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GAMIFICATION STRATEGIES FOR MOTIVATING STUDENTS TO STUDY INFORMATION SCIENCE

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The rapid development of digital technologies has created a need for improving the processes of acquiring new knowledge. As young people today are fond of computer games, gamification is becoming a means of introducing elements of innovation into the educational process and attracting the attention of students. The use of gamification during the classes of computer science is one of the methods that complement the learning process. Motivation and self-confidence in the process of learning computer science has always attracted the attention of educators and researchers, as modern society is constantly evolving and introducing new technologies. Numerous studies have shown that gamification increases interest in learning, motivates participants in the educational process to interact productively, discuss common problems, and defend their own points of view when solving various tasks in front of colleagues.

Analyzing research in the field of learning gamification, it can be noted that the use of the gamification method helps approach the educational process to real-life practical activities. Thus, it allows students to learn more effectively and improve their skills. Game technologies are closely

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related to self-realization of students' personalities, and they significantly improve the quality of learning. The use of gamification in the educational process is an important element in the development of students' professional competences.

The game can be considered as one of the types of interactive teaching methods aimed at implementing the psychological processes of student self-realization. During the game, students take an active position, which leads to an increase in their interest in the object of knowledge. In this context, the role of the teacher is transformed, they become the organizer and leader of the process.

The article examines the results of research by domestic and foreign scholars on the implementation of game technologies in the educational process. The analysis of the latest research in the field of educational gamification confirms the importance of using gaming tools to form algorithmic thinking, develop programming skills and expand professional competencies.

Keywords: digitalization, gamification, motivation, digital educational environment, information and communication technologies.

ВИКОРИСТАННЯ СТРАТЕГІЙ ГЕЙМІФІКАЦІЇ ДЛЯ МОТИВАЦІЇ ШКОЛЯРІВ ДО ВИВЧЕННЯ ІНФОРМАТИКИ

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Завдяки стрімкому розвитку цифрових технологій з'явилася необхідність у вдосконаленні процесів засвоєння нових знань. Оскільки сучасна молодь віддана комп'ютерним іграм, гейміфікація стає засобом внесення елементів новаторства в освітній процес і привертання уваги навчальників. Використання комп'ютерних наук може стати захоплюючою та важкою ідеєю, і використання гейміфікації в навчанні інформатики є одним з методів, що доповнюють навчальний процес. Мотивація та впевненість у собі в процесі вивчення інформатики завжди привертала увагу педагогів та дослідників, оскільки сучасне суспільство постійно еволюціонує та впроваджує нові технології. В численних дослідженнях зафіксовано, що гейміфікація підвищує інтерес до навчання, мотивує учасників освітнього процесу до продуктивного взаємодії, обговорення спільних проблем та відстоювання власних точок зору при вирішенні різних завдань перед колегами.

Аналізуючи дослідження в галузі гейміфікації навчання, можна зазначити, що використання методів ігровізації сприяє наближенню освітнього процесу до практичної діяльності в реальному житті. Цей підхід дозволяє студентам ефективніше засвоювати матеріал та поліпшувати свої навички. Ігрові технології тісно пов'язані із самореалізацією особистості студентів, і вони значно підвищують якість навчання. Використання гейміфікації у навчальному процесі є важливим елементом розвитку фахових компетентностей здобувачів освіти.

Гру можна розглядати як один із видів інтерактивних методів навчання, який спрямований на реалізацію психологічних процесів самореалізації студента. Під час гри студенти приймають активну позицію, що призводить до зростання їхнього інтересу до об'єкта пізнання. У такому контексті роль викладача трансформується, він стає організатором та лідером процесу.

Стаття розглядає результати досліджень вітчизняних та зарубіжних вчених з питань впровадження ігрових технологій у освітній процес. Проведений аналіз останніх досліджень у галузі гейміфікації освіти підтверджує важливість використання ігрових засобів для формування алгоритмічного мислення, розвитку навичок програмування та розширення фахових компетентностей.

Ключові слова: цифровізація, гейміфікація, мотивація, цифрове освітнє середовище, інформаційно-комунікаційні технології.

Introduction of the issue.
Information and communication

technologies (ICTs) are essential to every sphere of human life and every type of

professional activity. The same applies to everyday life, in which various ICT-based devices have become an integral part of life.

The modern education system has undergone significant changes in recent years: the content of educational programmes is being updated, with the introduction of e-learning, blended learning and mobile learning, and an emphasis is placed on the practical activities of future specialists. The use of computer networks, web applications, and interactive resources makes education more accessible, stimulates students' cognitive interests, and increases their motivation to learn. One of the most significant innovative trends in modern education is gamification, most commonly considered as a system which applies computer game components in non-game situations.

There is no doubt that game processes are a "sphere of emotionally intense communication" requiring the development of special relationships and contributing to the self-expression of its participants. At the same time, the involvement of students in game techniques should stimulate positive emotions based on the game's potential, and thus use informational, emotional, interactive tools to obtain quality results in the practical sphere in the activities of the future professional.

In today's context, representatives of the scientific community lack a unified approach to defining the conceptual foundations of gamification, identifying its potential in education, and implementing gaming experience in the learning process.

Many researchers point out that the use of gamification has a positive effect on student motivation, which leads to improved learning outcomes. Thus, it is important for every educational institution to study and effectively implement gamification tools to improve

the quality of education and training of students.

Current state of the issue. The analysis of modern research shows that the game, as an exceptional phenomenon of human life, has always attracted the attention of philosophers and researchers of different eras, such as Plato, Aristotle, G. Hegel, F. Schiller, and G. Spencer. They considered the game as a significant sphere of human activity. D. Ushynskiy, P. Blonskiy, S. Rubinshtein also studied play as a problem.

In the context of game application in educational institutions, many studies concern business (I. Makarenko, M. Kasianenko, M. Kriukov, Y. Hinzburg, N. Koriak, A. Verbytskyi, etc.) and role-playing (T. Oliynyk, L. Hrytsiuk, V. Notman, S. Karpova, L. Petrushyna, etc.) games. Theoretical aspects of the didactic game have been studied by A. Kapska, I. Nosachenko, V. Semenov, P. Pidkasystyi, N. Akhmetov, Zh. Khaidarov, L. Terletska, A. Derkach, S. Shcherbak, A. Tiukov, E. Smirnov, I. Nosachenko, P. Shcherban, etc.

Studies related to the development and an application of computer games in education are becoming a topical area in the study of computer-based learning (E. Marhulis, Y. Kosov, Y. Melezhyk, V. Horlenko, O. Humanska, M. Ihnatiev). Many scientists and educators believe computer games can fully reveal the didactic capabilities of the computer, contributing to the efficiency of the educational process.

Using various games in the educational process has been going on for decades and remains one of the leading methods of attracting children's attention to lessons in a more convenient form of activity. The terms "game technologies", "gamification" or "gaming" are often used to describe this process.

Outline of unresolved issues brought up in the article. Although the concept of "gamification" first appeared at the beginning of the XXI century, its massive

application in various fields of activity began in 2010. In particular, there are many works (I. Attali, L. Varenina, Y. Oliynyk, O. Orlova, L. Sheldon, F. Faiella, etc.) dedicated to clarifying the phenomenon of gamification. However, an analysis of these studies shows a lack of a single, established interpretation of this term in the scientific community.

Aim of research is to analyze the concept of gamification and determine the potential advantages and disadvantages of their integration into the educational process.

Results and discussion. With the global informatization of society, the use of information and communication technologies has a major impact on changing teaching methods (including in computer science) and leads to the use of new forms of effective organization. Among these modern forms of learning organization, there are three main areas.

Firstly, technical assistance and support provided to teachers in the context of constant changes and updates of both hardware and software learning tools. Secondly, the development and implementation of electronic educational publications and resources, and the use of electronic textbooks. Thirdly, the training of teachers to use modern teaching technologies in the classroom, which make it possible to organize a special motivating environment.

Gamification technology allows applying the principles of game design and game mechanics to a non-game process. Gamification technology requires special professional training of teachers, satisfies the interest of teachers in various methods of increasing student motivation, and introduces certain behavioral changes in computer science education [1].

The gamification used in the study of computer science involves the use of game elements as techniques that influence motivational factors; among them are instant feedback, the ability to

make mistakes, freedom to choose the trajectory of actions, conscious and/or desired achievements, progress mechanics, personal or team rating. All of these can be useful elements of improving students' computer science education and affect the level of motivation, engagement, and achievement of students in computer science lessons [2].

Experts estimate almost all students in grades 10-11 enjoy playing various computer games. From the perspective of influencing computer science education, gaming technologies can be used as part of the curriculum as an introductory tool in programming lessons.

Therefore, gamification:

- a new tool being actively used to improve the quality of education;
- increases the level of student's involvement in the learning process and his/her motivation; [3]
- helps to improve learning and understanding of the subject;
- affects the emotional background of the student: the game shows interest, there is joy and pride in the results achieved, other positive emotional experiences, optimism and pride appear;
- promotes social interaction between pupils through their communication, participation in joint discussions to find a solution;
- creates opportunities for students' self-expression;
- provides freedom of action to correct a wrong decision, and this can be done independently and without negative consequences [4].

The application of gamification in education (and beyond) has three main reasons: engagement, experimentation, and results. Gamification is a system that motivates people, creates conditions for attracting new participants and retaining those who are already involved in the game. This process is particularly meaningful because it stimulates activities that direct participants to solve new problems. All this is connected to the special state of a person in the game - the satisfaction that arises in the process of

in-game/out-of-game victories, rewards, and the approval of others. And just as importantly, it manifests itself in the development of intrinsic motivation, when a person strives for a result accompanied by interest.

Experimentation as a reason for gamification is the basis for self-improvement of the game participant and improvement of his/her results. Certain features can be noted. The first is that a person can always be a loser, but in this case, he or she has a chance to start over. The second is the presence of motivation for innovative approaches to solving problems.

The result may be one of the reasons for using gamification. Indeed, there are successful start-ups in the practice of gamification. But of particular interest are the activities of well-known global companies (Microsoft, Samsung, etc.) that use games to achieve various promising goals. The experience of using gamification shows the acquisition of new knowledge and mastery of new skills in the context of using the resources of gaming activities.

The gamification, as already mentioned, has a unique set of game mechanics and dynamics, techniques, and practices. The game practice of Kevin Werbach and Dan Hunter [5: 62] presents five main techniques of gamification.

Storytelling means "the telling of stories" in English. In the context of gamification, storytelling is a technique that conveys a fascinating story in a high-quality manner. According to the authors, this technique helps to reveal the necessary information by influencing emotions and feelings, entertaining the audience, capturing attention, and stimulating the active attitude of the listener. Storytelling uses a well-thought-out structure as the basis for a fascinating story that is understandable to the audience, a memorable and interesting plot.

The technique of "fragmentation of information" includes mini-levels in the work, the process of dividing information. As a rule, each subsequent mini-level is slightly more difficult than the previous one, and this helps to move forward, and it is better and more interesting than immediately offering participants a high difficulty level – hard, which, if not completed, will cause the participant to lose interest in the game.

The use of the "elements of the competition" technique gives gamification special emotions, the intensity of rivalry, and the achievement of the best result, which stimulates the interest of players.

The technique of encouragement also reveals one's inner potential emotionally. The authors argue that game cups and virtual points evoke no less strong emotions than teacher's assessments, as game signs are perceived in an emotionally vivid game action.

Finally, another technique, according to Kevin Verbach and Dan Hunter, is communication. The authors argue that games that use the potential of communication are the most popular and allow game participants to discuss the development of game ideas and the process of completing a task.

Below are some other ideas and principles of gamification of education:

Reward system. Use virtual or real rewards to motivate students. These can be electronic rewards (badges, medals, points) or physical rewards.

Levels and Achievements. Create a hierarchy of levels that corresponds to the progress of learners. Allow them to "climb" to a new level that can reflect their knowledge and skills.

Competition and Collaboration. Include elements of competition where learners can compete against each other or collaborate to achieve common goals.

Stories and Context. Present learning material in the form of stories or fairy tales, which makes the content more engaging and accessible.

Tasks and Challenges. Create tasks and challenges that require problem solving, knowledge application, and critical thinking.

Assessment and Verification. Use a grading system that takes into account learner progress and achievement, with the ability to receive feedback.

User Experience (UX). Develop gamified courses that incorporate game design aspects to facilitate use and interaction.

Real World and Application. Provide opportunities to apply the knowledge gained in the real world, which increases motivation and practicality of learning.

Gamification can be successfully used in different disciplines and at different levels of education, creating a stimulating and positive learning environment.

Different games can be used in computer science classes to teach and develop important skills for students. Here are some examples of games that can be used.

Scratch is a block programming and community platform designed to teach the basics of programming by creating interactive games, animations and other projects (<https://scratch.mit.edu/>). Scratch has several advantages in the educational process:

Easy to get started. Scratch uses easily dragged and dropped building blocks, making it ideal for beginners. Students can quickly start creating their own programs without having to type code on the keyboard.

Visual programming. The graphical interface environment allows students to visually express their ideas and programme logic. This helps to develop logical thinking and creativity.

Interactive projects. Scratch allows creating interactive projects such as games, animations, and other visually appealing applications that engage students.

Collaborative work. Students can work together on projects, share ideas and skills, which develops teamwork skills.

Learning programming concepts. Scratch allows students to experiment with basic programming concepts such as loops, conditions, and variables, providing them with fundamental knowledge.

Accessibility. Scratch is free and available online, making it attractive for use in a variety of settings.

Community support. Scratch has an active community of users and teachers who share experiences and learning materials.

Consequently, Scratch is a great tool for introducing students to the world of programming and making, giving them the opportunity to learn and create in a playful way.

Minecraft (<https://www.minecraft.net/>) has become a popular tool in the educational process in recent years, especially in STEM (science, technology, engineering and mathematics) education. Here are some of the important aspects of using Minecraft for educational purposes:

Creative process. Minecraft gives students the opportunity to build worlds, create game mechanics and develop creative skills. This helps to solve problems and projects in a creative way.

STEM learning. Using Minecraft in STEM education allows students to explore science, technology, engineering, and maths concepts in a playful environment. They can create physics experiments, explore math's concepts, and solve engineering problems.

Teamwork. Minecraft allows students to work collaboratively on projects and tasks, which develops teamwork and communication skills.

Problem solving. In a gaming environment, students can encounter various problems and tasks that require solutions, which develops problem-solving and critical thinking skills.

Historical learning. Teachers can use Minecraft to take students on a virtual journey back in time, exploring historical events and creating virtual reconstructions of historical sites.

Language practice. The game environment allows learners to interact in a language environment and practice communication skills, especially when they work in groups or teams.

Developing technical skills. Minecraft helps to develop technical skills, such as basic programming and technical systems, through the use of command blocks and game mechanics.

Almost any topic can be taught or learned with Minecraft, and it becomes a powerful tool to stimulate learning and engagement in a variety of fields.

Kodu Game Lab is a game creation software developed by Microsoft (<https://www.kodugamelab.com/>). Kodu Game Lab is aimed at teaching programming and developing creative skills among students. Here are some of the benefits and features of Kodu Game Lab in the classroom:

Simplicity of use. Kodu uses a visual interface and block programming, making it easy to learn and use, even for beginners.

Creative approach. Students can create their own games from scratch, which develops their creative and design skills.

Learning to code. Kodu allows students to learn the basics of programming, including conditions, loops, and event handling, through the use of blocks.

Development of logical thinking. Developing games in Kodu requires solving logical problems and understanding the interaction of game elements, which helps develop students' logical thinking.

Collaborative work. Students can work in groups to create large and complex games, developing collaboration skills.

Learning algorithms. Using Kodu, students can create and optimize

algorithms to control different aspects of the game.

In-depth learning. Students can dive deeper into game development by learning and applying a variety of programming concepts.

Pedagogical potential. Teachers can use Kodu to teach specific computer science and math's concepts through the lens of game creation.

The Kodu Game Lab can be an effective tool for introducing students to the world of programming and developing digital skills, while promoting creativity and logical thinking.

Roblox Studio (<https://create.roblox.com/>) is an integrated development environment for creating games on the Roblox platform. Using Roblox Studio in the educational process has several advantages:

Lua programming. Students can learn the Lua programming language, which is used in Roblox Studio to develop scripts. This allows them to learn programming in a real game environment.

Creative game design. Roblox Studio allows students to create their own games and learn aspects of game design, such as levels, characters, interface, and gameplay.

Graphic design. Students can use built-in tools to design graphics and animations, developing skills in graphic design.

Collaboration. Roblox Studio supports collaboration, allowing students to work on projects together, even in real time.

Teamwork training. Students can learn how to work effectively in a team by distributing tasks and combining their efforts to create a complete game.

Mastering various aspects of game development. Roblox Studio allows students to focus on specific aspects of game development, such as scripting, modelling, animation, and physics.

Learning the basics of physics and mathematics. Students can apply physics

and math's concepts to create realistic gameplay effects and solve problems.

Practical application of skills. Using Roblox Studio allows students to experience the practical application of their programming and game design knowledge.

Roblox Studio can be an excellent tool for learning programming and game development, especially for those interested in studying game design and working in the game industry.

CodeCombat (<https://codecombat.com/>) is an educational platform allowing students to learn programming by playing games. The platform is designed to make learning programming fun and provide a hands-on approach to learning skills. Here are some of the benefits of CodeCombat in learning programming:

Game-based approach. Students learn programming by interacting with the game environment, which makes the process fun and engaging.

Visual programming. CodeCombat uses block programming and visual elements to make it easy for beginners to get started.

Various tasks. The platform offers a variety of tasks and difficulty levels, from beginner to advanced, allowing learners to develop at their own pace.

Programming languages. CodeCombat supports several programming languages, including Python, JavaScript, HTML/CSS, Java, and others, giving learners a choice and allowing them to learn the language of their choice.

Community. Students can discuss tasks, share experiences, and get support from other users of the platform.

Advanced learning. CodeCombat also offers additional sections for deeper learning of certain programming concepts, such as object-oriented programming, database management, etc.

Interactivity. Students can see the results of their code in real time, allowing

them to see how their programs work right away.

CodeCombat can be a useful tool for teachers and students who want to learn programming in the form of a game, especially for those who are just starting out in the world of programming.

Math Blaster (<https://playclassic.games/games/educational-dos-games-online/play-math-blaster-plus-online/>) is a series of well-known open educational games that focus on teaching math and logical thinking. The games are designed to make learning math fun and engaging for children. Here are some of the features and benefits of using Math Blaster in the learning process:

Interactive learning. Math Blaster games offer interactive tasks and challenges that allow children to learn math through interaction and play.

Competition and motivation. The built-in competition elements allow students to complete tasks and compete with other players, which can increase their motivation and interest in math.

Adaptability. Some versions of Math Blaster have adaptive learning systems that adapt the level of difficulty of tasks to the individual needs and level of knowledge of each student.

Development of logical thinking. The game helps to develop logical thinking and the ability to apply mathematical concepts to solve problems.

Accessibility. Math Blaster can be accessed through a variety of platforms and devices, making it convenient to use at home or at school.

Visual appeal. The bright and fun graphics can attract children's attention, making the learning process more engaging.

A variety of tasks. Math Blaster has a wide range of tasks covering various topics in mathematics, from arithmetic to geometry and more.

The overall goal of Math Blaster is to make learning math interesting and fun

by giving children the opportunity to develop their skills while playing games.

Hour of Code (<https://hourofcode.com/ua>) is a set of games and exercises created specifically for the Hour of Code in schools. A global initiative aimed at promoting programming and computer science among students around the world. The main idea is to give every student the opportunity to experience programming for one hour so that they can understand how interesting and accessible it is.

Accessibility for all. "Hour of Code is open to students of all skill levels and ages, making it accessible to a wide range of learners.

Variety of platforms. The initiative offers a variety of learning resources and platforms, including visual programming, which makes it interesting for different groups of students.

Encouraging creativity. Students can develop their creativity by creating their own programmes and trying out new ideas.

Increase motivation. Students can experience the success and satisfaction of being able to create something new, even in a short time.

Collaboration and experience sharing. "Hour of Code can be an opportunity for students to work together and share experiences and ideas.

Support for teachers. The initiative gives teachers the opportunity to introduce programming into their lessons and encourages them to support students in this process.

"Hour of Code is an important step in promoting computer literacy and digital skills among young people, making programming accessible and fun for everyone.

The Codingame website (<https://www.codingame.com/start/>) is a platform aimed at teaching programming through a game-based approach. Codingame offers students and

programmers to develop their skills by solving tasks in a game format.

The main features and capabilities of Codingame for use in the educational process:

Programming tasks. The platform offers a wide range of tasks and puzzles to solve using different programming languages.

Community and competitions. Users can join the community, compete in programming battles and take part in competitions.

Online games. Customers can play games that help to improve their algorithmic skills.

Learning with peers (Code Golf): The competition is based on writing the shortest possible code to solve a specific problem.

Learning real programming languages. The programming languages for solving problems are Python, Java, C++, and many others.

Educational courses. In addition to tasks and games, Codingame also offers educational courses on various topics.

Analytics and statistics: It allows tracking your progress and getting analytics on your performance and solved tasks.

The overall goal of Codingame is to promote programming learning through an engaging gaming environment. It can be a useful tool for those who want to improve their programming skills or learn programming in a fun way.

Implementing gamification in computer science classes can face a number of potential challenges. Here are some of them:

Technical limitations. Insufficient hardware or an unstable internet connection may limit the use of online games or gamified platforms.

Language barriers. Many gamified platforms and games may be designed in English, which can be difficult for learners who do not have sufficient knowledge of the language.

Insufficient time. If gamification is accompanied by a large number of tasks, this can be compounded by insufficient time in the classroom, leading to stress for the teacher and students.

Unequal access. Not all students may have access to modern technical means, which can cause differences in the ability to participate and use gamified tools.

Lack of motivation (uninteresting tasks). If the gamified elements are not interesting or unfair, they may not motivate students to participate.

Defining success. Defining and assessing success in gamified scenarios may not be possible, as standard assessment methods may not be compatible with a game-based approach.

Teacher training. Teachers may find it difficult to implement gamification if they do not have sufficient skills or time to master it.

Conclusions and research perspectives. Possibility of distraction (game overload). If the game becomes the main aspect of the lesson, there may be a risk of distracting students from the main material.

For the successful implementation of gamification, it is important to consider the above-mentioned issues and develop strategies to address them, considering the specific conditions and needs of students and teachers.

Hence, a modern education system should consider improving the learning management system for computer programming, including code assessment environments and game experiences. These strategies will not only increase students' motivation and performance, but also encourage them to participate in various activities, such as lessons on reading program codes, programming, participating in programming competitions, and collaborating with other participants in gamified platforms. This approach motivates each participant in the educational process to cooperate and compete at the same time, contributing to their professional development and bringing about fundamental changes in computer science education in the new Ukrainian school.

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