard, N. Vitanova also offers an exemplary algorithm for gamification of learning, which includes seven consecutive steps. It begins with determining the plot, and "to turn the lesson into a game, an engaging story is needed." Then it moves on to defining the goal, game mechanics and assigning roles. A mandatory element is the use of familiar things in an unusual way, and some of the interesting smartphone applications can be included in the implementation of some of the tasks. The game within the educational process is unthinkable without motivation and reward, which are mutually connected (Vitanova, 2019: 43-44).



One of the main problems of the pedagogical process is the lack of motivation among students. The use of mostly traditional forms of work often leads to the fact that learners are afraid of the complexity of the discipline. This leads to a decrease in interest in the subject, and the ability to perceive information is reduced to a minimum.

The advantage of the gamified approach is that the teacher does not need to form motivation from external factors. The fact that play brings joy and everyone from childhood, and therefore the integration of game elements know pleasure generates motivation „from within“. The positive emotions accompanying the process of any game help increase the student's interest, focus his attention on the task, and also ensure easier memorization of the new learning material.

CONCLUSION

It can be summarized that the presented pedagogical technologies are basic tools that can ensure the transition of the modern school to a digital educational process. At the same time, their use does not exclude other traditional pedagogical technologies and learning methods, the effectiveness of which can also be significantly increased by integrating with new digital learning tools.

To solve the current problems related to modernization and digital transformation in education, the correct distribution of functionality between the teacher and tools to support digital learning is crucial.

At the same time, it is necessary to combine various learning technologies, learning formats and technical innovations into a single educational system, while maintaining a balanced use of traditional face-to-face learning models and mobile technologies, virtual and augmented reality tools and other digital tools and technologies.

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