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Methodology of Teaching "Algorithmic Languages and Programming" Based on the Gamification Approach: Theory and Practice

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Abstract: This article explores the theoretical foundations and practical application of the gamification approach in teaching the subject "Algorithmic Languages and Programming" at higher education institutions. It analyzes key concepts of gamification, its pedagogical and psychological foundations, and popular models such as Octalysis and MDA, along with their integration into education. Experimental lessons were conducted using gamified educational platforms—Coders War and ALGORI GAME—developed by the author. The study compares academic performance, student engagement, and motivation between experimental and control groups, substantiating the effectiveness of gamification. The article concludes with proposals and future directions for implementing gamified methodologies in higher education.

Key words: gamification, algorithmic languages, programming, innovative method, learning motivation, Coders War, ALGORI GAME, rating system.

In the 21st century, the rapid development of information and communication technologies demands profound reforms across all sectors, particularly in the field of education. These changes require students not only to acquire ready-made knowledge but also to develop skills in problem-solving, algorithmic thinking, logical analysis, and independent decision-making. The subject of "Algorithmic Languages and Programming" holds a vital place in the educational process, as it cultivates core competencies that are essential in most modern professions.

The process of teaching programming generally relies on both theoretical and practical components. However, during the initial stages, many students encounter confusion, a decline in motivation, or face challenges in grasping the material. Therefore, it has become crucial to apply innovative methods and modern technologies in education to stimulate student engagement, enhance participation, and improve the quality of learning.

From this perspective, gamification—the application of game elements in non-game contexts—has been recognized in recent years as one of the key methods for increasing the effectiveness of the educational process. Through gamification, students begin to approach learning as if it were a game: they complete tasks to earn points, level up, and receive rewards (virtual prizes), which in turn boosts their intrinsic motivation. Particularly in the field of programming, the integration of gamification enables students to explore abstract concepts within a practical and engaging environment.

Gamification – this term refers to the process of applying game-like mechanisms and elements to non-game contexts, particularly in fields such as education, healthcare, management, and others. Although the concept was first introduced in 2002 by British programmer Nick Pelling, it gained widespread academic and practical application starting from the 2010s. The primary goal of gamification is to increase user motivation, encourage active participation, and enhance positive experiences.

The core components of gamification include:

- Points – a means of evaluating and rewarding user actions;

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- Levels – represent stages of mastery, where access to new tasks is conditioned upon prior achievements;
- Badges/Rewards – granted for specific accomplishments;
- Leaderboards – foster a competitive environment by comparing users with one another.

With the help of these components, the educational process can be made more engaging, competitive, and effective.

Two popular models are widely used to understand the process of gamification:

1. Octalysis Framework (Yu-kai Chou, 2014)

This model is based on eight core motivational drivers:

1. Epic Meaning – the sense of being part of something greater;
2. Development & Accomplishment – the drive to progress and achieve goals;
3. Empowerment of Creativity – enabling creative expression and decision-making;
4. Ownership & Possession – the desire to own or control something;
5. Social Influence – peer pressure, mentorship, and social interaction;
6. Scarcity & Impatience – motivation through limited availability;
7. Unpredictability & Curiosity – the appeal of surprise and the unknown;
8. Avoidance – the desire to avoid negative consequences or loss.

These elements help deepen the user experience and provide psychological incentives for learners.

2. MDA Model – Mechanics, Dynamics, Aesthetics

According to this model, gamification is implemented in three stages:

- Mechanics – the rules of the game, points, levels, and rewards;
- Dynamics – the interactive processes that occur during the game, such as competition and collaboration;
- Aesthetics – the emotions, motivation, and interest evoked in the user.

This model serves as a fundamental tool for analyzing and planning gamified educational systems.

The application of gamification in education is grounded in cognitive psychology, constructivism, and active learning theories. Learning through game elements forms strong mental associations in the learner's brain, which contributes to long-term memory retention. Psychopedagogical research shows that gamification:

- strengthens intrinsic motivation in learners (Ryan & Deci, Self-Determination Theory),
- increases the level of active participation and communication,
- facilitates the gradual and accessible comprehension of complex topics.

Furthermore, gamified tasks planned in accordance with Bloom's taxonomy systematically develop students' skills in knowledge, comprehension, application, analysis, synthesis, and evaluation.

The subject “Algorithmic Languages and Programming” inherently requires skills in logical thinking, problem analysis, algorithm development, and coding. These demands can sometimes make the learning process monotonous and reduce student engagement when taught using traditional methods. Therefore,

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integrating gamification elements into the teaching of this subject has become a modern necessity. This approach not only increases students' motivation and interest but also reinforces their knowledge.

A gamified platform or lesson structure developed in accordance with the curriculum typically includes the following elements:

- Point accumulation system: Students receive points (ratings) for each successfully completed task. For example, 10 points for a simple task and 25 points for a more complex one.
- Levels: Programming lessons are organized progressively into levels (beginner, intermediate, advanced). To progress to the next level, students must accumulate a certain number of points.
- Character system: Each student creates a unique character. By writing code or completing assignments, the character becomes stronger—acquiring weapons, leveling up, or gaining new abilities.

For example, platforms such as "Coders War" and "ALGORI GAME" fully implement these elements: as users complete tasks, they earn titles like "Recruit," "Titan," or "Knight."

In gamification, quests refer to targeted assignments that are presented either sequentially or in sets (packages). For instance:

Quest 1: "Write a simple if-else condition"

Quest 2: "Analyze array elements using a loop"

Quest 3: "Create a solution using functions"

Each user who successfully completes a quest receives a reward (points, medals, weapons, or an increase in ranking). This system helps structure the learning process in a gradual, step-by-step manner.

On gamified learning platforms, students can compete with each other in the form of duels or tournaments. For example:

- In each duel, both users are given the same set of three tasks.
- The one who completes them correctly and quickly wins.
- The winning user receives bonus points or 1% of the opponent's points.

Such a system:

- fosters a healthy competitive environment among students,
- develops skills to handle high-pressure test situations,
- encourages rapid review and deeper understanding of the topics.

The advantages of a gamified learning environment are evident not only in improved educational quality but also in the formation of an active learning mindset among students. This approach involves more than just using game elements—it helps design motivational strategies tailored to the learner's personality.

In traditional teaching methods, students often take on a passive role: they receive ready-made information, complete tests, and receive grades. In contrast, in a gamified educational setting, the student becomes an active participant—sometimes even the main character of the process. Each completed task, earned point, or achieved title returns as a tangible result or achievement.

Through personalized rankings, virtual rewards, and a system of levels:

- students' intrinsic motivation is strengthened (based on Ryan & Deci's theory),

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- achievements lead to the desire to take on new challenges,
- the learning process becomes goal-oriented and grounded in positive competition.

Gamification encourages students to actively participate. Specially designed tasks, tournaments, duel systems, and user-based rankings prompt students to:

- attend classes regularly,
- complete assignments consistently,
- compare their performance with others,
- engage in self-assessment and reflection.

Experience shows that in gamified groups, the completion rate of homework and participation in peer-to-peer Q&A sessions are significantly higher.

With gamification elements, the learning process transforms from simple memorization or recall into the practical application of skills. As students complete assignments, they:

- go through stages of testing, applying, and improving their knowledge,
- reinforce learning through repeated tasks,
- engage in interactive and experiential learning based on course material.

For example, solving a coding problem at various levels—working with variables, conditional statements, and functions—expands a student's capacity for practical thinking. Game-like tasks offer an engaging way to repeat and reinforce this knowledge without inducing boredom.

To assess the effectiveness of the gamification approach in the subject "Algorithmic Languages and Programming," an experimental study was conducted. The study involved two academic groups from a higher education institution's Information Technology program: a control group and an experimental (gamified) group. Both groups followed the same topics, class hours, and curriculum for the course.

- In the control group, classes were conducted using traditional methods: lectures, practical sessions, tests, and independent assignments.
- In the experimental group, classes were organized within a gamified environment using platforms such as Coders War and ALGORI GAME. On these platforms:
- each student registered and selected a character,
- after each topic, they completed tasks to earn points,
- accumulated points allowed them to level up,
- they were motivated through quests, duels, and tournaments.

To evaluate the outcomes of the experiment, a comparative analysis was conducted based on the following criteria:

Criteria	Control Group	Experimental Group
Average rating score	65.3	81.7
Percentage of completed assignments	68%	91%
Number of students who received an "A" in final assessment	5	14
Regular class attendance	72%	93%

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Additionally, a survey was conducted among the students. According to the results:

- 87% of students reported that gamified lessons were interesting and motivating,
- 82% stated that they understood complex topics more easily through this method,
- 76% noted an increase in their active participation.

In conclusion, lessons organized using gamification-based methods:

- actively engaged students in the learning process,
- increased the effectiveness of topic comprehension,
- encouraged individualized approaches and personal development.

Scientific and practical research has shown that the gamified approach to teaching the subject "Algorithmic Languages and Programming" significantly enhances students' motivation, participation, and learning efficiency. A gamified learning environment not only makes the educational process more enjoyable but also purposeful, motivating, and reinforcing. The results of the experimental classes demonstrated that students in the gamified group participated more actively, completed tasks faster and with higher quality, and achieved greater mastery compared to the traditional group.

Recommendations:

1. Integrate gamified methodology into official curricula: A set of specially designed gamified tasks should be developed for practical sessions in the subject "Algorithmic Languages and Programming."
2. Introduce specialized platforms: By incorporating local or international learning platforms such as *Coders War* and *ALGORI GAME* into classroom activities, students' practical coding skills can be enhanced.
3. Organize lessons in a personalized and individualized format: An individual teaching strategy should be implemented using quests tailored to student levels, various achievements (badges), levels, and a rating system.
4. Provide training seminars and methodological guides for instructors: To ensure effective implementation of gamification, it is recommended to organize practical seminars and develop instructional guides for educators.
5. Introduce new evaluation criteria for students: Automated assessment systems can be developed based on points earned, in-game achievements, and participation levels.

Future Prospects:

- AI-based adaptive gamification: Systems can be developed that automatically suggest tasks tailored to each student's activity, knowledge level, and learning pace.
- Teaching coding through VR and simulation programs: Visualization tools using virtual reality can enhance the learning experience.
- Gamified education via mobile apps: Interactive apps should be created that allow students to complete exercises anywhere, compete in duels with peers, and share their achievements.

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