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THEORETICAL ASPECTS OF USING GAMES IN TEACHING STUDENTS OF NATURAL SCIENCES

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ABOUT ARTICLE

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Abstract: In recent years, a new approach to learning in the form of educational games has gained popularity, particularly in the teaching of physics and technology. This study proposes an innovative concept for implementing an approach to learning through educational games at a university. This is done to ensure continuous learning and interdisciplinary opportunities for students. The study examines the development of natural skills and knowledge in the context of game-based learning. It describes the moment when learning is expected and the role of game elements in student engagement and interaction with educational game content. The study also describes the principles of collaborative learning, which are key pillars for the acquisition of cognitive and research skills. The contribution of game-based learning is further linked to the improvement and development of thinking. The study also examines theories that are important for the development of a game-based learning approach: narrative-centered learning theory, problem-solving theory, and engagement theory. After outlining the theoretical foundations, the article examines teachers' views on the game-based approach to

learning. The advantages and disadvantages of game-based learning are also discussed.

Introduction. A common problem facing schools is the loss of interest in learning by many students. The reasons for this negative phenomenon are complex. These include an overload of monotonous educational material, imperfect methods, techniques, and forms of organizing the educational process, insufficient objectivity in assessing knowledge and skills, a disorganization that tires children, and poorly developed interpersonal relationships. Limited opportunities for creative expression also have a negative impact. The "Technology" educational program is designed to largely address these challenges. The diversity of its content significantly contributes to the development of positive motivation for learning and the development of creative abilities in students.

How can we ensure that students not only maintain interest in the subject but also strive to acquire new knowledge and skills? The solution is to use game-based learning. Such lessons produce excellent results. Game is a form of activity in simulated situations [1-3]. Game, in its preschool forms, begins to lose its developmental value during school age and is gradually replaced by learning and work, the essence of which is that these activities, unlike games that are simply enjoyable, have a specific purpose. Games themselves become new. Students find games of great interest in the learning process. These games force them to think, provide the opportunity to test and develop their abilities, and engage in competition with other students.

Students' participation in such games fosters perseverance, a desire for success, and various motivational qualities. Game-based situations help relieve fatigue, enhance involuntary memorization, and more fully reveal children's abilities and individuality. The use of game-based situations in technology learning enhances students' interest in the material being studied, developing memory, attention, observation, intelligence, a sense of timing, precision, motor coordination, spatial awareness, and more. The essence of the problem lies in the influence of games on the development of children's creative abilities, personal qualities, and improved academic performance in technology lessons. Games create a positive emotional environment in which all mental processes are most active. The use of game-based techniques and methods, their consistency, and their interrelationships will contribute to solving this problem. The relevance of this issue stems from the need of psychologists, teachers, and parents for improved methods of psychological and pedagogical influence on the developing student's personality, with the goal of developing intellectual, communicative, and creative abilities. The goal is to develop game-based methods for developing students' creativity, improving academic performance, and learning in physics lessons.

Literature review

Conceptual Framework

The nature of game reveals the origins not only of children's, sports, and commercial games, but also of such intuitive artistic endeavors as painting, music, literature, film, and theater, and even more so, politics and war. Human game cannot be explained using simple diagrams, brief formulas, or clear expressions. Game is the central concept of game-based methods, which can be defined as follows: a form of educational process in simulated situations aimed at recreating and assimilating social experience in all its manifestations: knowledge, skills, abilities, emotional activity, and in scientific and cultural subjects. Games are one of the tools that contribute to the development of intelligence. They develop spatial imagination and the coordination of the sensory and motor centers of the brain. As a person grows, games become increasingly serious and complex, until they are replaced by adult business games—life-like situations in which one must find a way out and win. The more diverse games a person experiences at an early age, the greater their knowledge base, the broader their horizons, and the more flexible their thinking, and the greater the likelihood that they will become a successful member of society. Game is a rational and purposeful activity, governed by the rules of a system of behavior. Game is analogous to adult work, the characteristics of which completely coincide with those of game, with the only exception being the outcome. Game is a natural form of work for a young person, a preparation for the future. He always games, and his game is meaningful, appropriate to his age and interests, and includes elements that lead to the development of necessary skills and abilities [4].

For young men, game is a sphere of social creativity, a place for their social and creative self-expression. Game is incredibly informative, and through game, students learn a great deal about themselves. Game is a way for students to find their place and role in a group. Game is a unique phenomenon of universal human culture, its source and pinnacle. Game is a form of student activity through which they learn and gain experience. Game evokes the highest emotional experiences in students and activates them in profound ways. Game can be perceived as a developmental process aimed at developing observation skills, imagination, and the concepts of skills, knowledge, and abilities. Game is so multifunctional, original, and unique, its boundaries so broad and transparent, that it is impossible to give it any clear, concise definition. Many scientific explanations of the term "game" are insufficiently precise and complete, and sometimes simply incorrect.

Game helps mitigate the teacher's authoritarian stance and equalizes the rights of all participants. This is especially important for gaining social experience, including experience in

interacting with adults. In game, young people encounter a variety of rules that they must understand, consciously accept, and subsequently, despite the difficulties modeled during the game, strictly adhere to. They often exhibit a game deficit—desiring to game, but unable to satisfy this desire in class. Therefore, by providing students with the opportunity to participate in a series of role-game and business games, the teacher activates them and transforms their motivation into something personally meaningful. The content of game connects participants to real life. Game allows participants to make mistakes and, by analyzing them, discern the causes and consequences of such actions. This fully meets students' needs to be mature adults. The following statements can be highlighted from the definitions of the concept of game [5] :

1. Games are one of the tools that contribute to the development of intelligence.
2. For students, game is a sphere of their social creativity, a place for their social and creative self-expression.
3. Game is a way for students to find their place and role in the group. Game is a unique phenomenon of universal human culture, its source and pinnacle.
4. A game is a form of student activity through which he learns and gains experience.

Next, it is necessary to consider the possibility of using game-based techniques in the student learning process.

The role of game in the development of cognitive processes

Game technologies are considered as part of pedagogical technologies, and the classification of pedagogical technologies and the specifics of games are discussed. Over time, course content lines have been identified and educational standards have been defined, but questions about what content and to what extent to teach remain of great interest to educational researchers. Teachers' primary efforts are focused on creating programs, textbooks, and teaching aids; however, today, increased attention is being paid to changing the means and organizational forms of instruction. A wide variety of teaching methods exist. The most common teaching methods are the explanatory-illustrative and reproductive methods, where the main characteristic is the reproduction and repetition of a method of activity based on teacher assignments [5-7]. Teaching methods enrich students with knowledge, abilities, and skills and develop basic thinking processes, but do not guarantee the development of students' creative abilities.

The traditional teaching method for a lesson is to spend the first half of the lesson listening to theoretical material, and the second half engaged in hands-on computer work. The effectiveness of this method has been proven over many years of practice, and it has earned a firm place at all stages of education in many institutions. A disadvantage of traditional teaching

is that situations can arise in which only the teacher is working, and some students stop actively participating. Despite this, teachers need to teach students creative thinking and prepare them for life. Unfortunately, this is not given enough attention in educational institutions.

To improve the learning process, making it more effective and engaging, active learning methods, including game-based learning, have been adopted. Active learning methods, characterized by a high degree of engagement, create opportunities for students to develop cognitive motivation and transform the student's role from passive listener to active participant in the learning process. Game-based learning methods increase the effectiveness of the learning process, reduce the time spent studying the material, and transform the learning process into a creative and engaging experience. The use of game-based learning methods in teachers' practice allows them to achieve a range of developmental goals, such as the ability to argue their point of view, and improve attention, memory, thinking, and imagination [9].

However, despite all the benefits of using game-based methods in science lessons, teachers still don't utilize them enough. The following teaching methods and formats are most commonly used:

1) dialogues;
2) work in groups;
3) information minutes;
4) heuristic approach.

Let's take a closer look at each of them. Dialogue is a type of verbal communication that, unlike monologue, takes the form of a verbal exchange between two, three, or more interacting interlocutors. Dialogue is actively used in theatrical performances and in the educational process. In lessons, it is necessary to develop dialogues such as " student-to-student" and "student-teacher." Group work involves students completing an assignment, communicating and interacting to solve a problem aimed at obtaining a common result. Information minutes are a form of training that takes no more than a minute and contains new information. It is advisable to begin an information minute with a dialogue. Students should, relying on personal experience and knowledge gained in the previous lesson during the information minute, answer the questions posed [7, 8].

The heuristic approach is one of continuous discovery. This approach allows teachers to provide students with greater independence and creative exploration. Teachers must be proficient in all of the above-mentioned teaching methods; this will diversify the learning process and increase its effectiveness. A sixth-grade teacher should place the greatest emphasis on lessons with various forms of learning activities, such as games. This is because games, which

encompass virtually all forms of work (individual, face-to-face, group, and collective), provide ample opportunities for creative activity and student intellectual development. Game also creates order, which is so valuable and necessary in today's unstable and turbulent world. Games have a system of rules that cannot be violated. Through games, students can strengthen existing groups or create ones that do not exist.

The world of game is a unique world with its own rules and patterns; it is a different form of reality [10]. Game removes the psychological barrier in the relationship between teacher and students, bringing a "living stream" of creativity, brightness, and originality to any collective or group activity.

Game, as a method of teaching and sharing experiences from older generations to younger ones, has been used since ancient times. Game technologies are widely used in pedagogy, educational institutions, and institutions. Game technologies encompass a broad range of methods and techniques for organizing the educational process.

Until recently, the use of game technologies in the educational process at the institution was very limited. In a modern educational institution, which places greater emphasis on enhancing the activism and effectiveness of the learning process, game activities should be used in the following cases:

1) as amateur technologies for mastering concepts, topics and even sections of a subject;

2) as elements of a more extensive technology;

3) as a lesson or part of it;

4) as extracurricular activities technologies.

Game technologies have the same properties as games:

1) free, developing activity undertaken at the direction of the teacher, but without his dictation, and carried out by students at will, with pleasure from the process of activity itself;

2) creative, improvisational, active in nature activity;

3) emotionally tense, elevated, competitive activity;

4) activities that take place within the framework of direct and indirect rules reflecting the content of the game and elements of social experience;

5) an activity of a simulation nature, in which the professional or social environment of a person’s life is modeled;

6) an activity that is isolated by its place of action and duration, the boundaries of space and time.

One of the most important properties of game is that both children and adults act as they would in the most extreme situations, pushing themselves to the limit to overcome difficulties. Moreover, they achieve this high level of activity almost always voluntarily, without coercion.

The highly active and emotionally charged nature of the game also generates a high degree of openness among participants. People open up, shed psychological defenses, lose guard, and become themselves [11,12]. This may be explained by the fact that the participant solves the game's problems, is engrossed in them, and is therefore unprepared for resistance from the other side. Game technologies are an integral part of pedagogical technologies, and they are differentiated by the prevailing method into:

1) game;
2) dogmatic, reproductive;
3) explanatory and illustrative;
4) developmental learning;
5) problematic, exploratory;
6) programmed learning;
7) dialogic;
8) creative;
9) self -development training;
10) information (computer).

Game technologies differ from other educational technologies in that the game:

1) a well-known, habitual and favorite form of activity for a person of any age;
2) one of the most effective means of activating participants, engaging them in game activities through the meaningful nature of the game situation itself and capable of evoking high emotional and physical tension. Difficulties, obstacles, and psychological barriers are significantly more easily overcome in games;
3) motivational in nature. In relation to cognitive activity, it requires and evokes initiative, persistence, creativity, imagination, and determination in participants;
4) allows to solve issues of transferring knowledge, skills, and abilities;
5) multifunctional, its influence on a person cannot be limited to any one aspect;
6) a predominantly collective, group form of activity, based on a competitive aspect;
7) allows you to receive any prize: material, moral, psychological and others.

Also, pedagogical games differ from other games in that they have one essential feature - the presence of a clearly defined learning goal and a corresponding pedagogical result, which

must be justified, highlighted in a clear form and characterized by an educational and cognitive focus.

To use game-based methods in school education, it's not enough to simply understand the classification of pedagogical technologies by their predominant method or the differences between game-based and pedagogical technologies. It's important for teachers to be able to define the place and role of game-based technologies in the educational process and combine elements of game and learning. It's crucial to distinguish between the functions and classifications of game-based technologies and the game environment, as the game environment determines the specifics of game-based technologies. Game-based technologies, particularly developmental ones, are interesting because the program of game-based activities consists of a set of developmental games that, despite their diversity, share a common concept and possess distinctive features. Examples include tasks in various formats: models, drawings, written or oral instructions. Thus, students learn various types of information and methods of conveying and presenting information. Senior students are characterized by vivid and direct perception and an easy ability to immerse themselves in images. They are easily engaged in any activity, especially game-based ones. Any activity is based on results, and planning these results is part of the teacher's responsibilities. The effectiveness of games depends, firstly, on their systematic use and, secondly, on the targeted nature of the game program in combination with standard didactic exercises [13]. Game technology is constructed as a holistic entity, encompassing a specific portion of the educational process and united by a common content, plot, and character. The game plot develops parallel to the main educational content, helping to activate the educational process and assimilate a number of educational elements. Compiling game technologies from individual games and elements is a promising task for every school teacher. Thus, the following conclusion can be drawn: game technology is aimed at teaching students to recognize the motives behind their learning, their behavior in games and in life, i.e., to formulate goals and programs for their own independent activity and anticipate its immediate results [14].

Game classifications

The first classification is based on the methods used to develop the student’s intelligence and cognitive activity in games.

1) group - object games, that is, manipulation with toys and objects;

2) Group 2: Creative games, i.e., role-game games, in which the plot is a form of intellectual activity. This group includes intellectual games such as "Lucky Chance," "Who Wants to Be a Millionaire," and so on. Travel games also belong to this group. These take the

form of geographical and historical expeditions undertaken by students using books, electronic teaching aids, and virtual museums. A distinctive feature of these games is the active use of the imagination, which creates the uniqueness of this form of activity.

3) a group of games - these are games with ready-made rules, usually called didactic. Such games require students to decipher, unravel, and solve problems, but most importantly, to know the subject matter. The best educational games are designed based on the principle of self-study. Learning typically consists of two stages: collecting the necessary information and making the right decision. These stages provide students with didactic experience. However, gaining experience requires a significant amount of time. Educational games include educational games of a psychological nature: crosswords, quizzes, puzzles, rebuses, charades, cryptograms, etc. Educational games arouse students' keen interest in the subject matter, allow them to develop their individual abilities, and foster cognitive activity [15,16]. The value of an educational game is determined by its effectiveness in solving a particular problem for each student;

4) a group of games – games reflecting professional activities (construction, work, technical, design). In these games, students master the process of creation, learn to plan their work, evaluate the results of their own and others' activities, and demonstrate resourcefulness in solving creative problems;

5) A group of games – intellectual games (exercise games, training games that impact the mental sphere). They are based on competition, demonstrate students' level of preparedness and fitness through comparison, and suggest ways to improve themselves.

A teacher, using all five groups of game methods in his work, has a huge arsenal of ways to organize the educational and cognitive activities of students.

The second classification of games is based on the principles of game construction.

1) role-game games;
2) organizational - educational games;
3) business games.

Determining the type of game is difficult, as some of the design principles of various games are similar, yet they have significant differences. All games, in one way or another, address three primary objectives: educational, developmental, and developmental. Each game teaches and cultivates specific qualities in players while simultaneously achieving developmental goals. Organizational and educational games, as a special form of organization and a method for stimulating collective activity aimed at problem solving, have emerged recently and have become widespread in both creative problem solving and intelligent control

systems. Such games are used as a tool for the collective search for optimal solutions to complex problems in real-world settings. Recently, business games have found widespread application in a wide variety of fields [17]. Business, or simulation, games are used to solve research problems, forecast, and test planned innovations. A business game simulates real production conditions, in which participants act in simulated educational situations representing specific work tasks. In a business game, participants, by assuming roles, more easily acquire knowledge, skills, and understand the processes they are involved in. The particular effectiveness of an educational game is explained by the fact that the player experiences it from the inside, being a direct participant. From an educational perspective, a well-organized game session demonstrates the interesting aspects of a particular profession.

Business games are divided into two groups:

- educational games;
- research games.

A game aimed at developing new knowledge, not previously expressed through verbal communication, is called an exploratory game. A game in which players acquire new knowledge, perhaps previously unknown but already expressed through verbal communication, is called an educational game. Educational business games are primarily used in educational institutions because learning is based on already known facts. Business games are a method of active learning. A distinctive feature of a business game, or simulation game, is the presence of a simulation model. Neither organizational training games nor role-game games employ simulation models. The term "role-game" is highly ambiguous and represents the highest form of children's game. It reaches its peak in preschool, serving as the leading activity during this period, and then gives way to learning.

Role-game games can be classified according to various characteristics.

The first classification is based on the method of their creation and the location where they are held (by game environment). The following role-game games fall into this classification:

- tabletop role-game games;
- pavilion role-game games;
- role-game games on the ground.

Let's take a brief look at each type of role-game game.

A tabletop (floor) rolegame game is a type of rolegame game with minimal props and extensive use of dice. Most such games require a trained leader; prior player preparation is not necessary.

Pavilion role-game games are so named because they take place indoors, and the action is confined to the confines of the space. They are similar in many ways to field games, but smaller in scale. These games require the presence of facilitators to regulate the game.

Field role-game games (or "field games") are usually held in a specially designated, and sometimes equipped, location—a training ground. They are the largest in terms of the number of participants and the space they occupy. These games typically require a specific setting (appropriate clothing, weapons, simulated settlements, etc.), and generally have a strong costumed appearance. Sometimes these games last several days. Many educational institutions typically conduct some form of role-game in specially created clubs.

The second classification is by difficulty level. This classification includes the following role-playing games:

- war games;
- fairy tale games. These are games that feature fairy tale characters and magic;
- historical and ethnographic games. They can be based on historical events, literary works, or the organizers' own developments;
- Information games. The most relaxed class of games, their participants are very limited in their choice of active game actions. Another name for such games is intellectual games. When preparing intellectual games, comprehensive training of participants is necessary. Games are divided by type of activity into: physical (motor), intellectual (mental), work, social, and psychological.

By the nature of the pedagogical process:

- educational, training, control, generalizing;
- cognitive, educational, developmental;
- reproductive, productive, creative;
- communicative, diagnostic, career guidance, psychotechnical and others.

Having examined the essence and functions of game, it can be emphasized that the need for game is one of the basic human needs in general, and of students in particular. The content of game varies depending on the cultural context in which the student is immersed. It is believed that not only the content but also the inclination toward activity in general depends on the social situation. The need for game persists throughout life for many people, which can be confirmed not only in research but also in everyday experience. Children's game can be viewed in different ways. But there are laws that are not subject to anyone's wishes. According to one of them, if one stage of development is not fully completed, the next will proceed distorted. Childhood is a time for game, and if a student's game abilities are stunted, not

allowing them to game to their full potential, then at subsequent stages of development they will game out the unfinished business instead of moving forward. Game is a powerful tool for overcoming crises, which has been successfully used in education for many years. Game technologies remain innovative in the Russian education system. Game technologies have enormous potential in addressing a key educational objective: developing students' subjective stances toward their own activities, communication, and self-awareness. Game is such a unique phenomenon that it is bound to be used in various fields of human endeavor, including education. In the educational process, game serves as a method of teaching and upbringing, sharing accumulated experience, beginning with the first steps of human society along its path of development. When discussing the characteristics of game, it is important to note the particular ways they are transformed in pedagogical game: the classroom-lesson system of instruction does not allow game to manifest itself in its pure form; the teacher must organize and coordinate children's game activities. Game learning is created in lessons using game techniques, elements, and situations that should act as a means of motivating and stimulating students to engage in learning. The implementation of game techniques, elements, and situations in the classroom follows these key approaches:

- the didactic goal is set for students in the form of a game task;
- educational activities are subject to the rules of the game;
- educational material is used as a teaching aid;
- competitions are introduced into educational activities, which contribute to the transition of didactic tasks into the category of games;
- successful completion of the didactic task is associated with the game result.

Thus, the following conclusion can be drawn: game technology is aimed at teaching students to recognize the motives behind their learning, their behavior in games and in life, i.e., to formulate goals and programs for their own independent activity and to anticipate its immediate results.

Significance of the study. Theoretical foundations of game technology

Three theories are necessary to develop a game-based learning model: narrative-centered learning theory, problem-solving theory, and engagement theory. In today's dynamic world, problem-solving skills are essential. Problem-solving skills increase a person's value to employers, thereby providing an advantage in the job market. Solving properly structured problems is a linear process consisting of two stages: 1) creating a problem space and 2) developing a solution by working within the problem space. However, solving problems in a properly structured space is easier than solving problems that may arise in real life. For example, problems in the workplace are typically ill-defined and not easily solved using

classroom methods. Therefore, creating an environment in which students can solve unstructured problems can enhance their ability to solve real-world problems after they graduate and enter the workforce. Educational games aim to bridge the gap between classroom problems and real-world challenges. A game-based learning approach helps develop problem-solving skills by first providing a multi-faceted approach to finding solutions, then assessing students' problem-solving abilities by posing ill-defined problems, and finally allowing students to work collaboratively to solve these problems. For example, engagement theory posits that students learn concepts better if they are given the opportunity to participate more actively in the learning process. Engagement refers to a student's awareness of the qualities of a subject, as well as their motivation and interest in the subject [18]. Students are encouraged to select tasks based on their competencies and then initiate actions when allowed to do so; as a result, they become fully engaged in completing the assigned tasks. Depending on the game aspects used in the educational process, student engagement can be determined by analyzing the dynamic, behavioral, and/or cognitive aspects of engagement they demonstrate. Thus, game-based learning can increase student engagement in the learning process. According to [18], engagement theory proposes three concepts for ensuring effective student engagement in the learning process: first, the learning process should focus on aspects of collaboration between students. Second, the learning process should be adapted to project-based activities and assignments. Third, to enhance the effectiveness of student engagement, authentic, relevant, and meaningful extracurricular activities should be assigned.

Teachers' views on game-based learning

The main reason for implementing technologies to support learning is to support and improve students' educational outcomes. Therefore, a combination of traditional and technological approaches (in the form of game-based learning) is of great importance in increasing students' motivation to interact with the learning material [19]. The application of game-based educational strategies is facilitated by the increasing availability of technology and the increase in the time students spend game video games, which has led to the formation of a game culture that should be utilized in the field of education [19]. According to [20], students demonstrate higher levels of satisfaction when they learn in an interactive manner, fully utilizing their cognitive abilities to solve problems. This means that the application of a technological approach is an optimal means of achieving satisfaction in a group. However, most teachers are not fully familiar with game-based approaches to education and, therefore, have little understanding of their potential. Many teachers are reluctant to use games and, when adapting them for classroom use, do so with little understanding of the game-based approach

to learning itself. However, the situation is improving after extensive research indicates the increased academic performance achieved through gamification in learning. Teachers' primary concerns regarding the implementation of technology relate to its distracting nature, with some teachers experiencing barriers in using game elements in the teaching and learning process [21]. Furthermore, some teachers lack prior experience with games, making it difficult to adapt them for educational purposes. These two issues lead to mixed reactions to the implementation of educational games in teaching at the college level. According to [20], a person's attitude (reflecting their personal perceptions) can influence the attitudes of those with whom they interact. Therefore, understanding teachers' attitudes toward technology-enhanced learning is important for determining their willingness to implement and use gamification in education. To understand these attitudes, it is necessary to study the level of acceptance of such technologies in educational institutions [22].

Methodology

Research Design. Participants

A questionnaire developed by the researcher was used as the primary instrument for collecting data on respondents' perceptions of the use of game technologies among 104 University students. Participants were given instructions on how to complete the questionnaire and were informed that the data collected would be anonymous, voluntary, and confidential.

Data collection. Survey Questionnaire

1. Students' knowledge and experience in the field of game technologies

Table 1 shows how often participants use game technologies.

Option	Number of participants	In percent
Daily	62	64.48
Every few days	18	18.72
Once a week	5	5.2
Rarely	0	0.00
Never	0	0.00
Several times a day	3	3.12
Often	4	4.16
Occasionally	1	1.04
Regularly	3	3.12
Only for specific tasks/assignments	4	4.16

As shown in Table 1, the majority of participants (64.48) use game technologies daily. Among the participants, one student (1.04) stated that he uses game technology from time to time. At the same time, four participants (4.16) stated that they use game technologies only for specific tasks. Meanwhile, many students (18.72) reported using game technologies every few days, and similarly, five students (5.2) use them once a week.

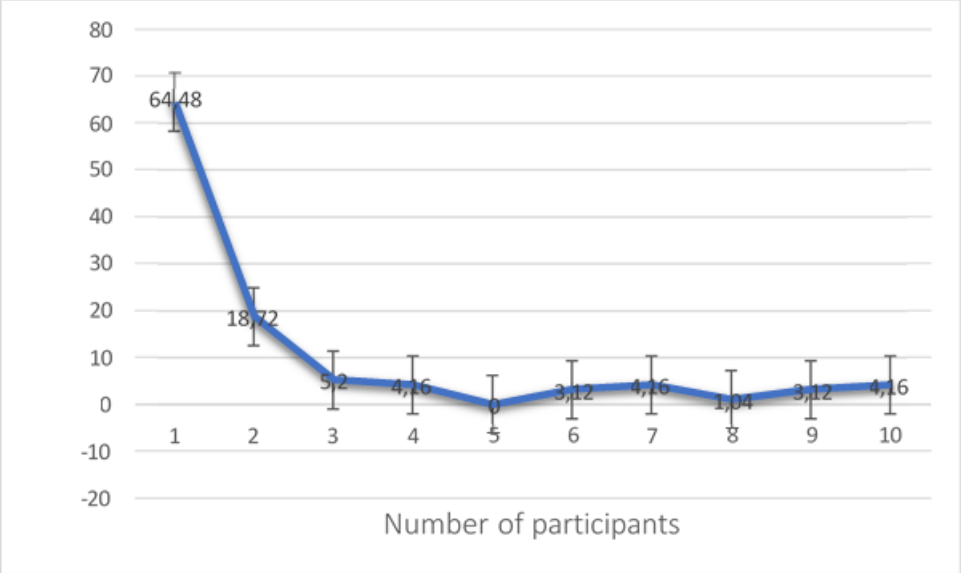

Fig. 1. Graph of results on students' use of game technologies.

Table 2 shows how often participants use technology applications to practice physical discipline.

Table 2. Frequency of students' use of technological applications for practice.

Option	Number of participants	In percent (%)
Daily	59	58.24
Weekly	21	21.84
Monthly	6	6.24
Rarely	4	4.16
Never	7	7. 28

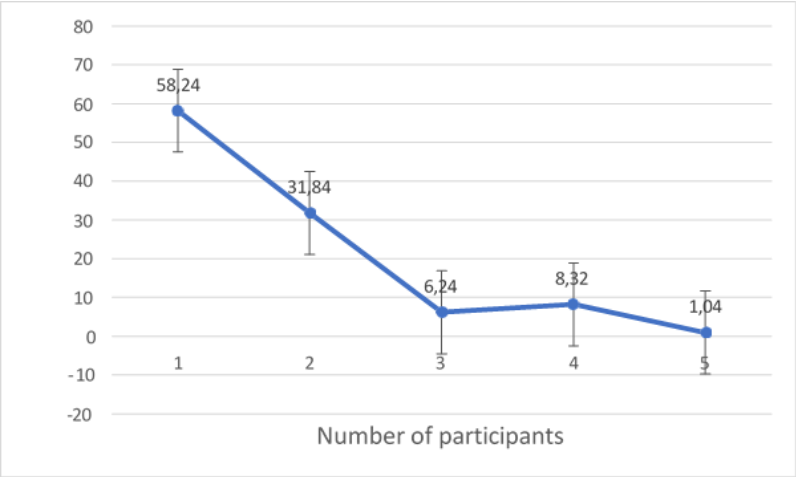

Fig. 2. Graph of results for the frequency of students' use of technological applications for practice.

Participants were asked about their use of technology applications for practice. As shown in Table 2, many participants use game technologies to practice physics. Among the participants, 21 students (21.84) stated that they use technology applications weekly to study physics. Meanwhile, 58 (58.24) participants stated that they use game technologies daily to study the subject. Meanwhile, 6 students (6.24) stated that they use game technologies monthly to practice physics. However, four students (4.16) stated that they rarely use technology applications to practice physics.

2. Students' game knowledge and skills

Table 3 presents students' opinions on their level of technology proficiency in the learning process.

Table 3. Students' opinions on their level of technology proficiency during the learning process.

Option	Number of participants	In percent (%)
Great	65	6 7. 6
Good	25	26. 00
Average	8	8. 3 2
Below average	4	4. 16
Poor	2	2 .0 8
I don't have the skills to use game	0	0.00

Students were asked about their level of technology proficiency in learning. Many students (67.6) believed they were excellent at using technology in learning. A few students (26.00) also believed they were good at using technology in learning. However, eight students (8.32) stated that their level of technology proficiency in learning was average.

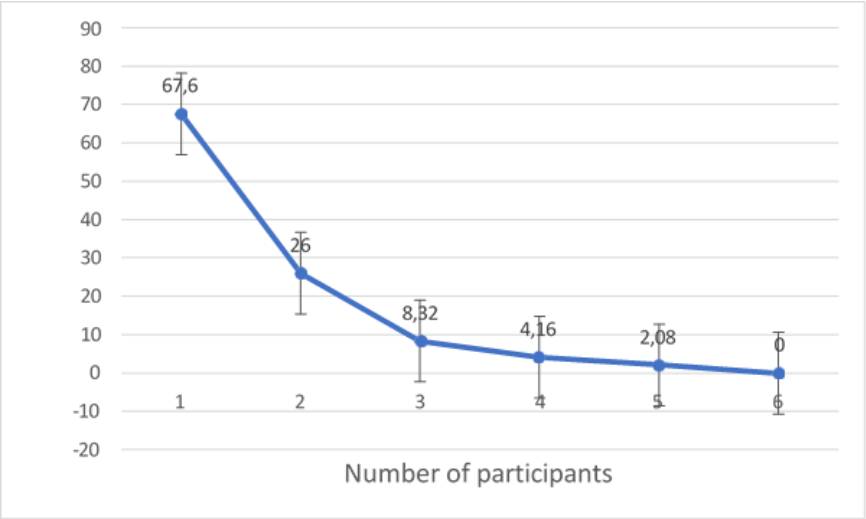

Fig. 3. Graph of results based on students' opinions about their level of technology proficiency during the learning process.

Table 4. Game technologies used by students to study physics

Option	Number of	In percent (%)participants
Computer	53	55. 12
Smartphone	27	2 8.08
Online learning platforms	5	5.20
Educational applications	0	0.00
Interactive whiteboards	1	1.04
Software for learning physics	3	3.12
Social media	1	1. 04
Virtual reality	3	3.12
E-books	4	4.16
Web games	2	2. 08
Video conferencing	5	5.20

Based on the data in Table 4, it is evident that the majority of respondents (27 students) use smartphones to study physics compared to other electronic devices. Furthermore, 1 student (1.04) uses social media in addition to smartphones, and only three students (3.12) use software to study physics. However, three students (3.12) use a computer, and only 5 students use online platforms for learning. Similarly, 4 students use e-books. Although 2 students stated that they use web games to study the subject, none of the respondents indicated that they use educational applications. Thus, it can be assumed that most respondents are familiar with the use of game technologies, particularly smartphones and computers.

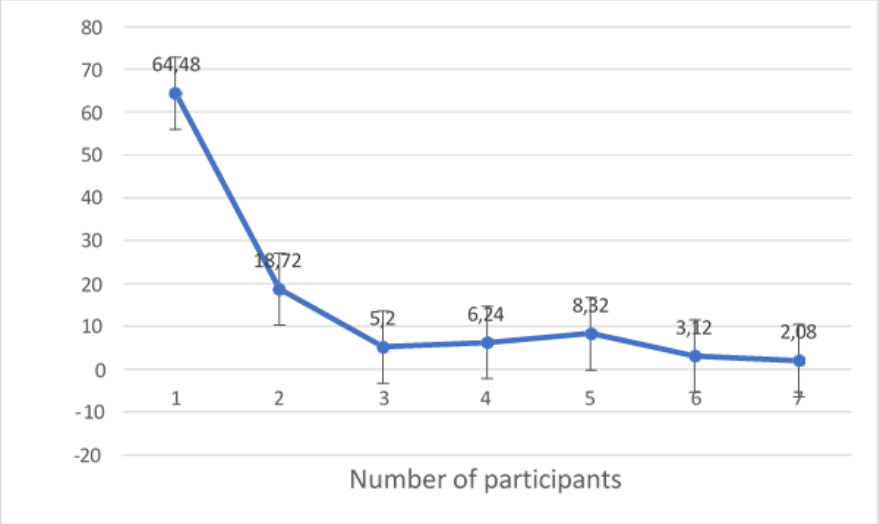

Fig. 4. Graph of results for game technologies used by students to study physical science.

Table 5 shows how comfortable students are with using game technologies to study physics.

Table 5. How comfortable are students using game technologies for studying physics discipline?

Option	Number of participants	In percent (%)
Very comfortable	62	64.48
Quite comfortable	18	18.72
Neutral	5	5.2
Quite convenient	6	6.24
No problem using game technology	8	8.32
I prefer traditional methods of studying the subject.	3	3.12
I am ready to use game technologies to study the subject	2	2.08

Students were asked how comfortable they were using game technologies to study physics. Table 5 shows that the majority of students (64.48) felt very comfortable using game technologies to study the subject, and another 18 (18.72) felt somewhat comfortable. However, five students (5.2) took a neutral position, and three stated that it depended on the technology and the application. Meanwhile, eight students said they had no problem using game technologies to study physics, and three of the students (3.12) preferred traditional methods of studying physics.

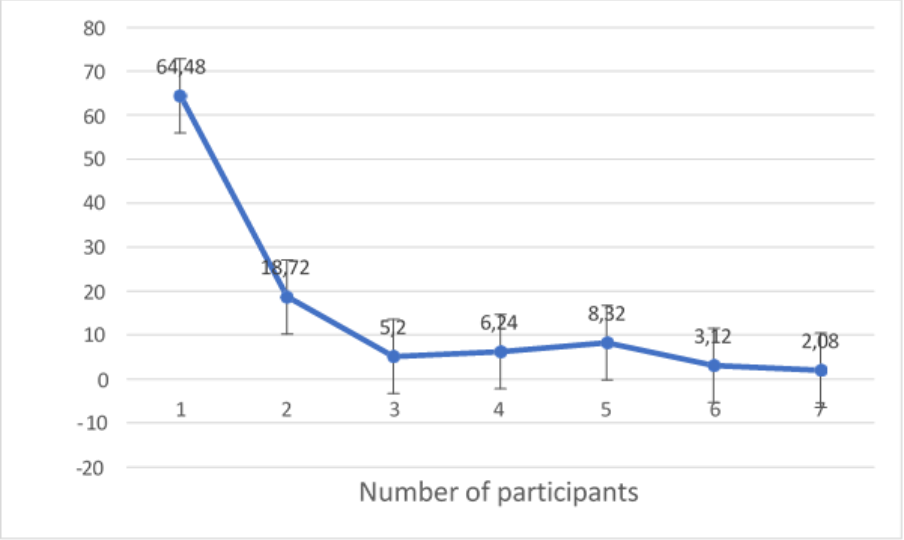

Fig. 5. Graph of results for game technologies used by students to study physics

3. Students' attitudes towards the use of technology

Table six presents students' views on the importance of game technologies for studying physical science.

Table 6. Students' attitudes towards the importance of game technologies for studying physical science

Option	Number of participants	In percent (%)
Extremely important	58	6 0.32
Quite important	23	23.92
Neutral	12	12:48
It doesn't really matter	8	8.32
It doesn't matter at all	3	3.12

Participants were asked about their attitudes toward the importance of game-based learning. Table 6 shows that the majority (58 students) believe that game-based learning is extremely important for learning physics. Furthermore, some students (23.92) believe that game-based learning is essential. However, only 12 students (12.48) took a neutral position, and none of the respondents (8.32) stated that game-based learning is unimportant for learning physics.

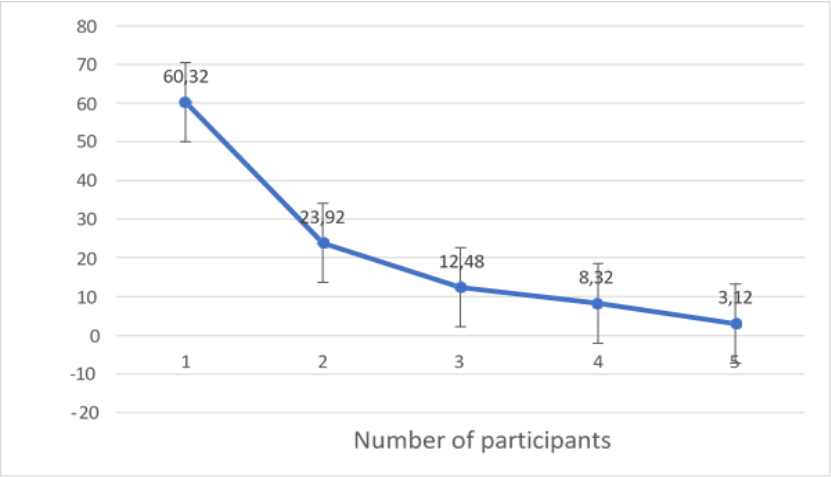

Fig. 6. Graph of results according to students' opinions on the effectiveness of using game knowledge in studying physical discipline.

Table 7 presents students' opinions about game knowledge and whether it helps them learn physics subjects more effectively.

Table 7. Students' opinions on the effectiveness of using game knowledge in studying physical discipline.

Option	Number of participants	In percent (%)
Yes, my knowledge of game technology improves my skills in studying physical science.	5 9	61.36
I'm not sure, I haven't thought about it.	31	32.24
No, my knowledge of game technology does not influence my studies of physical science in any way.	5	5.2
The use of technology in physical education has changed the situation dramatically.	6	6.24
I think that to some extent this is true, but not entirely.	3	3.12

Most respondents (61.36) stated that knowledge of game technologies improves their learning of physics. Additionally, 31 students (32.24) admitted that they hadn't thought about it, and only a few students (6.24) responded that using technology to study physics actually made a difference. However, only 5 students (5.2) believed that their knowledge of game technologies doesn't influence their learning of the subject. Several students stated that this depends on the specific game skills and tools used, and others believe that it also depends on the teacher and how they use technology.

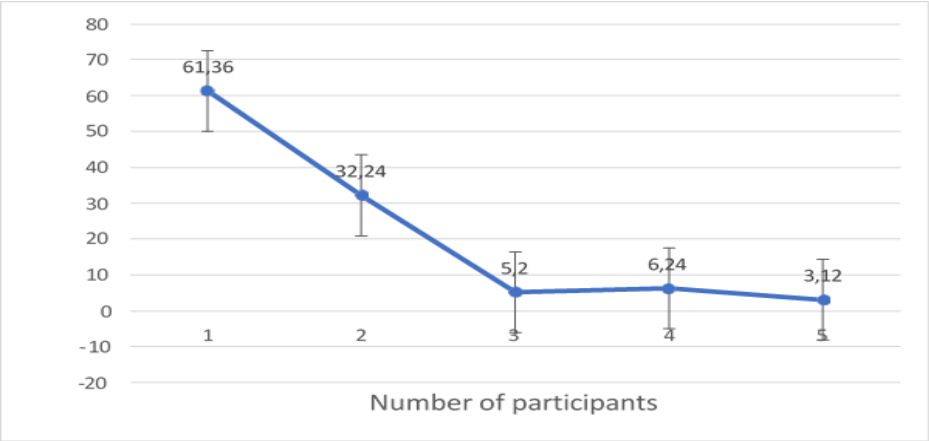

Fig. 7. Graph of results according to students' opinions on the effectiveness of using game knowledge in studying physical discipline.

Table eight presents students' views on how design technology improved their learning process.

Table 8. Using game technologies to improve students' learning experience in physics.

Option	Number of participants	In percent (%)
I believe that game technology can greatly enhance my experience learning physics.	56	58.24
Using game technology has improved my understanding and retention of material.	24	24.96
I have noticed a significant improvement in my physics skills through the use of game technology.	8	8.32
Game technologies have made learning more engaging and interactive.	7	7.28
Game technology has proven to be a valuable tool in enhancing my learning of physical science.	6	6.24
I'm not sure if game technology will improve my physical education skills.	3	3.12

Students were asked whether they believed that game technology could improve their experience of studying physics. Table 8 shows that the majority of them (58.24) believed that game technology could significantly improve their experience of studying the subject. In addition, 24 respondents (24.96) believed that the use of game technology improved their understanding and memorization of the material in the physics subject. However, 8 students

(8.32) noted a significant improvement in their skills thanks to the use of game technology, and the other students (7.28) stated that game technology undoubtedly made studying physics more fun and interactive. Meanwhile, 3 respondents (3.12) strongly believed that game technology gameed a crucial role in improving their experience of studying physics.

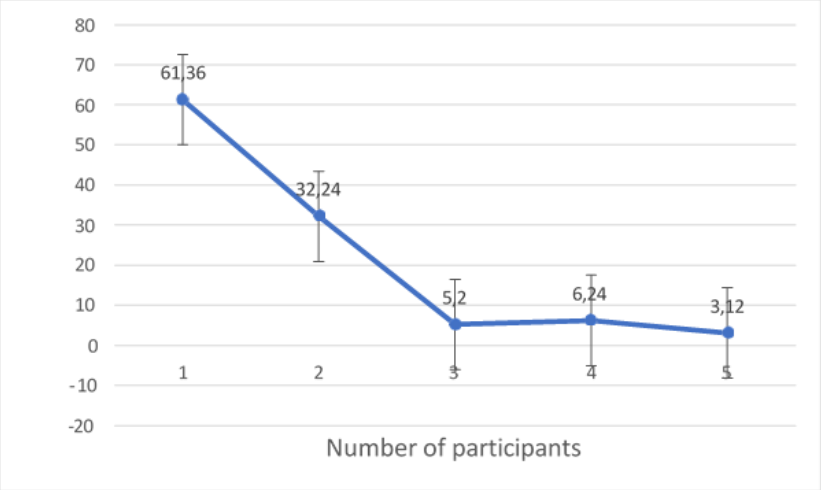

Fig. 8. Graph of the results of using game technologies to improve the experience of students studying physics.

This study demonstrates that students have a positive attitude toward using game tools and possess a sufficient level of game technology in their learning. All participants emphasized the importance of game tools in studying physics. When surveyed about their game technology skills, participants stated that they have basic knowledge and competencies in using technology for learning. However, most of them use smartphones and other electronic devices for studying physics and did not mention feeling comfortable using game technology. Thus, the need to develop students' game literacy was identified.

Limitations of the study

Limitations are related to the small sample size and the conduct of the study with future physical education teachers. Future studies should be conducted with a larger sample of students of other specialties.

Conclusion. This paper examines the potential of using games in student learning and demonstrates the effectiveness of using games and game elements in teaching physics. An analysis of the psychological, pedagogical, and methodological literature on the topic of study allowed us to identify the following statements from the examined definitions of the concept of game: games can relieve psychological fatigue; they can be used to mobilize students' mental efforts, develop organizational skills, adopt self-discipline skills, and create a joyful atmosphere in the classroom. Games contribute to the development of an emotional mood in students, evoke a positive attitude toward the activities they perform, improve overall performance, and

provide the opportunity to repeatedly review the same material without monotony and boredom. By using a variety of game-based activities in the classroom, a wide range of methods for organizing students' educational and cognitive activities emerges. For games to be educational and helpful to students, they must focus on content, emphasizing hypothetical models, and therefore should be developed by researchers and teachers and based on sound academic principles. Teachers should also monitor game-based learning sessions and ensure that failures or defeats do not negatively impact students, but rather encourage them to achieve better results in the future. Teachers should also explain to their students that success in the game is not the end goal, and that losers should not be treated with disdain. Teachers should ensure that game-based learning engages and motivates students, and develops a growth mindset.

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