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Published in the USA

European Journal of Contemporary Education
E-ISSN 2305-6746
2023. 12(1): 188-203
DOI: 10.13187/ejced.2023.1.188
<https://ejce.cherkasgu.press>

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Formation of “Teamwork Skills” in Future Teachers when Creating Didactic Games with Traditional and Digital Components

Elena V. Soboleva ^{a,*}, Tatiana N. Suvorova ^b, Dmitriy V. Chuprakov ^a, Irina Yu. Khlobystova ^c

^aVyatka State University, Kirov, Russian Federation

^bMoscow City University, Moscow, Russian Federation

^cGlazov State Pedagogical Institute named after V.G. Korolenko, Glazov, Russian Federation

Abstract

In accordance with the requirements of the professional standard, the teacher of the digital school must have skills related to information and communication technologies, communicative competence, and teamwork skills. The formation of relevant qualities in the conditions of higher education is complicated by a number of different problems. The purpose of the study is to study the features of the formation of teamwork skills in future teachers when developing didactic games with traditional and digital components.

Research methodology. Gamification is used both as a technology for acquiring new knowledge and as a technology for team building. The team activity method is used to design didactic games. The experiment involved 60 undergraduates of the Vyatka State University of the training program "Psychological and Pedagogical Education". To assess team effectiveness Laura Stack's methodology was chosen (five levels of team building).

Research results. The students of the experimental group are involved in team work on educational games: they study basic mechanics in didactic games; master interactive services; develop their own project, including both non-computer and digital elements.

In conclusion problematic questions are formulated, the answers to which make it possible to determine the directions of the work of the didactic game design team: discussion of the goal of the game and the game goal, the choice of basic mechanics and formed competences, the rules and resources, etc.

Keywords: gamification, educational game, digital services, cross-professional competences, soft skills, co-creation, interaction.

* Corresponding author

E-mail addresses: sobolevaelv@yandex.ru (E.V. Soboleva), tn_suvorova@vyatsu.ru (T.N. Suvorova), chupdiv@yandex.ru (D.V. Chuprakov), hloirina@mail.ru (I.Yu. Khlobystova)

1. Introduction

Under the influence of digital transformation, the entry of the economy into the fourth industrial revolution, changes are taking place in relation to the requirements to educational institutions at all levels of education. In particular, schools face the need to develop a corporate spirit and self-management skills in teachers. Effectiveness of the didactic process largely becomes dependent on activities of the entire team of like-minded people who are not indifferent to development of the information educational space.

Under these conditions, the employee's quasi-professional experience becomes important for the employer. L.N. Stepanova, E.F. Zeer determine that during interviews not only professional skills are often checked but also additional knowledge and skills that cannot be obtained at university. The scientists use the concept "soft skills" to designate a set of supra-professional skills (Stepanova, Zeer, 2019). I.A. Shcheglova notes that teamwork skills, the skills of joint activities are one of the most high-demand competences in the modern labor market (Shcheglova, 2019).

As a result, the future teacher of the digital school in the context of modern requirements for the quality of higher education, for the level of formation of digital skills for successful professional activity, needs to master ICT competences, understand features of organizing extracurricular (including gaming) activities, be able to create study groups and manage them (Soboleva et al., 2020). Modern school mentors can and/or should combine digital formats and teaching methods with classical forms (lessons, group work, excursions, didactic games, discussions).

At the same time, as G.P. Baibekova points out, innovative solutions in the field of teaching open up new opportunities for targeted, individual development of the required digital competences, supra-professional skills (Baibekova, 2021).

One of the options for integrating digital components into the traditional educational model is gamification of learning and cognition (Soboleva, 2019). G.I. Fazylzianova, V.Yu. Sokolova, V.V. Balalov highlight the need to accurately determine the goals of the game and the process that needs to be gamified as the problem of including this technology in the teamwork (Fazylzianova et al., 2021). For example, if the goal is to motivate a participant in information interaction (directly the student, parents, or the teacher), then achieving this goal implies the need to take into account and mutually influence the following processes: interaction with other participants, performing specific tasks within the framework of ongoing activities, self-development and self-determination. The organizer of the game needs to analyze various ways of gamification and choose the most optimal one to achieve the goal. In particular, ClassCraft, GoogleClass, etc. services can be used to gamify interaction with other participants. For the gamification of solving individual educational and cognitive tasks, LearningApps, Quandary, eTreniki, etc. are effective. When gamifying self-development and self-determination, Minecraft, Codu Game Lab, Uchi.ru, etc. are used.

Ya.N. Poddubnaya, K.S. Kotov, A.A. Slukina note that in the early stages of including game elements in education, teachers supported the idea of developing educational applications and platforms (Poddubnaya et al., 2021). The authors argue that teachers used to believe that computer games stimulate the communicative activity of users, the productivity of teamwork, and group thinking. However, N.E. Veraksa, M.N. Gavrilova, V.L. Sukhikh confirmed that the potential of board and business games, simulation games, and sports quests is singled out separately (Veraksa et al., 2021). It is traditional didactic games that are used to develop emotional intelligence, team building, and group activities.

So, on the one hand, interactive computer applications are effectively used to form teamwork skills in future teachers. At the same time, digital school mentors need the experience of gamification of joint activities even without game-based computer applications.

1.2. Purpose and objectives of the study

The purpose of the work is determined by the need to study the features of formation of teamwork skills in future teachers when developing didactic games with traditional and digital components.

Research objectives:

- To clarify the potential of gamification for formation of a set of supra-professional skills in future teachers of the modern school;
- To describe the principles of implementation of basic mechanics in didactic games with traditional and digital components using specific examples;

- To determine the stages of undergraduates' activities within the framework of the course on developing and applying computer games in education;
- To experimentally confirm the effectiveness of the proposed system of work.

2. Relevance

2.1. Literature review

2.1.1. Analysis of Russian scientific and pedagogical literature

Regarding to education G. P. Baibekova notes that trans-professional experience should be understood as acquisition by graduates of such knowledge and skills that provide them with awareness of the process of their own education and its real results (Baibekova, 2021).

M.A. Lukashenko determines that the willingness to work in a team, the skill of collaboration, joint creativity to solve a socially significant problem, the application of principles of self-management are among the high requirements that are imposed on modern teachers (Lukashenko, 2021).

The phenomenon of "team" is studied in science from various positions, most often sociological. At the same time, the features of the team are revealed in comparison with a group of people and a collective. In management, more attention is paid to the concept of "working in a team", principles of teamwork and improving the efficiency of actions (Ganseuer et al., 2015). In psychological and pedagogical research, "team learning" is analyzed in relation to obtaining in-demand professional or universal skills.

In a general sense, S.D. Lipatova and E.A. Khokholeva understand the concept "team" as "a group of people who complement and replace each other in the course of achieving the goals" (Lipatova, Khokholeva, 2021).

T.T. Sidelnikova defines teamwork skills and communication skills as competences demanded by the employer. In this regard, she substantiates the need to use various group forms of organization of learning (Sidelnikova, 2018).

G.I. Fazylyanova, V.Yu. Sokolova, V.V. Balalov substantiate that gamification under certain conditions and principles can be an effective technology to increase motivation for joint activities, promote team orientation (Fazylyanova et al., 2021). Their work analyzes the experience of gaming practices in business and politics, education and personnel management. For example, the mechanism of the game "10 Downing Street" is analyzed (the formation of communication skills, foresight thinking); "Pirates of the Caribbean" (development of the speed of thinking, emotional intelligence and the ability to work in conditions of uncertainty). And in each gaming practice special attention is paid to team building and group activities.

S.D. Karakozov, A.Yu. Uvarov, N.I. Ryzhova substantiate the need for a transition from the traditional school to the digital one (Karakozov et al., 2018). Indeed, every year there are more and more educational computer games, digital services for gamification (game platforms, mobile applications, online games, interactive simulators, etc.).

N.I. Isupova, T.N. Suvorova consider the problems of gamification using information technologies (Isupova, Suvorova, 2018). Ya. N. Poddubnaya, K. S. Kotov, A. A. Slukina indicate that interactive computer applications can be effectively used to form general cultural, professional and quasi-professional competences of future teachers (Poddubnaya et al., 2021). At the same time, digital school mentors need gamification experience without digital applications of game learning (Cherniavskikh et al., 2019).

K.A. Ocheretyany, D.A. Kolesnikova note that the game space-time is an interactive dimension (Ocheretyany, Kolesnikova, 2018). The game environment is presented by the authors as a set of solutions, as a universe of foreseeable tasks and goals. The designed gaming solution allows developers and users directly to express the integrity of the experience, individual identity, and the physicality of presence. According to the authors, the game is an affective-interactive model of involvement in activities and communication. As a result of the study the scientists come to the following conclusions: in the modern "digital universe", a gamer is a way to be in the world; a computer game is a source of language that allows developers to create and describe the experience of media reality.

E.V. Soboleva et al. determine that the basics of programming can be effectively learned through interaction with the game world. The authors also consider the possibilities of the environment Minecraft: Education Edition and Scratch. Based on experimental data, the authors show that the interest in programming awakens already at the first lesson (Soboleva et al., 2017).

The materials of the work confirm that such an effect is present even among those students for whom the very word programming was not only incomprehensible, but also hostile (Soboleva, 2019). The examples of didactic games given by the scientists allow us to conclude that specific tasks should not always be set in the game; the goal of the game may be to explore the game world, create the user's own rules of game behavior. Students in the game space get acquainted with the basics of program development, master algorithms, cycles, functions, variables. All of the above creates additional conditions for development of logical and strategic thinking, creative imagination, and emotional intelligence.

E.K. Gerasimova et al. conclude that the use of gaming technologies is, on the one hand, an auxiliary tool for the traditional form of education. On the other hand, it brings both developers and users closer to universal digital literacy (Gerasimova et al., 2021).

But the life in the new digital society sets certain rules of the "game", which create the conditions for a qualitative leap from the "person player" to the "person-doer" (Dieva, 2020). Increasing the intelligence of computer characters allows reaching a new level of aggregation of tasks facing the player. This significantly changes the essence of the gameplay. However, the level of complexity of game decisions is also increasing, which both the developer and users will have to perform on their own.

T.A. Balakireva, M.N. Mogilevich substantiate that problems in the implementation of educational programs may arise due to the integration of advanced technologies and conceptual ideas into traditional learning systems (Balakireva, Mogilevich, 2021).

2.1.2. Analysis of foreign studies

The research conducted by S. Noor et al. in European countries show that 93 % of employers consider "soft skills" to be the same important quality of employees as their professional skills (Noor et al., 2018). The analysis of the questionnaires performed by the authors allows them to conclude that a modern teacher needs to possess the following supra-professional skills: communicative literacy, adaptability, project management, emotional intelligence, etc. A high level of development of these competences will determine the success, professional self-realization.

R.W.M. Mee et al. determine that new technologies as a result of the globalization of society provide unlimited opportunities for exciting discoveries and developments (new forms of energy, medical advances, restoration of ecologically devastated areas, communications, exploration in space and in the depths of the oceans). Therefore, twenty-first century skills must be interdisciplinary and complex, increasingly project-based and research-based, including, and with the support of digital technologies (Mee et al., 2022).

K. Tenório et al. indicate that gaming technologies allow taking into account the peculiarities of perception and information processing of modern students (quick access to information, variability of its use, interactivity, visual presentation of information), their interests (adaptive, individual educational trajectories) (Tenório et al., 2022). Gamification provides effective tools for effectively building communication processes (mechanisms for quick feedback and intragroup communication), increasing the level of motivation of students, etc. However, game technologies have their drawbacks associated with the complexity of application and implementation. The authors come to the conclusion that when developing games for educational purposes, it is necessary to compare the interests and motivation of students with the interests and goals of teachers. This conclusion, according to the scientists, can significantly increase effectiveness of gamification in education.

I.J. Pérez-López, C. Navarro-Mateos, J. Mora-Gonzalez present a gamification project for a healthy lifestyle based on the plot of Star Wars (Pérez-López et al., 2022). The software solution is made in the form of a mobile application. According to students, the work in the interactive digital space using gaming techniques made it possible to visualize the technical reading and fixation of human physical development indices, increase motivation for a healthy lifestyle, intensify the mechanism for obtaining skills in a virtual environment, and activate cognition.

M. Torrado Cespón, J.M. Díaz Lage note that games additionally motivate students by offering them new opportunities for socialization (Torrado Cespón, Díaz Lage, 2022). During games in a new and non-obvious format, interaction with teachers and classmates takes place. The authors highlight the communication "student – teacher" as a guide of the game impact. In their opinion, the success of game learning depends on its nature and intensity. Not only the

methodology is important, but also the fact that the relationship between the student and the mentor in a virtual environment takes place in a special emotional atmosphere.

S. Qiao et al. conduct a multi-stage pedagogical experiment aimed at identifying the current and resulting from the introduction of gamification into the learning environment levels of motivation and subject knowledge in the English language (Qiao et al., 2022). The most effective gamification systems, in their opinion, use additional elements (for example, communication with other "players" - students), which in fact allows to pay attention to interests of all students.

S. Sampedro-Martín, J. Estepa-Giménez in their research show that modern didactic games provide an opportunity to show such qualities as honesty, courage, resourcefulness, wit, ingenuity (Sampedro-Martín, Estepa-Giménez, 2022). The game contributes to the formation of discipline, because every game is played according to certain rules. During the game children learn to reckon with the opinions and interests of others, to restrain their desires. Schoolchildren develop a sense of responsibility; collectivism, discipline, will, character are brought up. Playing the situation several times gives participants the opportunity to change roles, try other behaviors, and reflect on the activity.

C. Lhardy et al. describe the mechanics of the implementation of Unit Kemps – a cognitive, exciting, easy-to-organize game that is used for learning. Supported languages are English, French, and Spanish (Lhardy et al., 2022). The authors present a unique program that can be used in the process of studying physics. Students can find physical formulas, constants and change systems of calculation. Depending on preferences, the user has the opportunity to choose one of various topics.

R.M.C. Rodes, M.I.P. Arreola, A.S. Aranda describe the possibilities of gamification for constructing a thematic investigation in the detective genre (Rodes et al., 2022). The authors found that educational gaming technologies allow students to instill love for discovering the secrets of chemistry, substances, their transformations and various phenomena accompanied by their transformations. At the same time, additional conditions are created for the development of cognitive interest in the wonderful world of chemistry, control of work with chemical reagents when being a team member.

A. Burgess et al. consider the team as a "collective subject of activity", and add that the main characteristic of the team is the "skill to be a single whole" in relation to goal-setting, value orientations and norms of action (Burgess et al., 2019).

E. Jääskä, K. Aaltonen explore the benefits and challenges of using game-based learning methods in higher education in project management (Jääskä, Aaltonen, 2022). The goal of game design is to develop a team project. The scope of the project is limited by the time frame of the training sessions. Because of this, as a rule, a conditional educational project is proposed for implementation, which has no real practical value. The authors also note that educational games allow simulating the socio-psychological aspects of collective interactions. In a role-playing game, it is very difficult to quantify the actions of the participants, therefore, as a rule, qualitative assessments are used.

Thus, the analysis of the above scientific works allows us to substantiate the need for the additional study of the following issues of organization of team activities of future teachers:

- participating in traditional didactic games;
- using interactive services during gamification;
- designing own game scenarios that combine traditional and digital elements.

3. Materials and methods

3.1. Theoretical and empirical methods

In the study didactic games that combine non-computer and digital components are used to involve all participants in the educational process in various activities (cognitive, research, etc.). At the same time, gamification is simultaneously considered both as a technology for acquiring new knowledge and as a technology for team building.

To divide the study group into teams, the Wheel of Fortune service is used (<https://ru.piliapp.com/random/wheel/>). This is an online tool for random selection of a member. The program, due to the random number generator, allows to gamify the decision-making process. In traditional didactic game mechanics the principles of the game "Lapta", "Snake", "Mafia", "Monopoly", "Rock-Paper-Scissors", "Sorry", "Trivial Pursuit", "Battleship", etc. are studied.

Support tools are StudyStack (<https://www.studystack.com/>), Robotlandia (<https://robotlandia.ru/>), Domino Generator program.

The experimental study was carried out on the basis of the Vyatka State University when studying the course "Development and application of computer games in education." Team work on designing didactic games with traditional and digital components involved 60 first- and second-year students of the training program 44.03.01 Pedagogical education (master's degree level). The average age of the participants was 25 (50 % of women and 50 % of men).

The empirical methods (observation, analysis of the results of team work on a game project) were used to obtain up-to-date information about real qualitative changes in planning skills; degree of trust in each other; managing emotions in case of mistakes; communicative skills, information interaction in a team, interpersonal communication; mutual support; reflection in the team and individually, the use of feedback mechanisms; protection of the results of the game project.

To diagnose the formation of teamwork skills, the Laura Stack method was used, which offers tools for assessing personal and team effectiveness. A distinctive feature of the methodology is that each participant in the survey must conduct an individual assessment of the work of the team (own experience and perception).

The methodology is divided into 4 blocks: "Fair attitude", "Willingness to be responsible for the result", "Systems", "Technologies". For each of them factors for accelerating the teamwork are provided.

Block "Fair Attitude": building relationships, managing conflicts, strengthening integrity.

Block "Readiness to be responsible for the result": trust in colleagues, awareness of responsibility, maximization of efficiency.

Block "Systems": making effective decisions, managing time, increasing efficiency.

Block "Technology": effective communications, effective meetings, compliance with accepted rules.

For each factor 4 limiters are proposed - they are questions. There are 48 limiters in total.

All test questions begin the same way: "To what extent my team members are ...". Response scale: "1 = not at all", "2 = to a minimal extent", "3 = to some extent", "4 = to a large extent", "5 = to a great extent".

Next, a form for summing up is filled up.

In addition, the authors' testing which includes 50 tasks was developed to assess the quality of educational results. The materials are compiled according to the work program, taking into account the theoretical and practical nature of the activity.

Tasks are divided into the following groups: reproductive, constructive, creative (according to the level of complexity); facts, terms, figures, ideas, concepts, causal relationships, patterns, laws (according to the elements of assimilation). This gradation is determined by the university requirements for the course evaluation funds.

Based on the results of testing, the student receives a mark "credit" or "not credit".

Thus, when choosing the experimental and control groups, the authors took into account: the results of the Laura Stack method (Stack, 2018); the results of the authors' testing which consists of 50 questions, the principles and content of which are disclosed in the research program.

Methodological feature of processing the results:

1. At the stage of statistical processing of the changes that have occurred in the pedagogical system, regarding the formation of teamwork skills in future teachers, the Pearson's chi-square coefficient – χ^2 was used.

2. To assess the effectiveness of specially organized activities for designing didactic games with traditional and digital components in terms of improving the quality of education, the Fisher criterion was used.

3.2. The base of research

The main purpose of the experiment was to test the potential of designing didactic games by undergraduates using traditional and digital components as part of the course "Development and Application of Computer Games in Education" to develop teamwork skills that are in demand in modern society. 60 students of the training program 44.03.01 Pedagogical education (master's degree level) were involved.

The integration of gaming applications into training was carried out in the same classrooms, using the same equipment and software.

The materials for the test were developed by the authors in accordance with the current standard of higher education in the field of studies.

3.3. Stages of research

At the preparatory stage of the experiment various digital services for gamification of cognition, computer games with educational content were considered: "Heathstone" (mathematics, logical thinking), sports games (<https://igrouka.ru/sportivnye-igry/>), "Battleship" from the resources of Robotland, "Monopoly" (<https://monopoly-one.com/>), "Snake" (<https://multoigri.ru/igri-zmeyka>), "Domino" (<http://domino.ru/domino-na-chetveryx/>), "Mafia" (<https://maffia-online.ru/>), etc.

Classical non-computer games were analyzed, the didactic potential of which is recognized in the scientific and pedagogical community: "Domino", "Monopoly", "Chess", "True/False", quizzes, etc. Further, each group chose those of them which have the resources to form teamwork skills. Whenever possible, the games were divided into two groups "traditional - computer". For example, the games "Mafia", "Chess", "Lapta", "Battleship" can be non-computer and digital. Then, the basic game mechanics, game strategy, components, rules of interaction were determined for each group of games.

To assess the input conditions, it was decided to use the L. Stack method. The main reason is that her questions are formulated precisely in terms of soft skills and correspond to the challenges of Industry 4.0 as much as possible. Other methods and criteria for choosing exactly the specified one are described in paragraph 4.3.1.

To interpret the results, conditional names of the levels of team orientation were introduced: "My team", "We are on the right track", "Our golden mean", "We are all waiting for changes", "You, I, he, she, they...".

In addition, 50 questions for the control work were compiled. Task examples are also presented in paragraph 4.3.1.

The students could get from 0 to 100 points for the control work. According to the results of measurements, the marks were determined as follows: from 0 (inclusive) to 55 points – "credit" and "not credit" in all other cases.

Thus, it was possible to collect data on 60 undergraduates, from which the experimental and control groups were formed. Each of them has 30 people. The sample was not random. The experimental group included 50 % of women and 50 % of men

The second stage of the experiment was devoted to determining the structure of the course in accordance with the purpose of the study.

The third stage of the study is the training of undergraduates based on the materials of the course "Development and application of computer games in education" and the design of didactic games by undergraduate teams.

4. Results

4.1. Key concepts of designing didactic games

In the course of the analysis and generalization of the scientific literature, the authors' positions regarding the key concepts of the study were determined:

- gamification is a technology for involving all participants in the didactic process in educational, cognitive, research activities. At the same time, gamification has the potential both for acquiring new knowledge and for team building;

- teamwork - the skill to accept the unity of values, the consistency of goals and actions, the priority of common goals over personal ones;

- resource management – distribution and rational use of existing human, financial, technological potential;

- competence "teamwork skills" is closely related to the readiness for joint creativity, the ability to interact and resolve conflicts, emotional intelligence, adaptability;

- joint creativity involves a combination of communication skills and creative work in groups;

- the ability to interact – the willingness to work with people and technical systems, the ability to understand and accept the opinion of another in the context of the relationship between

human and artificial intelligence. These skills are manifested through peacemaking and conflict resolution;

- emotional intelligence: empathy, the ability to maintain a positive attitude and high motivation, overcome negative emotions, inspire others;
- adaptability (openness to new things, willingness to learn, unlearn) implies the ability to respond effectively to any changes in the working environment.

In the present study, a team is understood as a group of like-minded people cooperating with each other to achieve the intended common goals. As a result of such interaction, it becomes possible to achieve much better results in a fairly short period of time than working alone. In a close-knit team, all responsibilities are clearly distributed among its members: some generate ideas, others critically evaluate them, and others offer implementation tools (Filatova et al., 2018). Then a general plan and separate tasks for each are developed. Thus, complementing each other, the participants create a single balanced team.

As part of the course, undergraduates in both groups (control and experimental) studied theoretical material: a game, a didactic game, and classifications of games. In addition, the concepts of game mechanics, the goal of the game and the game goal were introduced into consideration.

Game mechanics is an informational/mathematical model that describes the interaction "game – players" and defines the rules, possibilities, limitation. The mechanics involves the characterization of the following relationships: "Player – Moves", "Player – Actions", "Player – Resources", "Player – Players".

4.2. The activities of the undergraduates within the course "Development and application of computer games in education" and designing didactic games by teams

At the beginning of the course, the teacher and students considered an example of the most famous and simple basic mechanics - the choice mechanics. The choice mechanics were implemented in practice - the study group was divided into teams. In the experimental group at this stage of the work a coin, a cube, etc. were used for that purpose.

A discussion was organized that the game goal and the goal of the game are not always identical concepts. For example, the goal of the game is to go through 10 levels and save the princess, and the game goal is to study folk signs.

The next stage of the activity in the experimental group is modeling of a traditional didactic game ("Battleship", "Monopoly", "Lapta", "Domino", "Mafia").

The teacher initiated an activity to analyze personality traits that are in demand in modern society, which are formed by this or that didactic game. For example, emotional intelligence, critical thinking, creativity, etc. In the experimental group, everyone could give an example of a game action that contributes to developing the discussed qualities.

At the next stage, the theory on computer and online games was studied (history, basic concepts, role and significance in the development of personality). Classifications of computer games were considered (role-playing / non-role-playing, by game genre; by time mode; by the number of players, etc.). The students in the experimental group analyzed the basic game mechanics in computer and online games in detail ("Race", "Queue", "Khorovod", "Voting" and others).

Then, again there was a division into teams. In the experimental group, the Wheel of Fortune service (<https://ru.piliapp.com/random/wheel/>) was used to gamify the decision-making process with a random number generator. For the real participation of students in computer games, the services "Igroteka" (<https://igrouka.ru/sportivnye-igry/>), "Battleship" from Robotland, "Monopoly" (<https://monopoly-one.com/>), "Snake" (<https://multoigri.ru/igri-zmeyka>), "Domino" (<http://dominoo.ru/domino-na-chetveryx/>), "Mafia" (<https://maffia-online.ru/>) and etc. were used.

Further, the teacher organized the following discussion: the analysis of the personality traits that are in demand in modern society, which are formed by this or that computer game for educational purposes. For example, the speed of thinking, emotional intelligence, communication skills, etc.

The division of students into teams of their own choice at the next stage of the course was the same in both groups.

Then the undergraduate teams in the experimental group designed their own didactic games that combined digital and non-computer components. Teams from the control group could choose

both board and sports games or develop an ecological quest, an online competition for memorizing flashcards, etc.

Here is an example of one of the projects designed as a traditional didactic game supported by digital resources. This is an intellectual game "Information Domino".

The idea and logic.

1. Each team at the beginning of the game receives 50 bonus points and a Starting Task.
2. For the correct solution of the Starting Task the team is awarded 10 points.
3. For the incorrect answer to the Starting Task points are not reduced.
4. The solution of the Starting Task is submitted to the game teacher for verification.
5. Then the selection of a domino bone is organized, on the back of which the following problem is presented.
6. Each team has two attempts to give the correct answer.

Scoring algorithm:

- If the correct answer is given after the first attempt, then the number of points received is equal to the sum of the numbers on each of the sides of the domino bone;
- If the correct answer is formulated after the second attempt, then the number of points obtained is equal to the largest of the numbers on the sides of the domino bone;
- If the answer was incorrect or incomplete after two attempts, then the team loses the number of points equal to the smallest number on the sides of the domino bone. For example, we chose the 6-3 domino. Then for the correct answer after the first attempt, the team receives 9 points, for the answer on the second - 6 points;
- If both answers were incorrect, the team loses three points (-3);
- Refusal of the domino bone is equal to the wrong answer in both attempts.
- The domino bone "o-o" is evaluated separately. The answer to this question can only be formulated once. If the answer is correct, then the team gets 10 points; if not, then nothing is lost;
- The end of the game. This happens if the presenter does not have a single task left that the team has not yet solved; or the total time of the game has expired.

The first limitation on interaction: if there are 5 minutes before the end of the game, new dominoes are not given.

The second limitation on interaction: it is desirable to involve two presenters for the game. One will check the answers and enter the scores in the evaluation table. The second will oversee the implementation of the rules, maintain order in the cards and dominoes.

Examples of tasks on cards:

1. What is this mnemonic rule used to remember: "We Only Advise Well-Brought-Up Individuals"?
2. D'Artagnan, walking around Paris, went to Porthos. Then they went together to Aramis. And already all three of them went to the Bois de Boulogne. Which of the presented pictures shows the route of friends?
3. Write down the first three numbers of the sequence. If the first number is "5", and the rule is "subtract 2 from the previous number and multiply the result by 3".
4. In a fantasy land all computers have the Alpha operating system installed, while none of the mobile phones has the Alpha operating system installed. What conclusion can be drawn from this? Answer options: in fantasy land, all mobile phones are computers; some mobile phones in fantasy land are not computers; in fantasy land, no mobile phone is a computer; some mobile phones in fantasy land are computers.
5. Hare and Wolf came to play in a computer club. There were 8 games on the server (Minecraft, GTA, Sims, Klondike, Spider, Shrek, Cyberpunk, Winx). How much information does the message that Hare will play Sims contain?

After simulating the game in real learning conditions, the undergraduates implemented its digital representation using the Domino Generator program. Domino Generator allows easily and quickly creating print-ready images of domino sets. Any raster images or any text can be used as pictures.

4.3. Experimental assessment

4.3.1. The ascertaining stage of the experiment

To assess the input conditions, it was necessary to choose a method for diagnosing the formation of teamwork skills. The questionnaires of R. B. Kettel and K. Leonhard, G. Shmishek

were reviewed and analyzed; "Preferred Selection Lattice"; methods of V. Stefanson "Qsorting" and Laura Stack for assessing personal and team effectiveness (Stack, 2018). Taking into account the requirements of employers for future teachers of the digital school, the norms of the current professional standard, the specifics of teamwork in the information educational space, it was decided to use the L. Stack method. Her questions are formulated precisely in terms of soft skills and correspond to the challenges of Industry 4.0 as much as possible.

To interpret the results, the conditional names of the levels of team orientation were introduced.

Level "My team" (from 216 to 240 points). Each member of your group understands perfectly well what a truly mobile and effective team is; how to form and maintain a constructive interaction environment; achieve high quality education. The need for a point adjustment of work in a team arises only from time to time.

Level "We are on the right track" (from 169 to 215 points). In the work of your team, you can improve some areas, but in general, all members of the group are focused on the single result and joint creativity. Try to maintain a positive attitude and high motivation.

Level "Our golden mean" (from 121 to 168 points). Your team is in the process of formation and consolidation. It is necessary to work more actively to improve the efficiency of activities, to master new pedagogical solutions and technologies.

Level "We are all waiting for changes" (from 72 to 120 points). Serious changes in group management are required. It is necessary to reconsider approaches to the organization of joint creativity, the implementation of projects; apply other incentives and motivators for interaction. It is necessary to improve the general professional competence of your team in each of the key areas of activity.

Level "You, I, he, she, they ..." (from 48 to 71 points). Your team needs to start working on improving performance. Now the personal goals of each participant take precedence over the general ones. It is required to develop the skills of joint creativity, group thinking.

In addition, the authors compiled 50 questions for the control work.

An example of a task of the type "Practical/Constructive/Presentation": list and describe the sites used to create interactive applications. Demonstrate the elements of work in one of these services.

An example of a task of the type "Theoretical/Constructive/Representations": mark the correct arrangement of the elements of an electronic educational resource in ascending order of clarity: "diagram – table – text"; "text – table – diagram"; "table – text – diagram"; "text – diagram – table".

An example of a task of the type "Practical/Creative/Patterns": describe the cycles of activity in games and give examples in your future professional activity. Develop a visual diagram to illustrate.

An example of a task of the "Theoretical/Reproductive/Facts" type: choose 3 types of gamification identified by K. Werbach (external, consumer, internal, behavior-changing, and productive).

An example of a task of the type "Practical/Constructive/Cause-and-effect relationships": list the pedagogical goals for using computer games in education.

An example of a task of the type "Theoretical/Creative/Patterns": give examples of digital tools for organizing teamwork in the development of computer games.

For the control work, the student could get from 0 to 100 points. According to the results of measurements, the marks were determined as follows: from 0 (inclusive) to 55 points – "not credit" and "credit" in all other cases.

Thus, taking into account the results of processing materials according to the method of Laura Stack and the data of the authors' testing, it was possible to collect data on 60 undergraduates. Then, the experimental and control groups were formed.

4.3.2. Forming stage of the experiment

Thus, the teacher of the course "Development and application of computer games in education" organized activities in the experimental group in the following stages:

I stage. The study of theoretical material.

II stage. Dividing the study group into teams, modeling a traditional didactic game.

Implementation feature: in the control group students themselves suggested a method for division: by name, by rows, by sympathy, etc.

III stage. Reflection. New fragment of the theory. Reflection is an essential element of the methodology.

Reflection exercises should help the undergraduates: remember the material covered; combine all the studied blocks into an overall picture of the content of the game; see specific ways to transfer the acquired knowledge into real life. For example, write a "Cinquain".

Line 1 – "Multiplayer computer game"; line 2 – "fascinating, virtual"; line 3 – "it is necessary to plan, interact, negotiate"; line 4 – "from separate parts into a single whole"; line 5 – "Team".

IV stage. The division of the study group into other teams (different in composition from the original ones). Participation in a computer didactic game.

Implementation feature: the students in the control group studied the essence of those indicated in paragraph 4.2., games with the help of network resources, tutorials, additional methodological literature.

V stage. Reflection. Divide the group into teams of the students' own choice.

VI stage. The activities of the undergraduates in designing their own didactic game that combines digital and non-computer components.

Implementation feature: the undergraduates of the control group were not purposefully involved in such activities.

VII stage. Team defending game projects.

An example of a team project in the experimental group is indicated in paragraph 4.2 (the project – intellectual game "Information Domino").

An example of a team project in the control group is the game "At a party".

There are n candies in the box. The two take turns playing. It is allowed to eat one or two candies per turn. Whoever cannot make a move loses.

The participants in the control group designed and developed a program that:

1) displays the rules of the game, while choosing the number of candies in the box randomly in the range from 15 to 25.

2) finds out whether the user will play first or second.

3) plays with the user.

4.3. 3. Control stage of the experiment

At the fixing stage of the experiment, the survey was also conducted according to the L. Stack method and the authors' testing based on the course materials. When characterizing the relationships of the features under consideration are used the Pearson's chi-square coefficient – χ^2 . Information about the levels of formed teamwork skills in future teachers before and after the experiment is presented in Table. 1. (Table 1).

Table 1. Assessment of formation of teamwork skills

Level	Group			
	The experimental group (30 undergraduates)		The control group (30 undergraduates)	
	Before the experiment	After the experiment	Before the experiment	After the experiment
"My team"	3 % (1)	33 % (10)	3 % (1)	20 % (6)
"We are on the right track",	7 % (2)	40 % (12)	10 % (3)	20 % (6)
"Our golden mean"	20 % (6)	17 % (5)	17 % (5)	13,5 % (4)
"We are all waiting for changes"	27 % (8)	7 % (1)	30 % (9)	33 % (10)
You, I, he, she, they..."	43 % (13)	3 % (2)	40 % (12)	13,5 % (4)

The following statistical hypotheses were accepted: H_0 – the level of formation of teamwork skills in the experimental group is statistically equal to the level of the control group; H_1 – the level of the experimental group is higher than the level of the control group. In the online resource (<http://medstatistic.ru/calculators/calchit.html>) the values of the criterion were calculated before ($\chi^2_{obs.1}$) and after ($\chi^2_{obs.2}$) the experiment.

For $\alpha = 0.05$, according to the distribution tables, χ^2_{crit} is equal to 9.488. Thus, we get: $\chi^2_{obs.1} < \chi^2_{crit}$ ($0.390 < 9.488$), and $\chi^2_{obs.2} > \chi^2_{crit}$ ($10.244 > 9.488$). Therefore, the shift towards an increase in the level of formation of teamwork skills can be considered non-random.

The verification of the reliability of the results of the control measurement for the quality of education was performed using the Fisher criterion. Testing data before and after the experiment is presented in [Table 2](#).

Table 2. The results of the authors' testing based on the course materials

	Before the experiment		After the experiment	
	The control group	The experimental group	The control group	The experimental group
The share of undergraduates who have "not credit"	63,3% (19)	66,7% (20)	56,7% (17)	26,7% (8)
The share of undergraduates who have "credit"	36,7% (11)	33,3% (10)	43,3% (13)	73,3% (22)

Calculations were made using the online calculator (<https://www.psychol-ok.ru/statistics/fisher/>). The critical value of the Fisher criterion for a significance level of 0.05 (φ_{crit}) is 1.64.

The following hypotheses were accepted: H_0 – the level of educational results in the experimental group is statistically equal to the level of the control group; H_1 – the level of learning outcomes of the undergraduates in the experimental group is higher than the level of the control group. The empirical value of the Fisher criterion before the start of the experiment is 0.279 ($\varphi_{emp}=0.279 < \varphi_{crit}=1.64$). So, before the start of the experiment, the hypothesis H_0 is accepted. The value of the Fisher criterion after the experiment is 2.401 ($\varphi_{crit}=1.64 < \varphi_{emp}=2.401$). Hypothesis H_0 is rejected and H_1 is accepted.

5. Limitations

Let's pay attention to the possible limitations for the study:

1. Formation of questions for author's testing in such a way as to ensure that the control and experimental groups have the same knowledge and skills that form the basis of the teacher's professional competences (including the skill of "teamwork", ICT competence).

2. The inclusion of game mechanics in the design of educational projects, the creation of didactic games is included in the training program for a limited number of specialties.

3. An important condition is the fact that throughout the experiment, the gamification of joint activities in the digital environment and without computer applications of a gaming nature was carried out by the same game teacher. The gamification of learning took place in the same classrooms. The software also remained unchanged.

4. When developing and using computer games in education, it is necessary to take into account the didactic principles of game interaction, variability, personal adaptability, expediency.

6. Discussion

Performing a quantitative analysis of the data obtained, we can conclude that after completing the course, the level of skill formation in the experimental group of undergraduates in the experimental

group increased from 3 % to 33 %. A significant positive shift has also taken place in terms of the level "We are on the right track": from 7 % to 40 % of the respondents. However, the most qualitative changes were recorded in "You, I, he, she, they ...". Only 2 respondents still have a weak motivation for joint creativity and effective interaction to achieve common goals. At the beginning of the course, the number of such respondents was 13 (43 % of the entire experimental group).

For the control group, there is also a positive trend in all levels. But it is less significant. For example, at the level of "My team", the indicator increased from 3 % to 20 %. "We're on the right track" the value increased from 10 % to 20 %. And for "You, I, he, she, they ..." it is defined as 13,5 % (4 undergraduates in the control group), with the initial value of 40 %. The educational results in the experimental group after studying the course "Development and application of computer games in education" according to the proposed structure for integrating digital elements of gamification into the traditional methodology also increased: the share of undergraduates with the mark "credit" increased by 40%. In the control group, the increase was only 6.6 %.

When discussing the potential of incorporating digital components into core game mechanics, it was found that building teamwork skills occurs because:

- in the process of a computer game, secretive, uncommunicative, shy team members become more free in interaction;

- calculation of points, ratings is simplified and visualized ;

- the process of decision-making and choice is supported;

- the distribution of resources is optimized within the existing limitations;

- there is an acceptance of the need to comply with "virtual" rules, follow the rules and strategies;

- the fear of making a mistake and letting everyone down is minimized;

- a joint effort to defeat the "enemy" from the digital space is transferred to reality.

In general, the pedagogical experiment allows us to conclude that the simulated educational and cognitive activity contributes to the formation of the competence "teamwork skills" as one of the most demanded in modern society. Activities for development of games for educational purposes, integrating non-computer and digital elements, provide additional opportunities for training specialists for joint creativity, the skill to interact and resolve conflicts in a team, the skill to empathize and motivate, and adapt to the challenges of society.

The obtained results support UNESCO initiatives to develop socially significant game forms of joint cognitive creative activity of teachers, children and parents in order to preserve the cultural heritage of Russia. The research materials develop the ideas of M. Torrado Cespón, J.M. Díaz Lage on the didactic possibilities of gamification tools (Torrado Cespón, Díaz Lage, 2022). In addition, the conclusions of G. I. Fazylzianova, V. Yu. Sokolova, V. V. Balalov about the possibilities of using games to increase motivation for joint activities and support team orientation are confirmed (Fazylzianova et al., 2021).

7. Conclusion

Currently, the gamification technology is actively used to improve the performance of employees, to manage innovation, to motivate personal development; to support interaction with customers; in the field of education. The inclusion of gamification elements in the didactic process stimulates development of students' cross-professional competences that are most in demand by the market and therefore attractive to employers.

The competence "teamwork skills" in the concept of "soft skills" is singled out by many researchers as one of the main results of high-quality professional training. Scientific works of a pedagogical, socio-economic nature substantiate the need for additional study of the potential of gamification, feedback mechanisms, the use of digital services for development of skills that determine the formation of a quasi-professional experience of joint activities and collective creativity. New gamification services provide innovative tools to support decision making, choice, centralized control, feedback. At the same time, it has been convincingly proven in world didactics that traditional non-computer games contribute to development of skills to listen to the alternative opinions of other members of the team, accept standards and values of others, and follow rules and regulations.

When developing games for educational purposes, integrating non-computer and digital elements, reference points were formulated – directions for teamwork. These are dichotomous

questions, the answers to which must be discussed before starting the design of a didactic computer game:

1. Consider well-known games for educational purposes (computer-free or in digital form) in order to analyze the rules and capabilities of players, limitations. For example, the following scenario was proposed:

- What is the goal of the game?
- Are the goal of the game and the game goal the same?
- Is this game a team game or an individual game?
- If this is a team game, will there be special roles/functions or not?
- If this game is individual, is it allowed to communicate with all participants?
- If this game is a business one, is there a role component for the participants ("play" other people) or do the participants "play" themselves?
- If the game is a simulation, are all the functions of the participants strictly distributed at the beginning of the game, or do the participants determine their place themselves?
- Do the players take turns or play at the same time?
- Do those players who act faster get an advantage?
- Is there any play money?
- Is it a conflict game or a cooperative one?

2. Consider the impact of the game mechanics chosen for the implementation on the competences in demand (emotional intelligence, flexibility of thinking, decision making, etc.).

An obligatory stage of the described educational and cognitive activity is the analysis of the obtained game result and the game goal, the result of the game and the goal of the game. As a direction for improving the proposed option for organizing activities of undergraduates when designing didactic games with traditional and digital components, it was proposed to introduce a block of game theory with a larger mathematical component. For example, to determine with what probability this or that player will be a representative of the "Mafia".

The results of the study allow us to state the advantages of developing didactic games that integrate non-computer and digital elements to motivate students of pedagogical specialties for group forms of organizing classes, for collective creativity and communication.

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