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Designing learning outcomes using game technologies: example of elements and processes of architectural design - I course

El diseño de los resultados de aprendizaje utilizando las tecnologías de juego: un ejemplo de los elementos y procesos del diseño arquitectónico - I curso

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ABSTRACT

Introduction: This article describes the possibilities of forecasting learning outcomes after using gamification methods. The analysis of data collected within the framework of one academic discipline is given. The development of a regulating program using game technologies for the course is proposed. **Materials and Methods**: The methodological part is concentrated on identifying the problem areas of the course and selecting gamification elements for specific tasks. **Results and Discussion**: The expected result after the implementation of the program is described. A hypothetical idea about the prospective use of individual game mechanics for educational purposes is described but requires further practical trial. The relevance of the development of complex motivational programs integrated into the educational process and solving the problem of improving the effectiveness of learning is identified. **Conclusions**: The use of various ways of involving students, and maintaining the balance between educational and game tasks is described.

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INTRODUCTION

Kazakhstan's national project "Quality education. Educated nation," one of the 10 national projects focused on the goals of the 2025 National Development Plan, was signed in October 2021. One of the objectives of the project is to increase the competitiveness of Kazakhstan's universities and their image on the international level. The issues of intellectual potential development and new opportunities for young people are also considered[1].

The state tasked higher education institutions with training specialists of a new generation, ready for the challenges of the modern world. The future of the state's economy depends on the successful training of qualified personnel. The level of human capital development directly affects the sustainable development of the country and its economic growth. Education plays a key role in this process. The training of specialists currently requires a completely different approach, different to traditional education. Digitalization, the speed of information exchange, and the technological nature of the educational process make many educational models and forms unnecessary and ineffective. Some professions are no longer relevant, as well as some principles of building a career. Currently, there is no requirement for obtaining a profession and a workplace once and for as long as possible.

The approach to professional training has also changed. Memorization has ceased to be a key student skill. The "digital generation" has replaced this learning process with the skill of quick search and processing of information, visual learning and instant feedback. Rapid data exchange not only makes the learning process dynamic, but also radically changes its structure. Many traditional forms of education, such as studying and copying information in libraries, or face-to-face consultations with a teacher, disappear as unnecessary. At the same time, new ways, mainly related to process virtualization, are emerging.

The developing role of computer games was recognized, studied and began to be applied in practice back in the 1980s. Their learning potential was recognized and implemented in the field of education in the form of didactic games. The speed and quality of mastering the proposed material according to the research results was significantly higher than when using traditional teaching tools. First of all, this was associated with instant feedback and the possibility of repeating the actions if unsatisfied with the result. The forced universal transition to remote learning, which occurred during the pandemic, moved the development of education in a new direction. There are online platforms, international (LearningApps.org, Docebo.com, Edx.org, Gloster.Com etc.) and local (Platonus.kz, E-learning.kz), which facilitated online learning, combining educational and didactic function of exchanging educational information, documenting results, and a broader methodological role. The technical capabilities of the platforms allow teachers to independently create game scenarios of various topics and directions, while maintaining the principles of didactic play - to complete the game and educational task simultaneously. Usually, these scenarios are characterized by a simple structure, the absence of a storyline and complex game interactions[2].

The lack of direct contact prompted teachers to search for new ways to organize the educational process, to support the interest of students, to go beyond traditional approaches to educational activities. For many, gamification – the use of game mechanics and elements in solving non-game tasks — has become the solution. The concept of gamification as an educational technique is already quite popular. However, not everyone fully understands what it is. Gaming technologies have been used in educational programs for quite a long time, which creates the illusion of simplicity and accessibility. But it is still an area of specific knowledge that is not directly related to learning. Specialists who develop games for business, marketing, and personnel management, distinguish the educational segment as a separate entity. Higher education has its own special context, which differs from other fields of gamification application. The presence of well-known teaching methods challenges the need to use another, less-studied, method of student engagement.

If we talk about the game as a method of engagement, the research of Soviet psychologists D.B. Elkonin and L.S. Vygotsky revealed its key importance in the development and education of young children [3,4]. At the time, games were considered in the context of application as a means of adult education. The current generation of students was formed under the influence of computer games, from the simplest "five-minute-games" to complex multi-pass strategies that take months, and sometimes years. With the advancement of digital technologies, the role of games in the lives of adults has acquired a new meaning. And along with it, there became opportunities to influence people's behavior using means borrowed from electronic games. The emergence and development of gamification as such and its integration into education were predetermined by the development of technological and information resources of higher educational institutions, as well as trends in the development of new curricula and methods.

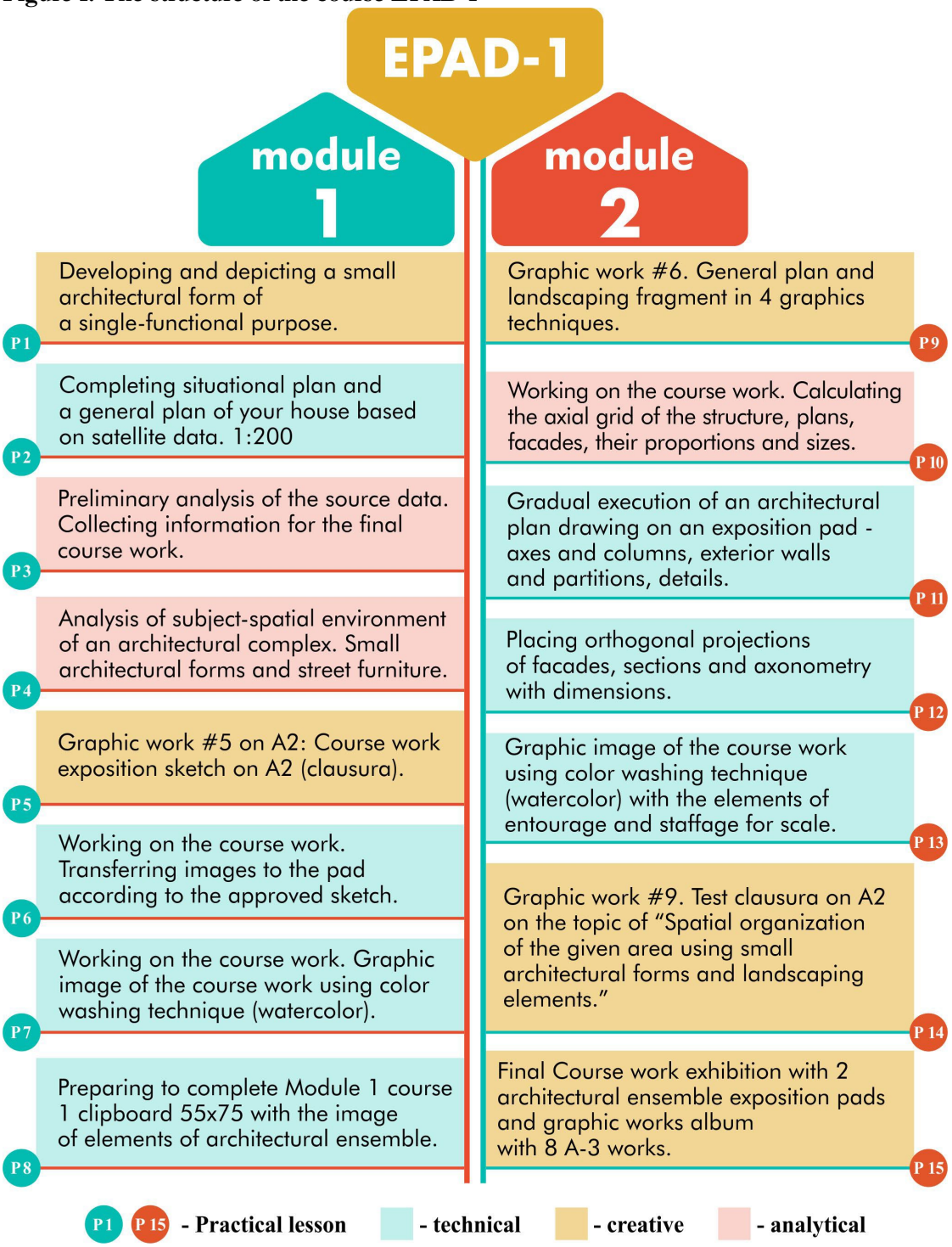
Gamification has already taken a fairly strong position in the educational environment, mixing with other pedagogical motivational tools and educational and didactic methods. The involvement of a game designer in the development of a course or a class gives a guarantee that the choice of game technologies will be justified, and the result will be easily forecastable.

What elements of gameplay can be used for educational purposes?
• Progress – visual representation of growth through leveling up and collecting points.
• Investment – a sense of pride in contributing to the game, recognition for the completed tasks, investment into the other players, the development of the game world, and global significance.
• Gradual discovery of information – consistent access to new information, unlimited event outcomes, delevopment of the plot, the players and opportunities[5,6].
The purpose of this study is to determine how effective the use of individual elements and game mechanics can be in solving the problem of improving the efficiency of the educational process. The intermediate and final results of the design course for second-year students at the Design Department specializing in Architectural Design were collected, the most problematic areas of the educational process were identified, and it became possible to forecast the outcome of the training of subsequent groups on their basis. For positive changes in these results, a learning structure was formed using game technologies, gamification.

MATERIALS AND METHOD

The task of teaching students of creative majors, in particular designers, is to form an integrated approach to design among them. In a broad sense, it is to set the main trajectory for the formation of a professional approach that will allow graduates to become in demand in the labor market.
The course "Elements and Processes of Architectural Design-I" (hereinafter EPAD-I) is designed to give 2-year students basic knowledge of the design of architectural environment objects, understanding of the sequence and methodology of project documentation development, compositional thinking skills and professional graphic presentation of the material. This is the first comprehensive academic discipline in which students apply all previously acquired skills in professionally oriented areas. Why was this course chosen for the study? Since the EPAD-I discipline lays down basic professional knowledge and skills, it is necessary to identify which factors influence students' interest in learning.
The first stage of the study involved recording attendance data, deadline compliance and the level of quality of work. In the process of collecting information, general behavioral trends among students were identified, as well as the relations between these factors and the content and nature of the academic load.
The data was collected in the course of one semester - 15 training sessions. The study involved students of two groups of 35 people. The statistics that served as the basis for the work were recorded on the educational portal http://elearning.kazgasa.kz. In the future, when working on a gamification program, the portal's capabilities and its functionality can be used as game mechanics tools and integrated into the gameplay. It is possible to visually correlate the content of the course with the cognitive reactions of students after considering its educational and methodological content. The structure of the course and the main content of practical classes are given in the table. (Figure 1)

Figure 1. The structure of the course EPAD-I

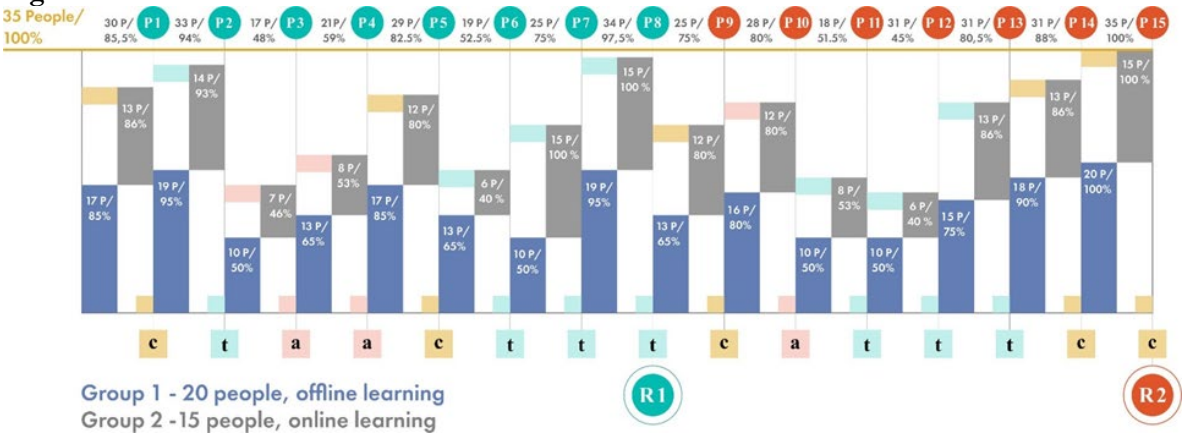


The main method was the construction of graphs based on the collected data. The information was collected directly in the educational process, when attendance, completion, quality assessments in the point-rating system, as well as the activity and engagement of students in the number of consultations and questions asked during the student's independent work with the teacher were recorded during classes.

The graphs revealed certain behavioral patterns and served as the basis for the development of a project to improve learning outcomes using gamification. The first graph represents student attendance statistics. It shows that the indicators of the number of students present at classes are close in percentage, and only in some cases, there is a difference. This may be due to the fact that one of the groups was on remote learning, and the other was studying in

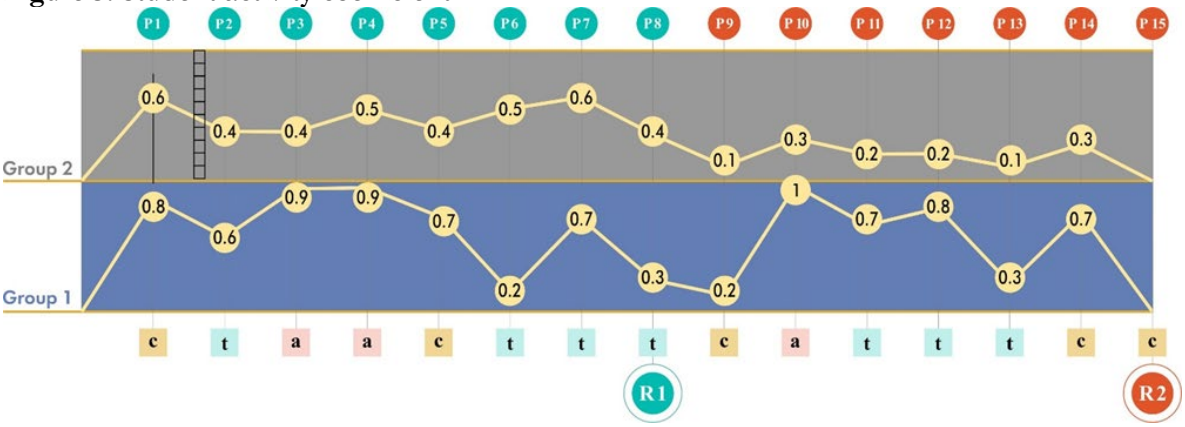
person. The presence of two groups with different forms of learning allows us to identify how these factors affect the educational outcome. Also, when the statistics of the online and offline groups coincide, it is possible to identify the reasons for the decrease in student activity for subsequent study and correction of behavior. (Figure 2)

Figure 2. Attendance of the EPAD-I course



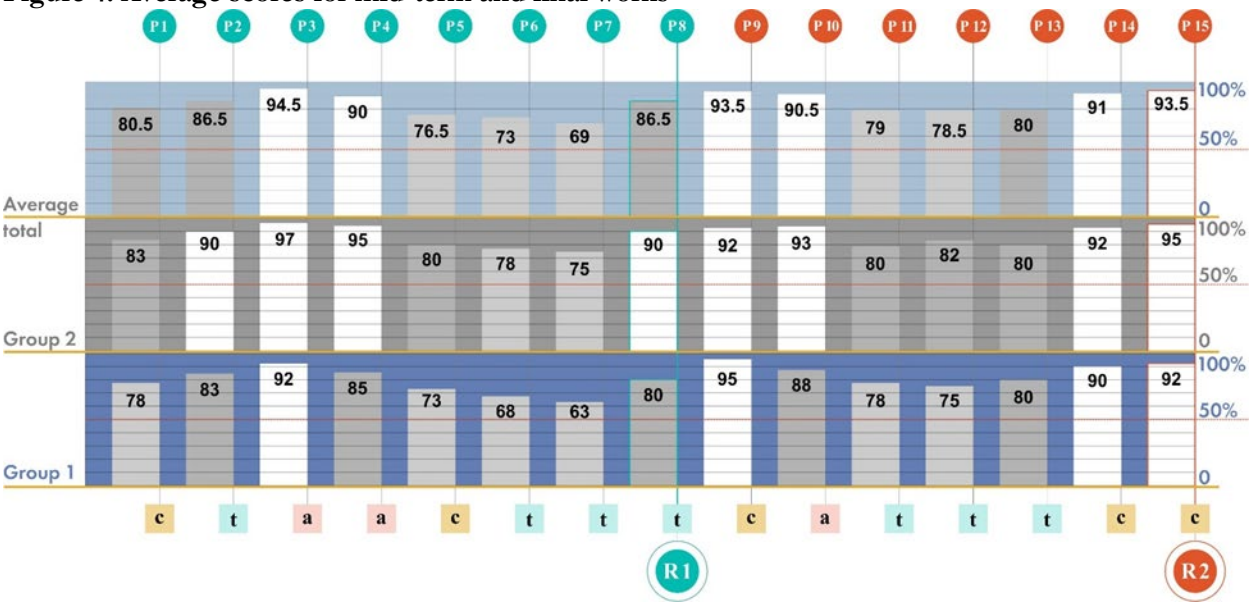
An important factor in the formation of an educational result is the students' activity. It can be determined by the number of consultations and independent appeals during the lesson, as well as the number of students taking initiative. Another criterion for assessing activity is the attendance of extracurricular additional classes as part of the student's independent work with the teacher. To plot the activity graph, the coefficient obtained as a result of summing up all the listed data for each lesson and divided by the total number of students was calculated. (Figure 3)

Figure 3. Student activity coefficient



The last in order, but not in importance, was the graph for evaluating the quality of submitted works in the point-rating system. It does not only reflect the actual level of students' skills. These data form a picture of students' interest in completing tasks at a higher level and improving the level of skills, or lack thereof. The average score was calculated based on the sum of all the submitted works. The works that were not submitted, as a result of which they received a score of 0, were not taken into account when calculating, since they do not reflect the qualitative side of the students' skills. (Figure 4)

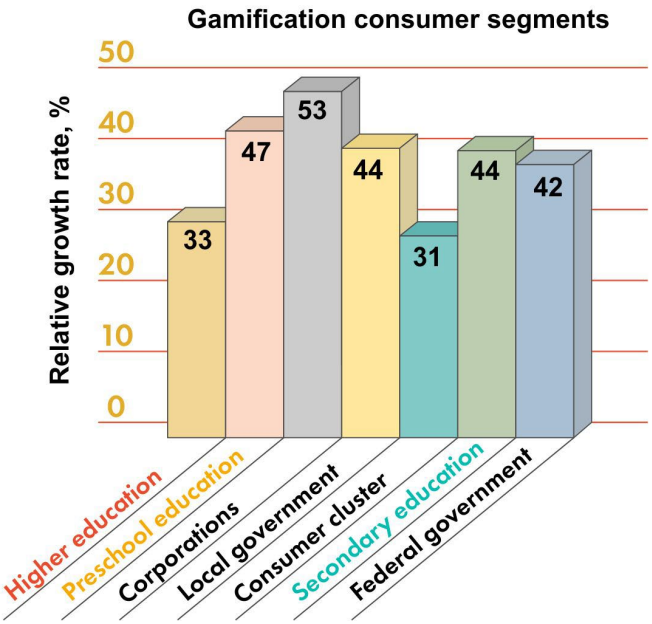
Figure 4. Average scores for mid-term and final works



Data analysis revealed statistics and the qualitative nature of the educational activity. Based on the evidence of the study, it became possible to forecast how the learning of this course will develop in the future. As a result, the question arose - is there an opportunity to influence the learning outcomes? Is it possible to design the learning process in such a way as to knowingly anticipate its results?

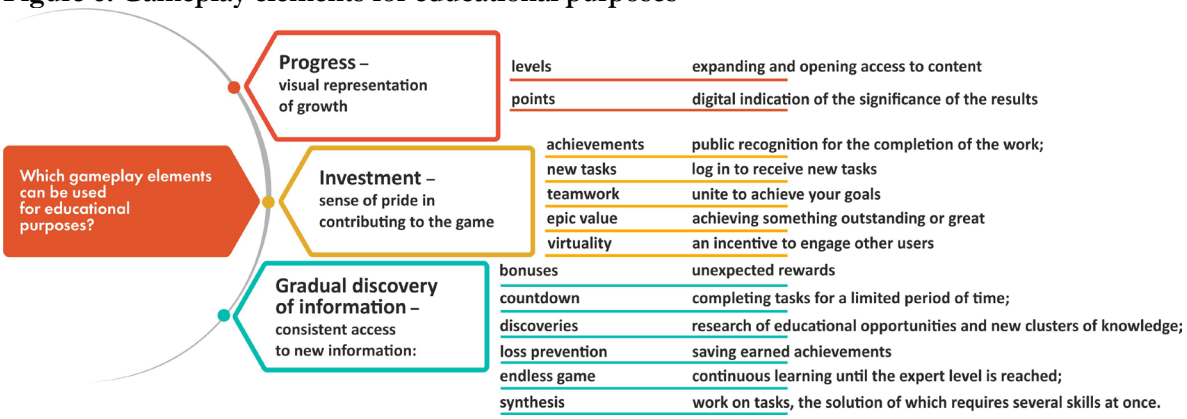
The answer was developed through numerous positive experiences with the use of gamified cases. The Metaari company, which analyzes advanced educational technologies from 122 countries of the world, has identified eight main users of gamification techniques. Educational organizations occupy the main positions on the list[7]. According to statistics, there is a dynamic growth in the use of gamification products among the mentioned study participants. The table below clearly shows the forecast of growth rates in the main segments, consumers of gamification. (Figure 5).

Figure 5. The growth rate of gamification consumption in the main segments



To understand whether gamification can be used as a technique that will improve the effectiveness of learning in the case of the course in question, it is necessary to recall the characteristics of game elements and mechanics most used to solve educational problems. (Figure 6)

Figure 6. Gameplay elements for educational purposes



Meanwhile, many of the above-mentioned elements take place in the point-rating system for evaluating students' educational achievements, which has been used for a long time in secondary and higher education. They do not always affect the result properly, and teachers expand the range of methods used, through gamification and more. In the point-rating system, the only essential tool for influencing behavior and managing educational results, as well as its measure, are grades – points received for work. Achieving high results by earning high grades is a motivational marker for only a fourth of the total number of students, the so–called achievers. The rest have other psychotypes and mental characteristics, which means that the point-rating system does not serve them as a motivational and engaging environment.

Gamification has a number of properties that neutralize the pressure and stress of waiting for ratings. First of all, it includes voluntary participation and independence in decision-making, as well as setting high goals and having a non-educational purpose in the students' actions. Another property is the presence of fun, excitement and narrative, which are completely absent in the point-rating system. These reasons are enough to make the use of gamification elements effective.

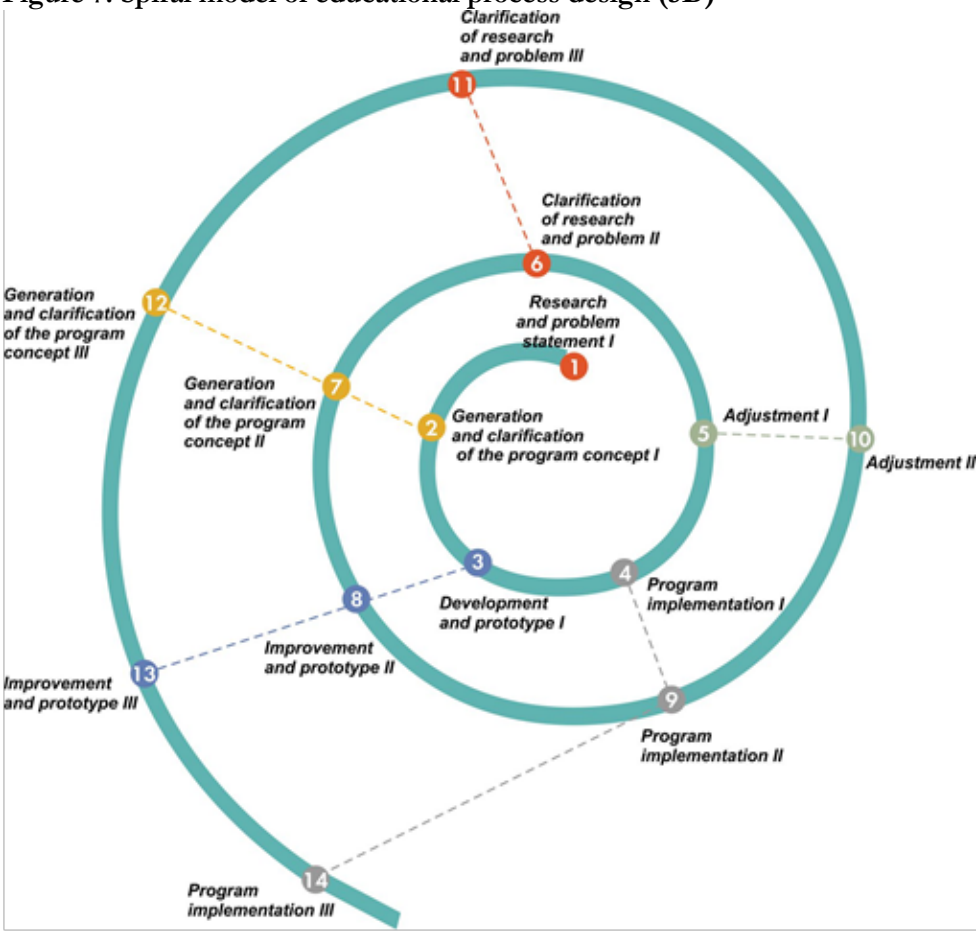
In addition, there is no need to completely rebuild the existing educational system, it is enough to integrate game elements there at the right stage, add additional connections and purposes to it, the ideology of the game, and the educational result will become manageable. As mentioned earlier, gamification is not a simple process that can be constructed by someone without proper training in the field. Using gamification without consulting a professional is similar to self-medication when you just take any medicine you have hoping that it helps. Individual, single elements can be used by any teacher in their practice, but it is necessary to invite a specialist to build a functional balanced system program of gamification. Therefore, in order to create a program to improve the educational result, consultations were held with a specialist gaming practitioner, and it was determined which game mechanics and elements can be applied to the most problematic points of the educational course.

RESULTS

The process of designing learning outcomes requires a preliminary study of the educational experience, its subsequent analysis, planning and structuring. Subsequent actions design aimed at improving results may include various methods. Gamification is one of the most effective mechanisms for correcting and improving learning outcomes.

The analysis of the data presented in the research part of the article shows the need to adjust the intermediate learning stages in order to improve the final results. Designing algorithms of the educational process by the spiral model method, also called 5D – Discovery, Design, Development, Deliver, Debrief. (Figure 7) This design strategy involves the development of the project process in a spiral, where initially there is a certain general idea, initial data, and problem statement, and then there are sequential actions, as a result of which the concept of the program is born. It is necessary to "unfold it in a spiral, each time passing and clarifying the five components: the student, educational goals and results, educational strategies, evaluation methods and metrics of program success" [8].

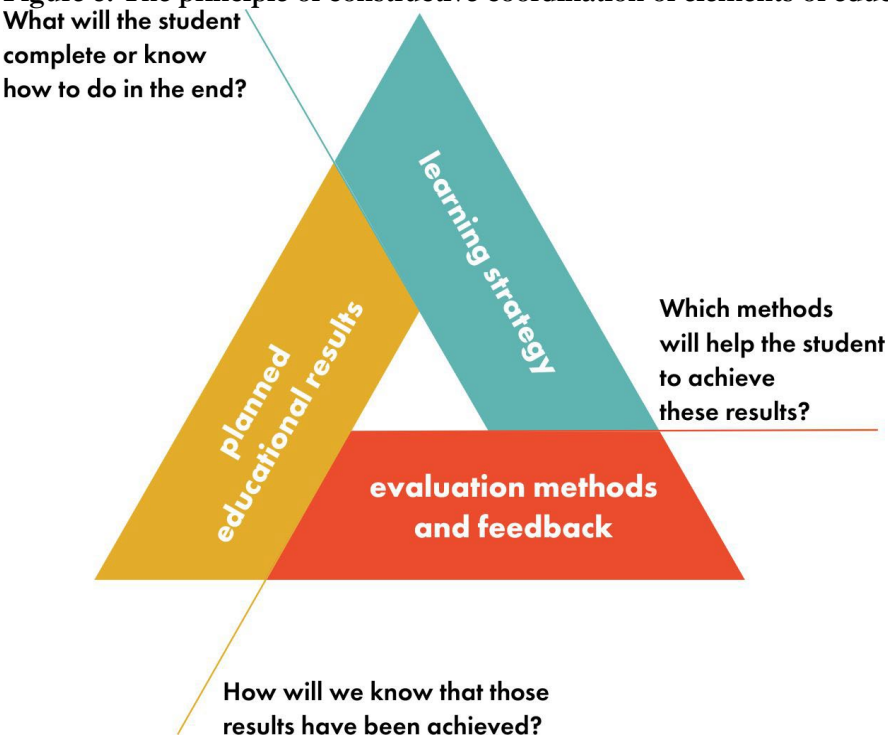
Figure 7. Spiral model of educational process design (5D)



Gamification is a tool for improving a ready–made process or product, and is based on user experience, statistical data analysis, and testing results of an already existing program. Therefore, in the spiral model, the integration of gamification elements occurs at the stages of concept refinement and improvement – points 7 and 8. At the same time, objective evaluation plays a very important role, since in game constructions cause-and-effect relationships are algorithmized, and the key element is not so much the comparison of student indicators, as the individual progress of the student compared to their own results.

Another important component of the educational process design is the coordination of the main components of educational activities that set the framework for the student's independent development of the educational experience. These components are a system that combines results (what is the desired result?), methods (how will we achieve it?) and assessment methods (how to determine that it has been achieved?). This principle reflects the work of J. Biggs [9], which talks about the relationship of these elements as an external shell, inside which students "construct" their own significance (Figure 8).

Figure 8. The principle of constructive coordination of elements of educational activity



Gamification, a game narrative performs the same function – adding meaning to routine activities. When focus on learning and motivation to complete tasks decrease, gamification switches attention, adds focus, and increases interest. In order for learning to be truly effective, the main pedagogical task is not so much teaching as such, as creating a favorable motivating educational environment in which the student strives to achieve the best results. It is also necessary to link together the components of the "result-strategy- evaluation method" and create an ideal structure for which the student will independently build up their own educational experience.

The purpose of the study is to improve the learning outcome. It should be clarified what we mean by this concept. Specifying the definition will help to identify the trajectory of achieving it. The learning outcome is a set of actions that a student can perform upon completion of the program, and which can be measured or objectively evaluated.

Following this definition, the importance of accurate task-setting, goal-setting, and formulation of the expected outcome becomes obvious. In order to be able to design a learning outcome, it must meet a number of conditions:

- be relevant - be based on a clear goal,
- be unambiguous – not to contain contradictions in the description of the process and the final result,
- be feasible – implementation is possible in a given time, with available resources and a set of knowledge,
- be observable – possible to track progress at certain stages of the process of achieving the goal,
- be measurable – the student must indicate an acceptable level of academic performance.

If these conditions are met, the learning outcome is embedded in the designed program and becomes its component and not the object of contradictions[8].

In other words, achieving a positive result in the educational process is impossible without a clearly formulated final goal, transparent and consistent evaluation conditions, and obvious implementation algorithms. The principles of gamification fully correspond with this paradigm. Before the start of the game process, a general goal is always formulated, which can only be achieved through the desired behavior. The actions of the participants can always be observed and measured, and the result is always obvious both for gamification participants and for outside observers. The main principle of the game is that the rules are transparent and understandable for everyone. Each student should understand exactly what they must do to achieve success at each stage, what should be paid attention to and how it will be evaluated. Subjective evaluation is excluded in gamification. The fairness of the game system gives everyone a chance to win. The algorithm has built–in rigid sequences – "if, then", which eliminates discrepancies. In case of failure to perform any actions, further progress is impossible.

To design the integration of gamification into the educational process, it is necessary to determine the main elements, which form the basis of development and implementation. (Table 1).

Table 1. Stages of gamified educatuional program development

Designing a gamified educational program		
№	**Design objects**	**Stages**
1.	Quantitative learning outcomes	Setting the learning objectives
2.	Game process outcomes	Non-game goals of the gamification. What needs to be better in the educational process or in the participants' results. How are we going to measure the project's results.
3.	Learning trajectory, actions and interactions, activity points.	Designing desired behavior and eliminating unwanted activities. What are we going to be motivating the students to do, how often, and in which ways.
4.	Target audience and its needs classification	Determining the motivation helps to choose the correct tactics and game mechanics.
5.	Feedback, reward system	Development of the game system (mechanics, game design elements, rules). How do we make each of the students' actions to be noticed and interpreted correctly by the teacher and other students.
6.	Project completion, the connection of the in-game and learning outcomes.	Program implementation, testing, refinement and correction.

In this study, five stages of development and design were completed. The sixth is the practical stage of implementation. It is to be tested on the following groups of students who will take this course.

It is planned to create two control groups, in one of which a gamified learning process will be practiced, while in the other traditional process will be conducted according to the existing point-rating system. At the end of the semester, a comparative analysis of the results will be carried out and conclusions will be drawn on the effectiveness of the implementation of the proposed program.

Next, we will consider in detail each stage of designing a gamified learning program.

Stage 1. Setting the learning objectives

Pedagogical goals and objectives include various levels of information acquisition, such as memorization, understanding, application, analysis, synthesis, evaluation, and others[10]. To describe the educational objectives of the EPAD-1 course, the criteria "knowledge", "abilities", "skills" and "competencies" were selected. Each criterion contains a list of practical tasks to be solved when mastering the discipline. If, at the end of the course, the student is able to fulfill each of the above requirements, it can be considered that the training was successful.

The list of the main objectives of the course is given in Table 2.

Table 2. EPAD-I objectives

Course mastering results	
Knowledge	Theoretical foundations of architectural design
	Methodology and progression of course projects
	Functional, compositional, geometric, and figurative characteristics of the design object
	Fundamentals of design and graphic technique
Abilities	Apply the acquired knowledge when performing practical tasks
	Collect and analyze the original data, find the dimensions, proportions and other characteristics of existing objects based on the data
	Choose the optimal scale for drawings
	Compose visual information for the most effective presentation of graphic material
Skills	Application of the acquired knowledge at the professional level
	Execution of a course project from pre-project analysis to the presentation of the results of work
	Performing graphic presentation of project materials in various manual techniques, including polychrome watercolor washing technique
Competencies	Understanding of the set theoretical, methodological and practical tasks
	Independent decision-making regarding the work performed
	Interaction with the teacher and other professional sources to obtain and consolidate knowledge and skills
	Performing graphic works at any stage of design – from sketch to drawing
	The ability to effectively use the allotted time, adequately assess the amount of work and distribute the load
	Application of the acquired knowledge for further professional development

Stage 2. Non-game gamification goals

The main non-game objective for a student in this course is "the completion of a course project from pre-project analysis to the presentation of the results of work". It is obvious that the completion of the course project is a key goal, which is supplemented by the smaller intermediate challenges listed in Table 2. Using gamer terms, this is the final boss that can be defeated if you train regularly, performing smaller and simpler tasks. Thus, gamification can be considered as a chain of related quests or a mission with several stages. At the same time, quests can be diverse, flexible, and modified depending on the dynamics of the training and gameplay. The variety of game content is one of the important conditions for gamification, which is equally important for all psychotypes. In addition, this structure allows you to flexibly respond to changes in the external situation, include additional elements, or remove and replace those that didn't spark interest in the students.

The final non-game goal of gamification, in this case, is the following: "100% of students complete the course project within the required period (Rating - II) at the extent and quality corresponding to the work program of the course, as well as complete educational and creative works within the time limits set by the work program as intermediate results". That is, the key metrics are timing or speed, quantity and quality of work, and compliance with the standard. It is by these metrics that the personal gaming progress of participants can be measured.

The objectives of the gamification of the Elements and processes of architectural design-1 course are defined:

• To create opportunities for the completion of creative tasks in cooperation with the teacher: generation of creative space with a creative atmosphere without strict restrictions that usually go hand in hand with traditional educational processes; organization of unusual formats of training sessions in the form of tours, master classes, creative workshops;

• To encourage research, cognitive and analytical excitement, search, study, and application of initial project data: contests, quizzes, and intellectual games on the subject of training;

• To maintain discipline: attendance of classes, completion of tasks, compliance with deadlines: the introduction of strict rules, compliance with which gives game bonuses, and as a result, improves learning outcomes, and non-compliance leads to losses and penalties.

• To change the attitude of students towards learning: create an experience of receiving positive emotions from the routine process, and a new look at familiar things.

To achieve these goals, it is necessary for the students to perform certain actions, which they will be motivated to do by the mechanics embedded in the gameplay.

Stage 3. Designing the desired behavior and eliminating unwanted actions

Predicting and adjusting the desired behavior is one of the main tasks solved by gamification. The expected behavior of the participant in the game is based on the learning objectives mentioned above. In accordance with them, a list of actions is formulated that will lead the student to success in the game, and, as a result, improve the educational outcome. In addition to knowledge, skills, and competencies, we considered it necessary to focus our attention on informing, motivating, and supporting the students, since solving these tasks within the framework of the game does not require additional efforts, and is an additional effect.

Table 3. Target actions

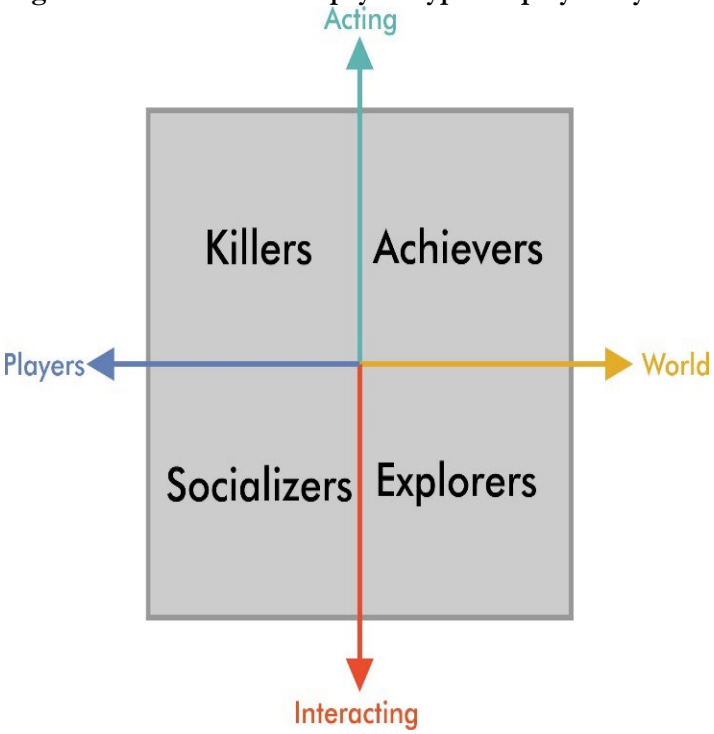
Improvement area	Target actions (what we want the participants to do or not do)	What other (in-game, non-educational) experience do they need
Course as a whole	To complete all of the stages of the coursework, mentioned in the study program: gradually and in compliance with the deadline	Enjoyment of the learning process in general
Informing the students	Shared the information about the program with their classmates who are not participating in the experimental group, shared their impressions on the department's page	Communication skills, creating an in-game micro-community
Motivating the students	Attended all of the classes, started to act on their own, demonstrated engagement in the process, interest in the subject, asked questions	Support and encouragement of others
Knowledge	Shared their experience and conclusions, demonstrated knowledge of other subjects and general professional knowledge, completed the rating task with 85%+	Information research as a game resource
Skills	Completed all of the tasks, including those outside of the classroom, visited additional workshops and lectures	Working on a bigger goal Focus on the achievements
Competencies	Completed the course project with 85%+	Experimenting
Supporting the students	Created a database of the methodological materials for the younger students and submitted it to the electronic archive and department's exhibition hall	Development and sharing of experience

Target actions describe the concept of participants' behavior step by step. Following this concept, students will be able to achieve the game and non-game goals of the program. Gaming experience is optional and does not affect the effectiveness of the actual training in any way. However, it is very likely to be achieved in the process of performing target actions.

Stage 4. Determining the motivation

In order for students to be maximally involved in the learning and gaming process, it must largely meet their personal needs and motives. That is, the use of only one game mechanics, for example, the formation of ratings, professional prospects, or the creative process, works as a motivator only for some portion of the students with the appropriate motivation. To a large extent, the player's behavior is influenced by their game psychotype. One of the best well-known classifications of game participants is the Bartle model. Richard Allan Bartle, a professor at the University of Essex, studied the behavioral markers of gamers and developed a classification, identifying four main groups, which, to varying degrees, focused on four parameters: focus on acting – interacting, focus on other players or the game world/environment[11] (Figure 9).

Figure 9. Classification of psychotypes of players by Bartle



To create a more generalized model based on the Bartle system, the British gamification expert Andrzej Marczewski used an extended typologization principle. This HEXAD model for gamified systems consists of six categories of players, and has flexible typology boundaries depending on the characteristics of behavior [12] (Figure 10).

Figure 10. The Marczewski User Typology Model

What are the features of psychotypes in the Marczewski system?

Players play for the sake of external rewards and achievements. Their actions are aimed at being at the top of the list of winners. To motivate this type, various kinds of competitions are used with the distribution of places and prize bonuses.

Socialisers (similar to Bartle's classification) tend to maintain social ties and communicate with other players, create a network of interactions. For this group, it is necessary to create a discussion space – real or virtual: a thematic game chat where the team can discuss a strategy to achieve the goal.

Philanthropists add significance to the game and are focused on a great goal. They are ready to help and give without expecting anything in return. This psychotype is allocated more for gamification than for digital games, since this type of behavior is more common in social interactions than in gaming.

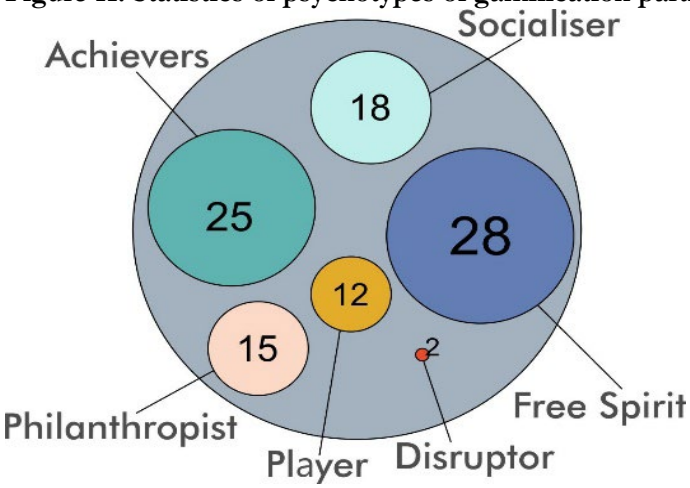
Free Spirits are the most creative participants in the game, who partly overlap with explorers in Bartle's typology. Their behavior is based on self-expression. They prefer to act without restrictions and rigid structure. Explore new opportunities or create them themselves. These players are really invested in special tasks, which might be optional but are exciting and difficult.

Achievers' (similar to Bartle's classification) behavior is based on constant self-improvement, searching for opportunities to become better, develop abilities, earn points, and level up. Difficulties are not a hindrance for them. The mechanics that can be used are related to regularity and accumulation, serial tasks of the same type, or step-by-step movement.

Disruptors are the opponents of the system. They are ready to destroy and change, to make things better according to their ideas. They involve other players in this process. This is the main risk zone when implementing gamification as disruptors require an individual approach.

The absence of rigid classification boundaries in the Marczewski model makes it the most appropriate for further work on determining the psychotypes of gamification participants. As a percentage, a generalized portrait of the course participants is shown in the figure (Figure 11).

Figure 11. Statistics of psychotypes of gamification participants



Thus, when choosing tools to influence the target audience, we understand that traditional tools, such as a point-rating assessment system, are suitable and motivate only 25% of students. 28% require more freedom and opportunities for self-expression, 33% (philanthropists + socialisers) are focused on community development, communication and support, 12% expect external rewards. It is obvious that there is no universal method of motivation management, and the initial division into psychotypes is the allocation of basic behavioral patterns of participants. It is much more important to track the trends of interactions in the game, and, in case of emerging undesirable changes, balance the process.

Stage 5. Game system development (mechanics, game design elements, rules)

To complete the gamification development process for the curriculum, it is necessary to take into account a number of factors: the content of the curriculum, the timeline (the frequency of classes and the length of pauses for independent activity), the needs of students, a virtual platform for communication, audience characteristics, organizational capabilities, and much more. The combination of target actions and all these factors makes it possible to adapt the program to a specific group.

The first step in assembling a complete system is the choice of game mechanics. There are a number of ready-made sets of game mechanics, from which you can choose based on your goals. We used a large list of Raph Koster's social mechanics (40 mechanics), Board Game Geek developments (48 mechanics), SCVNGR's PlayDeck project materials (47 mechanics), and other sources[13,14,15]. With a certain skill, you can decompose computer or board games and embed your favorite elements into the learning process. As the main setting, you can use the theme of great architects, and their projects, creating cross-references to related subjects. In order to link this setting with the presentation of the final project, a quest of finding stylistic elements inherent to different great architects in the works of classmates can be implemented. Gamification can immerse participants in a specific setting (e.g. alien city) with specified parameters, or it can be plotless and based on real practical tasks, which is a more appropriate option for a university.

Next, we offer an indicative set of specific mechanics that, in our opinion, are most effective in completing the objectives.

Table 4. Game mechanics for different learning tasks

Mechanics	Description	Motivation type	How to use
Achievement	A material or virtual representation of the result of an action. One-time fixation or repeated actions with cumulative effect.	Achievers	This mechanics is the most useful during the learning or training stages, in the process where you can measure the level through a test or questions answered correctly. By recording the achievements in different areas, you can build a rating system — a progress bar or a dashboard
Progress	Recording of all changes and results of the player's activity in the game	All types	This is basically an easy-to-comprehend visualization of the results. The dashboard can contain the latest data on the personal and team progress in the gamification
Handicap	Giving an advantage to a weaker competitor to equalize the chances	Player	This mechanic allows for lowering the skepticism toward the game result. Can be used in the process with clear achievement measurements
Reward for trying	Positive emotions from the game or the anticipation of the reward are stronger than tiredness. The reward must be named in advance, and the ways of getting it must be clear and available to the participants	Player	In pursuit of a reward, players enter the so-called flow state. The initial interest in the reward and the desire to compete is replaced by sincere pleasure from the process. This most often occurs at the stages of skill training and implementation into practice
Loss prevention	Completing a target action to avoid punishment or loss	Player	Because the game is voluntary, this method can lead to disappointment or sabotage. Punishment is used in very specific situations and usually consists of losing game benefits or points
Lack of reward	Not getting a reward if certain conditions aren't met	Achievers	This is different from punishment, in that it's an opportunity to consider several criteria at once. It can be used during difficult multi-stage challenges when obtaining knowledge and skills
Constraints	Penalties that limit the unwanted behavior of the players	Disruptor	All forms of limits and the consequences of breaking them are mentioned in the game rules. This method is more useful during team games when all of the players can suffer because of one player's actions
Set meeting	Completing a certain action exactly at the same time to get or not lose an advantage	Achievers	Because discipline and compliance with the deadline are key success factors, the program needs to have several mechanics that focus on creating a time management skill at any stage of the learning process
Countdown	Strict time limit to solve the task	Player	A countdown adds excitement and makes it easier to concentrate on the main element. It can be used to limit the action or in situations of a sudden deadline
Limited information	Gradual access to the information based on the player's status or time spent in the game	Free Spirit	This method can be used in the beginning, creating intrigue and interest
Event chain	Reward for completing the task is unblocking another opportunity in the chain of events	Achievers	This mechanic works well with limited information. This is one of the key ways to make the game in the quest format: when you complete one task, you can move to the next
Status	Changing the level or position of the participant	Achievers	A status can express the player's role, identity, their place in the hierarchy, level of achievement, etc.
Self-expression	An opportunity for a player to use their creative potential	Free Spirit	This mechanic can take the form of any type of competition: write something, draw something, take a photo, etc. It's important for the task to be connected to the learning process or reveal an interesting side of it
Collaborative exploration	Temporal collaboration of players to solve one or a series of tasks	Socialiser	The formation of working groups can take place at any stage and on any principle. Groups can be stable or mixed, being re-mixed in the process if needed.
Fun once — always fun	Adding simple actions that make the process more fun and enjoyable	All types	Fun activities similar to warm-ups that are used in business training

Behavioral impulse	Continuation of an action a player has done before	All types	It's important to not get too excited with the variety of mechanics and to make the process a cycle with small differences. It helps to make in-game and real actions a part of the routine and make habits
Illusion of choice	Giving participants options, which eventually lead to the same result	All types	Because gamification solves educational goals, the algorithm is either a network that leads to the same result or a choice without choice
Epic value	Giving value and significance to the actions expected from the players	Philanthropist	Expanding the perception of one's activity, creating a new meaning in the routine process through storytelling works effectively at any stage of the game process

After choosing a mechanic, it is necessary to describe a consistent scenario and rules for the participants. The scenario records the sequence and wording of tasks, plot leads, necessary resources, connections with processes external to gamification. The rules are a clear and short description of the conditions of victory, opportunities and limitations in the process of achieving it. A complete set of game documentation is necessary for the understanding of everyone involved, as well as the prevention of conflict situations.

When analyzing the data from the graphs of the educational process, it became obvious that the main focus of training was on the assimilation of knowledge. At the same time, the motivation and support stages are not taken into account at all, and skills development is mostly carried out in the form of independent work or homework. The addition of the program with gamification elements will compensate for the missing methodological resources, make learning more balanced and exciting, and switch the attention of students from routine monotonous actions to the process of the game. The scenario of the gamification of the curriculum and the results of the implementation will be published after receiving and analyzing the data of this educational experiment.

CONCLUSIONS

The results of the project described in the article are an intermediate stage of complex work on a multi-stage methodological problem. The introduction of a gamification program begins with data collection and analysis. This process is described, statistics are provided, and a database has been prepared for further practical implementation.

The study of statistics made it possible to determine the main issues of the educational process in the course EPAD-1. A profile analysis of the nature of the problems revealed the most characteristic recurring moments in which there is a decrease in interest in learning or a slowdown in the acquisition of knowledge. For example, this happens during the transition from creative and skill tasks to calculations and analysis. The considered set of data, which included attendance statistics, student activity coefficient, average academic performance scores, as well as data on the psychotype of students, and a list of main target actions, made it possible to select the most effective game mechanics. The authors of the article collected data on the learning process of two groups, which served as the basis for the game design of the EPAD-1 training course. In the upcoming academic semester (Spring 2023), it is planned to implement the program with the integration of gamification elements in the experimental group of second-year students. In parallel, another group will be trained according to the traditional point-rating system. This will make it possible to make a comparative analysis based on the results of training and to identify the effectiveness of implementation.

In addition, since the authors expect a positive effect from the implementation in order to continue designing gamified curricula, it is planned to conduct an initial stage of research and data collection on other design courses in the Graphic Design and Industrial Design specializations. Students of other levels of study will also be involved in the following work, the experiment can be expanded to third and fourth-year students. The collected data will serve as a basis for the further development of gamified programs and their adaptation to the specific features of disciplines and age groups of students.

As a result of launching a complex of gamified programs at different levels of education, we would like to see an increase in the overall level of interest in the learning process, and a qualitative increase in results, which will be reflected in the creative and skill characteristics of student works.

How can we evaluate the effectiveness of the program and its results?

Firstly, have the educational goals set before the start of training been achieved? How much did the chosen mechanics affect the learning outcome? Secondly, was the learning process balanced, did the students manage to avoid emotional stress, and were interest and engagement maintained throughout the process? Thirdly, did the learning outcome coincide with the student's expectations, did they achieve their personal goals? If the data on all these parameters are

not satisfactory enough, then the program requires adjustments. Then the following groups will be trained taking into account the previous educational experience and will be able to get the best results. Here it is necessary to mention the importance of methods for assessing educational experience. They have to be described in advance and checked at the design stage. Evaluation of the quality of the program takes place sequentially at each stage, so that it is possible to consistently make changes to the current process.

The focus on the further development of the experiment and the search for new methodological possibilities is connected with the modern conditions imposed on graduates of higher educational institutions. The traditional paradigm of higher education is based on a certain reference object, relative to which the learning outcome of each student is evaluated. However, the professional activity of graduates, their adaptability in practice shows that this assessment is far from objective. In addition, competencies such as the ability to self-development and the application of acquired knowledge in practice are given little importance in the traditional system.

The introduction of gamification is not an end in itself, but a search for new opportunities to harmonize the learning process and, as a result, improve the learning outcome. The inclusion of game elements in the training reflects the specifics of the mentality of the digital generation. If we take into account their personal qualities, level of preparedness, desire for development, interest, the nature of motivation, and activity cycles, then the use of a game technique can bring not only a short-term positive result in one discipline, but also give an impetus to development in other areas of study.

The connection of real learning goals with the game makes it easy to involve students in learning, keep their interest in the subject of study for a long time, develop creativity and research abilities. Thus, a carefully developed gamified program makes it possible to design a learning outcome following a fairly simple and transparent algorithm of actions.

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