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GAME-BASED TEACHING METHODS: DEVELOPING CRITICAL THINKING AND ANALYSIS

Abstract

The article discusses the role of games in the educational process, particularly in modeling students' future professional activities. The author examines artificial games as a form and method of teaching, emphasizing the importance of active participation, creative approaches, and feedback. Examples of games used in teaching chemistry and analytical chemistry are provided, and their advantages over traditional methods are discussed.

Educational games hold an important place in the learning system. They enable the simulation of professional scenarios and teach students to make decisions in problematic situations. The article explores various types of games, including simulation and symbolic games, which can be used as educational tools. Games are considered as an independent activity aimed at developing students' intellectual and practical skills.

It is shown that game-based learning enhances students' engagement and interest in the subject, contributing to better retention of the material. Games help develop analytical and decision-making skills by simulating real-world processes.

As a form of teaching, games prove to be an effective means of activating students' learning activities, enhancing their cognitive and professional skills. The use of games in the educational process improves the quality of learning, making it more engaging and productive.

Keywords: *game, artificial game, learning, modeling, professional activity, didactic value, chemistry, analytical chemistry, students, feedback*

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ОҚЫТУДАҒЫ ОЙЫН ӘДІСТЕРІ: СЫНИ ОЙЛАУ МЕН ТАЛДАУ ДАҒДЫЛАРЫН ДАМЫТУ

Андатпа

Мақалада ойындардың білім беру үдерісіндегі рөлі, әсіресе студенттердің болашақ кәсіби қызметін модельдеуде маңызы талқыланады. Автор жасанды ойындарды оқыту формасы мен әдісі ретінде қарастырып, белсенді қатысу, шығармашылық көзқарас және кері байланыстың маңыздылығын атап өтеді. Сондай-ақ, химия және аналитикалық химияны оқытуда қолданылатын ойындардың мысалдары келтіріліп, олардың дәстүрлі әдістермен салыстырғандағы артықшылықтары талқыланады.

Білім беру ойындары оқыту жүйесінде маңызды орын алады. Олар кәсіби жағдайларды модельдеуге мүмкіндік береді және студенттерді мәселелерді шешу кезінде шешім қабылдауға үйретеді. Мақалада оқу процесінде қолдануға болатын имитациялық және символикалық ойындар сияқты әртүрлі ойын түрлері қарастырылады. Ойын студенттердің интеллектуалдық және практикалық дағдыларын дамытуға бағытталған дербес әрекет ретінде қарастырылады.

Ойын түріндегі оқыту студенттердің пәнге деген белсенділігін және қызығушылығын арттырып, оқу материалын жақсы меңгеруге ықпал ететіні көрсетілген. Ойындар нақты процестерді модельдеу арқылы талдау және шешім қабылдау дағдыларын дамытуға көмектеседі.

Оқыту формасы ретінде ойындар студенттердің оқу белсенділігін арттырудың тиімді құралы болып табылады, олардың танымдық және кәсіби дағдыларын дамытады. Білім беру үдерісінде ойындарды қолдану оқыту сапасын жақсартып, оны қызықты әрі өнімді етеді.

Түйін сөздер: *ойын, жасанды ойын, оқу, модельдеу, кәсіби қызмет, дидактикалық құндылық, жарты есеп, аналитикалық жарты, студенттер, кері байланыс*

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ИГРОВЫЕ МЕТОДЫ В ПРЕПОДАВАНИИ: РАЗВИТИЕ КРИТИЧЕСКОГО МЫШЛЕНИЯ И АНАЛИЗА

Аннотация

В статье обсуждается роль игр в образовательном процессе, особенно в моделировании будущей профессиональной деятельности студентов. Автор рассматривает искусственные игры как форму и метод обучения, подчеркивая важность активного участия, творческого подхода и обратной связи. Также приводятся примеры игр, используемых в обучении химии и аналитической химии, и обсуждаются их преимущества по сравнению с традиционными методами.

Образовательные игры занимают важное место в системе обучения. Они позволяют моделировать профессиональные ситуации и учат студентов принимать решения в проблемных ситуациях. В статье рассматриваются различные виды игр, включая имитационные и символические, которые могут быть использованы как форма обучения. Игра рассматривается как самостоятельная деятельность, направленная на развитие интеллектуальных и практических навыков студентов.

Показано, что игровая форма обучения повышает активность и интерес студентов к предмету, способствует лучшему усвоению учебного материала. Игры помогают развивать навыки анализа и принятия решений, моделируя реальные процессы.

Игры как форма обучения оказываются эффективным средством активизации учебной деятельности студентов, развивают их познавательные и профессиональные навыки. Применение игр в образовательном процессе способствует улучшению качества обучения, делая его более увлекательным и продуктивным.

Ключевые слова: *игра, искусственная игра, обучение, моделирование, профессиональная деятельность, дидактическая ценность, химия, аналитическая химия, студенты, обратная связь*

Introduction. The game must be clearly linked to educational goals and objectives, ensuring the development of knowledge, skills, and abilities necessary to master the material. All students should be involved in the game process. To achieve this, it is essential to consider their level of preparation, interests, and individual characteristics. The rules of the game should be clearly formulated, easy to understand, and feasible so that participants can focus on completing tasks rather than interpreting the rules. The game should take place in a friendly and supportive environment, allowing participants to feel comfortable making mistakes and expressing themselves.

Game-based technology should promote the development of communication, collaboration, and joint decision-making skills. After the game, it is important to discuss the results with participants, identify the strengths and weaknesses of their actions, and provide recommendations for improvement. Game tasks should be related to real-life situations or professional activities, enabling students to apply the skills they have acquired in practice. The game should be adapted to the age, preparation level, and personal characteristics of the participants. Upon completing the game, it is necessary to evaluate how effectively it contributed to achieving educational goals and make adjustments for future use. These rules ensure the effective application of game-based technologies, transforming the learning process into an engaging and productive experience.

Educational games play a significant role in the learning system. They allow students to model professional situations and teach them how to make decisions in problem-solving scenarios. This article examines various types of games, including simulation and symbolic games, that can be used as a form of learning. Games are considered as independent activities aimed at developing the intellectual and practical skills of students. As previously noted, artificial play encompasses both tangible and theoretical activities. This implies that play simultaneously occurs in both an external material form and an internal cognitive process.

It is evident that artificial play operates within a well-defined realm of material activity (for instance, a chessboard) while having an almost limitless sphere of theoretical activity. Play is possible only when specific rules are adhered to, within particular conditions, and within a given system of coordinates, symbols, and communication tools [1].

Artificial play is defined by rules that are designed to maintain the stipulated conditions of the game, to constrain the field of play both temporally and spatially, and to regulate player behavior, among other factors. Certainly, the concept of rule-based activity is a broad definition of play, and the presence of rules does not necessarily limit the creativity involved in the game.

The material component of the play sphere (MPS) is always constrained by the game's rules. The theoretical component in most artificial games is not restricted by rules but is limited by the duration of the game. Players engage in MPS activities that are oriented towards the game's goal; the activities of other players are also directed towards the same goal. The goal must be positioned at the center of MPS or at least within its central area. This is because, in most artificial games, there is a unity of goals among all players. From this perspective, artificial play is a relatively stable system of player activity aimed at pursuing and achieving the game's goal [2].

It is clear that within MPS, all fundamental elements of the game (player, goal, player activity) have well-defined positions, coordinates, and quantitative and qualitative characteristics. For example, a player achieves the goal precisely when their activity intersects with a predetermined goal point with specific coordinates. In simpler terms, in football, a forward scores a goal when the actions of their teammates and opponents allow them to reach a distance from the goal, strike the ball with a certain force and precision, such that the goalkeeper cannot block it. In a chess game, this corresponds to the coordinates of the last move.

Artificial play represents a reality, a specific domain of human activity enclosed within a unique "shell" comprised of the game's conditions and rules. It exists and evolves within this "shell" due to the pervasive influence of human theoretical activity. It can be asserted that the main distinction between play and practical activity is that the former exists as an artificial construct within a fictional "shell" of conditions and rules, which separates it from the surrounding world while simultaneously integrating it into a unified flow of time.

It is also crucial to note that play occurs under artificial conditions where material and ideal objects are represented as various models and symbols, and actions with them simulate real phenomena and processes.

The theory of artificial play should be grounded in the concept of development— the essence of any living system [3,4]. Play represents a vibrant reality, dynamic, purposeful movement— in other words, development.

Artificial games adhere to the following laws:

1. Law of Goal Unity - This law expresses a clear, ultimate result of the play activity for all participants (e.g., checkmate, scoring a goal).
2. Law of Material Equality - This manifest in the fact that all players start with equivalent material resources in the game's objects, materials, and tools (e.g., 16 chess pieces per player, equal-sized goals in football).
3. Law of Cyclicality - This signifies the return to the initial state after a player achieves the game's goal.
4. Law of Action - This law denotes the necessity and sequence of players' actions.
5. Law of Limited Freedom - This law stipulates that all player actions must be within the material activity sphere (MAS), constrained by game rules. It also defines the duration of the game.

In the construction of artificial games, the following psychological and didactic principles can be identified:

– Activity. This is the fundamental principle of play, expressing the active manifestation of physical and intellectual forces during the game.

– Dynamics. This reflects the significance and impact of the time factor in play. Play is movement; it has a beginning and an end, thus the time factor in play holds as much importance as it does in real life.

– Engagement.This denotes the captivating and interesting aspects of play that exert a strong emotional influence on individuals and can be a primary motivation for participating in or observing the game. The pedagogical significance of this principle lies in its ability to enhance cognitive interest and activity.

– Role-Playing.In artificial play, role-playing is based on the simulation of human activity, reflecting the phenomenon of reproduction and improvisation. The didactic value of role-playing is that it allows for modeling future professional activities of graduates and teaching students based on professional activity models.

– Collectivity. This reflects the collaborative nature of student activity within gaming groups or teams. As a collective educational activity, artificial play promotes the development of camaraderie, teaches cooperative thinking and actions, and underscores the necessity of collective work. As famously expressed by N.K. Krupskaya, play is a school of organization.

– Modeling. This is based on imitation modeling of systems and reflects the simulation of real or imagined realities. From a didactic perspective, implementing this principle in the learning process enables the modeling of the functioning of active systems, which are the objects of study in higher education. According to the renowned German educator P. Wolfram, this encapsulates the very essence of problem-based modeling learning-one of the modern theories of active learning.

- Feedback.This is a fundamental principle in the design and conduct of artificial games, reflecting the cause-and-effect relationships in player interactions and the simulated reality. By "feedback," we refer to the discrete flow of information regarding the progress of the game, based on which students manage their activities and directly influence the course of the game.

- Problematic Principle. This principle expresses the logical and psychological regularities of thinking. As is well-known, when an individual is presented with a challenging goal and there are known motivations for pursuing it, objective problems usually arise along the way, leading to problematic situations in the individual's thinking.

- Effectiveness. This reflects the understanding of the outcomes of gaming actions as specific material activities. At higher levels of gaming development, the results of the game are seen as outcomes of abstract theoretical activity. Effectiveness is a foundational principle of the game, representing the truth that allows us to view artificial play as a productive activity.

- Autonomy. Any artificial game constitutes independent activity. The essence of autonomy in artificial play lies in the fact that the goal of the game always carries a function of controlling the player's activity.

- Competition. Competition in artificial play is based on the effectiveness of gaming activities and represents the primary motivations for participation in the game. Without competition, there is no game; the spirit of competition permeates the entire atmosphere of the game. The pedagogical value of this principle is evident competition encourages active independent activity and mobilizes the full potential of a person's physical and intellectual forces [5,6,7,8].

Materials and methods. As previously noted, artificial play has its own stable structure and organization. From this perspective, educational and instructional activities organized as artificial games can be referred to as a game-based learning format. It is important to emphasize that the game exists and develops as a system of communications, primarily as a sphere of human interaction. Thus, artificial play serves as a distinct structure of direct and mediated communication between players, aimed at achieving educational and developmental goals.

From this, we can identify four organizational forms of play:

1. Individual- Involving a single player (e.g., solving chess problems).
2. Pair- Involving one player A and one player B (e.g., chess, checkers).
3. Team- Involving a team of players A and a team of players B (e.g., hockey, football).
4. Group- Involving a group of individuals consisting of one player A, one player B, one player C, player D, and so forth. An example is the well-known game "Sportloto".

The Educational Game Format in Learning

The educational game format involves organizing and conducting educational games. An educational game is an active, independent human activity aimed at acquiring specific knowledge, skills, and abilities and applying them to achieve the game’s objective. Clearly, the goal of an educational game differs significantly from the goal of play. In the former, the objective is purely educational (e.g., mastering specific knowledge or skills), while in the latter, the goal is often recreational (e.g., winning or scoring points) [9,10,11].

Play, like any human activity, not only has forms but also methods of execution. From this perspective, an educational game can be both a form and a method of learning. This phenomenon suggests that an educational game has an "internal driving force" – purposeful independent cognitive activity – and an external "shell" – the game format as a means of organizing, managing, and evaluating this activity. Let's examine the educational opportunities of artificial games using chess as an example. Initially, the learning process is purely informational. During a "lecture," the instructor explains the basics of chess, describes the pieces, clarifies the objectives, and teaches the rules. Once both parties agree that the lecture material has been understood, they move on to practical exercises.

In chess, there is always a goal, and as previously noted, when a challenging goal is set (which is nearly unattainable for the learner at first), objective problems typically arise on the way to achieving this goal, leading to problem situations in the learner's thinking.

During the game, the law of action excludes the player's withdrawal from activity. Teaching how to act is the primary pedagogical purpose of the artificial game. In these conditions, the learner begins to hesitantly move pieces in response to the instructor's deliberate moves. Early on, significant mistakes are common, leading to failures. The "student" may feel disheartened, thinking they cannot play and will never master it. This represents a known crisis in learning—preparation alone does not teach action or independent thinking.

The instructor decides to combine "lectures and practical exercises": patiently explaining everything initially and demonstrating their own strategy and tactics. This approach creates problem situations in the learner's mind, making them seek clarification, ask questions, and strive to understand the details. The entire course of the artificial game involves planning, organizing, and resolving problem situations arising in the learner's mind while tackling educational problems. The didactic phenomenon of the game is that it creates its own conditions for the emergence and resolution of problem situations, which appear almost spontaneously, independently of the player, similar to real life. Everything is predetermined by the game's objectives, rules, and conditions, creating a unique "microclimate" conducive to the continuous emergence of new problems [12,13].

At this stage, learning becomes problem based. The instructor notices that the learner begins to understand their actions and anticipates problem situations, such as a "checkmate in three moves." The instructor organizes these situations, and the game itself requires the learner to resolve them independently. Problem situations in the game include psychological stress related to unexpected moves by the opponent and the inability to reverse a decision. Even here, the instructor can subtly guide the learner's independent work, steering the game in the "right direction."

Thus, we assume that the learner has acquired the necessary knowledge about the game, developed skills, learned to plan and create strategies, and cultivated the ability to foresee problem situations. At this level, learning becomes highly problem-based: issues continuously arise and are resolved by the players, leading to the emergence of new problems. Indeed, the game is an ideal generator of problem situations, and the ability to identify problems where the opponent does not see them leads to victory. Consequently, the learner becomes a chess player through purposeful independent activity involving planning, organizing, and resolving problem situations within the context of the artificial game.

So, how can we integrate gaming activity into the educational process? The answer is simple: create an educational game. In our view, such a game should represent independent cognitive activity within specific rules and conditions, aimed at searching, processing, and assimilating educational information for decision-making in problem situations.

Result. It has been shown that the game format of education increases student engagement and interest in the subject, contributing to better assimilation of the educational material. Games help develop skills in analysis and decision-making by simulating real-life processes. The article presents examples of the use of games in the educational process, particularly in chemistry education, demonstrating their effectiveness compared to traditional teaching methods.

Discussion. *Simulative and Symbolic Educational Games*

Educational games can be broadly classified into three main types: simulative, symbolic, and exploratory games. Simulative educational games are well-known from literature on business and management games. Furthermore, under the guidance of the prominent Soviet scholar P.I. Pidkasisty, special pedagogical research on simulative games has been conducted, with some of the results published in international and Soviet journals. Given this, we will focus on two aspects of the theory and practice of simulative games.

A simulative educational game is an active, independent student activity centered on simulating the studied systems and modeling future professional activities. Thus, the key distinguishing features of this type of educational game are its explicit imitation of reality and the role-playing of individuals in various professional fields. An example of a simulative educational game in pedagogy is the "Pedagogical Practice" game, which simulates modern teaching technology and involves role-playing as teachers, students, and education professionals. Currently, the development of educational simulative games is being actively pursued at many leading universities in our country. While earlier research primarily focused on business and management games, recent efforts have been made to create educational symbolic games based on specific subject knowledge of fundamental disciplines and intended for teaching students across various higher education institutions. Why is this the case?

Aside from various explanations, two main reasons can be highlighted: First, many authors of business games, relying on the achievements of industry faculties and professional development institutes, tend to automatically extend their experiences to university education practices, which is a clear mistake. Second, there is a strong focus on the "business, narrowly specialized" aspect of educational games, and during the description of specific experiences, the essence of the educational game format often gets lost. Moreover, specific business games typically have a limited scope of implementation, such as within a particular course, university, or, at best, a group of related universities. This may explain why the educational game format is slowly being integrated into practice, as creating even a single business game requires years of intensive work from educators.

Let's consider a new type of educational game: the symbolic game, based on the materials from the course of qualitative analysis in analytical chemistry. As is well-known, chemistry is a fundamental subject taught in general education and professional schools, technical colleges, nearly all technical universities, universities, and pedagogical institutes, as well as in many specialized institutions, such as medical and agricultural universities. It is evident that the scope of application for symbolic educational games will be much broader compared to business and management games.

Practical Course in Qualitative Analysis: Symbolic Educational Games

The practical course in qualitative analysis is based on a variety of chemical reactions involving specific ions (or substances) that produce different visual effects, which fundamentally enables the creation of educational games that can be progressively modified and complicated. These visual effects in qualitative analysis typically include the formation of precipitates with specific properties, gas evolution, and more. A series of symbolic educational games and their application methodologies have been developed. For example, consider the educational game "Chemical Reaction," which is based on the property of certain cations and anions to "form precipitates" when present together in a solution. The choice of using precipitation as the core principle of the educational game is due to the fact that most real chemical methods for qualitative analysis recommend techniques for ion separation through the sequential formation of precipitates. Thus, the main rule of the game is directly linked to the content of state educational standards and reflects real-world practices [14].

One of the primary criteria for assessing students' readiness in analytical chemistry is their ability to solve "theoretical mixtures" of various components. In practical sessions, students are given a task describing several compounds allegedly present in a hypothetical solution. For instance, a task might be: "Analyze the mixture: barium chloride, sodium nitrate, potassium bichromate, strontium nitrate". To solve this mixture correctly, a student must identify which of the listed cations and anions will remain in the solution and which will "precipitate." Based on their knowledge, the student might conclude that barium chromate will precipitate, while the other cations and anions will stay in the solution. The student then submits this solution to the instructor, who must check the answer and assign a grade. The "task-based approach" to teaching students is widely used in educational programs for analytical chemistry. However, it has some limitations, such as the instructor's inability to simultaneously monitor all students' solutions and promptly address their mistakes. The educational game "Chemical Reaction" addresses this significant drawback by keeping the instructor informed about all the events related to solving these tasks. In the game, "theoretical mixtures" are provided as a set of cards, each depicting only one component of the mixture. This allows the introduction of cards representing elements that the instructor believes students should study. Consequently, the "Chemical Reaction" game can be applied at various stages of learning. It can be initiated after students have studied the properties of the first groups of cations according to the curriculum, with additional cards for new groups being introduced later.

The game is played using cards that display symbols of chemical elements, compounds, cations, or anions. Each card represents a single ion or molecule of a compound.

Game Mechanics and Teaching Strategy for "Chemical Reaction"

In the game "Chemical Reaction," each student is dealt an equal number of cards, each representing a specific ion or molecule. The main objective of the game is to "get rid of" these cards as quickly as possible while adhering to the game's rules. The game concludes when one student has no cards left, and this student is declared the winner. Cards are removed from the game when their chemical components form a precipitate together. For example, the formation of silver chloride requires two cards: one with a silver ion and one with a chloride ion. Similarly, the formation of Iron (III) hydroxide needs four cards: one with an iron ion and three with hydroxide ions.

Game Setup and Rules:

1. Card Dealing and Removal-Each player receives an equal number of cards. Cards representing chemical elements that can form a precipitate together are removed from the game. These discarded cards are placed face down in the center of the table. This serves two purposes- to ensure control and avoid errors and to provide visual reinforcement of the precipitates formed.

2. Penalty for Mistakes- If a player makes a mistake, they lose their next turn and must retrieve their incorrectly discarded cards. This rule encourages players to pay attention and identify errors made by others.

3. Gameplay Mechanics- Players take turns in a clockwise direction, passing one card at a time.

Before their turn, each player must identify and discard cards that can form precipitates with other cards they hold.

For example, if a player has barium and sulfate ions, they can discard these two cards if they form barium sulfate precipitate.

4. Example of Play- Suppose a student has cards for barium, aluminum, chloride, and hydroxide ions. If they receive a sulfate card from another player, they can discard the barium and sulfate cards as they form a barium sulfate precipitate. The player then chooses which of the remaining cards to keep and which to pass to the next player.

5. Instructor's Role- The instructor acts as the "respected arbiter" of the game, overseeing rule adherence and providing subtle, impromptu guidance when errors occur. Visual aids, such as colorful posters, can also be used to enhance understanding.

6. Game Cycles- A game cycle ends when a player has no cards left. Afterward, cards are redistributed, and a new cycle begins.

7. Number of Players and Card Count-The game is designed for 3 to 10 students, with 5-6 being the optimal number of players. The total number of cards should reflect the volume of material

studied. For instance, in the final stage of the qualitative analysis course, up to 60-70 cards may be used to cover around 30 cations and their corresponding anions.

Recommendations for Implementation.

- Card Inventory- Include a surplus of common anion cards, such as halogens, hydroxide, and sulfate, to increase the variety of game scenarios.
- Development and Feedback- Involve well-prepared students in developing the game's "chemical component." They can provide valuable insights and assist in explaining the game's objectives, rules, and strategies to their peers.

By using the game "Chemical Reaction", students can reinforce their understanding of qualitative analysis concepts in a dynamic and interactive manner, while instructors can effectively monitor and guide their learning process.

Enhanced Teaching Strategies for the Game "Chemical Reaction"

After students have played the game "Chemical Reaction" several times, you can progressively increase the complexity of the game. Here are some advanced rules and modifications that can be introduced:

1. Environmental Considerations

Introduce the need to consider the environment in which a precipitate forms. For example, aluminum hydroxide is amphoteric and dissolves in both acids and bases. To remove aluminum hydroxide from the game, students will need an additional card labeled "Neutral Environment." This means students must collect five cards to form a precipitate, which adds complexity compared to the original version.

2. Color Considerations

Introduce the requirement to account for the color of the precipitate. This can make the game more challenging and engaging as students must not only identify the ions but also consider their visual properties.

3. Customizable Cards

Provide "blank cards" on which students can write the ions or molecules they need. This can be especially helpful when students face difficulties in the early stages of playing the game. A recommended number of blank cards is two to three, allowing students to adapt the game to their needs.

Advantages of the Game-Based Learning Approach

1. Active Engagement.

Student Participation: The game encourages active involvement, leading to diligent study of the material, such as reviewing textbooks and summarizing key reactions. This active engagement helps in better retention and understanding of the subject.

2. Engaging and Competitive.

Motivation: The competitive nature of the game makes learning more enjoyable and motivating. Students are more likely to engage in self-monitoring and self-directed learning due to the game's dynamic and entertaining format.

3. Dynamic Learning Experience.

Understanding Chemistry: The game's dynamic nature helps students observe and understand the continuous relationships between different chemical reactions. This approach aligns with the principles and phenomena of chemistry, providing a more realistic learning experience.

4. Broad Implementation.

Widespread Use: Games like "Chemical Reaction" and other chemistry-related games can be widely implemented in universities across the country, enhancing the educational process and making it more interactive.

Future Implementation of Game-Based Learning

Specialized Units. Establish specialized scientific and methodological departments within major universities to develop and implement game-based learning for fundamental, engineering, and specialized disciplines.

Long-Term Use. Educational games can be effectively used for many years, especially in subjects like chemistry, physics, mathematics, and pedagogy. They offer a valuable tool for enhancing both student engagement and teaching quality.

By incorporating these advanced rules and strategies, you can further enrich the learning experience provided by the game "Chemical Reaction," making it an even more effective tool for teaching qualitative analysis and other subjects.

Research Games

Human gaming activity can be utilized not only for educational purposes but also for organizing scientific and research work for students and faculty. This is a particularly interesting and promising application of gaming, which is currently intensively developing in the fields of invention, project design, and technical system construction.

In our research, we have examined only one aspect of the scientific-research application of games—the organization of "brainstorming" during educational simulation games. As known, this phenomenon is the basis of synectics—a highly effective method for stimulating inventive activity. A simple illustration of the complex processes involved in "brainstorming" can be found in a typical chess game, where active spectators try to persuade the players of the correctness and timeliness of their proposed moves. In such an environment, all observers participate in analyzing the problematic situation, proposing their own and rejecting others' action options, and thus spontaneously search for a collective solution based on comprehensive and multifactorial analysis of the emerging problem.

The phenomenon of "brainstorming" in artificial games indicates that it is an effective means of acquiring new knowledge and methods of action. In games, human cognitive activity can self-develop, "generating" the necessary amount and quality of knowledge to achieve the game’s goal. The information obtained in this way generates a new portion of information, which, in turn, "pulls" the next portion, and so on, until the game’s goal is achieved. This development of a "chain reaction" of knowledge underpins creative cognitive activity. Thus, in its preliminary form, we can define a research game as: a specially organized activity where the goal is to win by finding new knowledge and methods of action to resolve problems. In the game, students independently identify problems, formulate their essence, and pose and solve relevant problem tasks.

Essence of Research Games

The essence of any problem that a person "attacks" with their ideas is inherently related to the nature of the object being studied and thus has an objective character. As Professor P. I. Pidkasisty rightly notes [2,11], "the emergence of contradictions in a student's mind is based on the contradictions existing in reality." As G. S. Altshuller emphasizes, "to make an invention means to devise a technical system that does not have the contradictions inherent in the preceding system." Therefore, during a "brainstorming" session, students, having perceived and assessed the problem situation, do not limit themselves to merely stating the contradiction but determine what specifically needs to be done to eliminate it and achieve the goal of the game.

General Scheme of a Research Game

1. Participants

– Facilitator- The instructor who leads the game and poses questions.

– "Criticism" Group- Responsible for identifying and discussing the weaknesses of proposed solutions.

– "Defense" Group- Defends the proposed solutions, arguing their effectiveness.

– Experts Group- Includes specialists such as economists, engineers, technologists, etc.

– Inventor and Patent Specialist- Develop new ideas and check their patentability.

– Public Representative- Represents public and state interests.

2. *Game Process*

– Preparation- The instructor, together with experts (inventor, patent specialist, and public representative), prepares patent information materials on a specific, relevant problem. It is crucial that the problem is clear to all so that students can independently analyze it, identify tasks, and formulate questions.

– Problem Analysis- Students analyze the problem, formulate questions and tasks, and actively participate in the discussion.

– Dialogue-The instructor and experts interact with students, asking questions and providing additional explanations.

– Problem Solving- Students propose solutions during the game, which are then discussed and evaluated by different groups of participants.

Advantages of Research Games

1. Development of Inventive Skills. Games promote the development of skills in finding innovative solutions and eliminating contradictions in design and construction.

2. Active Discussion. Students learn to work in teams, discuss and defend their ideas, which enhances their critical thinking and argumentative abilities.

3. In-depth Understanding of Problems. The active search for solutions helps students better understand the essence of the problem and find effective ways to resolve it.

Recommendations for Organizing Research Games

Preparation. Advance preparation of materials and questions ensures the successful conduct of the game.

Roles and Responsibilities. Clear distribution of roles and tasks among participants helps to ensure effective interaction.

Interactivity. Supporting an active dialogue between students and instructors contributes to a deeper understanding of the problem and effective solution finding.

Research games open new horizons in the educational process, enabling students to develop skills in scientific research and invention, which is crucial for their future professional activities.

In an Active Dialogue Setting

During the active dialogue, the instructor provides a general analysis of the problem, reveals its essence alongside the students, demonstrates its relevance, specifies the problem using well-known real-life examples, and convinces the students of the solvability of the posed problem tasks. At this stage, the instructor turns to the experts, highlighting and describing the main criteria for analyzing and evaluating the proposed solutions. In technical systems, these criteria typically include the simplicity of design, cost-effectiveness, reliability, and versatility of the proposed solution.

Conduct of the Research Game

In a research game, there are no strict rules as found in simulation or symbolic games. The game is conducted as follows:

1. Presentation of Solutions

The inventor presents several well-known solutions to the problem from literature to the critics. The chronological sequence in which these solutions are presented and described is important for the students.

2. Critique Phase

The primary goal of the "Critics" group is to pose as many problem-related questions as possible to the "Defense" group, which must then defend the proposed solution. The experts, including the inventor, listen carefully to the responses from the "Defense" group and evaluate the proposed solutions. The students' responses should include their own independent ways of solving the problem. If the "Defense" group cannot answer the critics' questions, the instructor will answer on their behalf. In such a case, the "Critics" group earns a point, making the score 1:0 in favor of the critics.

3. Further Solutions

The inventor then presents another solution to the problem from patent information materials. The "Critics" group asks questions, and the "Defense" group responds successfully. The solution presented by the students is evaluated by the experts as the most optimal. The score is updated to 1:1. The inventor then presents and describes a known solution to the problem that is very close to the students' solution. The process of questioning and defending continues until one group demonstrates a clear advantage over the other, such as a score of 4:1 or 5:2.

Expert Group Responsibilities:

Analysis of Questions and Answers. The expert group must thoroughly analyze the questions and responses. The inventor and patent specialist should recognize new solutions to the problem in the "Defense" group's responses, as they have detailed patent information materials [15].

Economic Assessment. The economist evaluates the funding scale, cost, level of profit, and overall economic feasibility of the proposed solution.

Production Assessment. The engineer provides a "production assessment" of the solution.

Public Interest Evaluation. The public representative evaluates the solution from the perspective of state interests, and their assessment is crucial.

Handling Disputes

If disputes or fundamental disagreements arise among the experts, the instructor must quickly and tactfully address the situation to prevent it from negatively affecting the behavior of the "Critics" or "Defense" groups. Careful selection of the expert group is essential to avoid conflict situations.

Conclusion of the Game

At the end of a successful research game, the "Defense" group achieves the best solution to the problem, which is recognized by the inventor and patent specialist as a new device or method. The game concludes with the instructor providing an official conclusion regarding the novelty and usefulness of the proposed solution. While students still have a lot of work ahead to make a real invention, this work will be carried out outside the game, in real life.

The Nature of Games

A game is a specially organized activity characterized by active competition, where players pursue and achieve a common goal based on identical initial conditions, using the same means, adhering to the same rules, and achieving strictly fixed results. In our opinion, the game embodies the eternal dream of equality and fairness. A vivid example of this is chess. As E. Lasker aptly stated, “On the chessboard, there is no place for deceit and hypocrisy. The beauty of a chess combination is that it is always truthful. Ruthless truth expressed in chess devours the eyes of the hypocrite.”

Educational Games for Children and Adults

Games are an integral part of children’s lives. For millennia, children of all times and cultures have been so engrossed in their play that they forget to eat and sleep. What a happy time childhood is! According to the famous saying of A. M. Gorky, play is the way for children to learn about the world they live in and are destined to change.

The educational value of games is undeniable. It is of immense importance not only for the upbringing of children but also for the development of adults, who often find themselves too busy to play with children due to pressing tasks and responsibilities. Yet, what can compare to the joyful interaction with the bright and intelligent eyes of little, trusting individuals? Even on rare evenings when the television is forgotten and parents truly have free time, many do not know how to play with their children. And it's not just about playing for fun and killing time, but about doing so with meaningful benefit.

In an era of continuous scientific and technological progress, children show great interest in the activities of scientists, inventors, and engineers. This interest is vividly manifested in the development and application of the game "Scientists, Inventors, and Engineers." The main rule of the game is that cards with the names of scientists and their works, inventors and their inventions, engineers and their creations can be removed from play to earn points. For example, a card with "S. P. Korolev" and a card with "Vostok Spacecraft" will earn two points, a card with "D. I. Mendeleev" and a card with "Periodic Table of Elements" will also earn two points, and finally, a card with "V. G. Shukhov" and a card with "Cracking Process of Oil" will earn another two points.

Lexical Game "Frank"

The lexical game "Frank" (available in French, Russian, English, German, and Kazakh languages) is designed for simultaneous learning of several languages. In this game, a table is created for ten words in the specified five languages. For example, words related to a specific theme: house, street, road, car, bus, underpass, traffic light, sidewalk, store, pedestrian. These ten words in five languages are displayed on 50 cards. You will need to read the table several times to the children, read aloud with them, and only then begin playing with the table. The main rule of the game is that children must collect cards with the same word in two, three, four, or five languages, earning two, three, four, or five points respectively. The children must also correctly pronounce the word in these languages. After mastering one theme, such as "Family" (with words like mother, father, grandfather, grandmother, aunt, uncle, son, daughter, brother, sister), the game can transition to another theme. Experience shows that the "Frank" game yields excellent results not only for children but also for students on topics related to their future professions. However, this game is most successful for family education. How much joy, laughter, and determination are found in our children, who grasp everything quickly, possess a remarkable dynamic memory, and after two or three games, significantly advance in both points and knowledge. Of course, when developing game themes, consulting foreign language teachers and specialists is advisable, as it won't take much time for either party.

Mental Calculation Game "Mini-Maxi"

The ability to quickly and accurately perform mental calculations is a valuable skill. Nowadays, with the availability of electronic calculators, many adults and children do not place much importance on this ability. This, however, is a mistake. Imagine what would happen if, at a crucial moment, a calculator is unavailable, or if the power system fails, or the display breaks.

The educational game "Mini-Maxi (Quick Count)" is designed to help children learn to calculate quickly and accurately under conditions of severe time constraints and unpredictable actions from opponents. The game uses cards similar to those in previously described games. Each card features a single digit, such as 1, 2, 3, 4, 5, 6, 7, 8, 9, 10—ten cards in total. There are also cards with numbers from 10 to 100, such as 20, 80—ten cards. Another ten cards range from 100 to 1000, plus six cards with values of 1, 2, 3, 5, 15, and 20.

Thirty-six cards are dealt to the players. If there are not enough cards, the remaining ones are placed on the table. It is best to play with 4-6 people.

Main Rule of the Game

The main rule of the game is that, upon request from the card dealer, the children must construct an equation using the digits available in their set of cards. The dealer may specify the "Mini" version, which means creating the smallest possible number from the equation. The equation is constructed using basic arithmetic operations: addition, subtraction, multiplication, and division. In more advanced versions of the game, operations such as exponentiation and root extraction may be used.

Let's consider an example. Suppose the card dealer has the following set of digits: 1, 10, 20, 70, and 3. The dealer announces the "mini" version and creates the equation:

$$1 = \frac{70+10}{20} - 3,$$

Other players have different sets of cards but must also create an equation at the minimal level. For instance, if they produce equations resulting in 3;5, the dealer wins 2 and 4 points respectively. The primary objective in the "mini" version is to win this point difference.

In contrast, the "maxi" version requires players to create the highest possible number. For the given set of cards, it could be something like:

$$20 + 1 = \frac{70x3}{10},$$

If other players achieve maximum equations like 13;44, the dealer wins 8 points in the first case and loses 23 points in the second. Points are tracked using a table with two columns: one for the "mini" version and one for the "maxi" version. As shown, this game is not simple and can be compared in complexity to chess.

Initially, it is advisable to play separately the "mini" version and then the "maxi" version before moving on to the combined "Mini-Maxi" game. You can adjust the number and size of the digits to suit the simplicity and dynamics of the game. The "Mini-Maxi" game can be used to automate mental calculation skills with electronic calculators. Experience shows that using calculators significantly speeds up the game pace and may lead to mental overload for children. This should be avoided. The game should be paused, the children thanked for their hard work, and their attention redirected to the enjoyable aspects of the recently played game. After a break, the game can be resumed.

All the described educational games are aimed at applying known knowledge, seeking new knowledge for children, and using it together with known knowledge to win the competition. The desire to win through honest competition in knowledge is a major motivation for many children to participate in the game. It is precisely this competition that mobilizes children's creative forces, allowing them to easily and effectively absorb educational material, often without even realizing it. Isn't this a wonder?

Conclusion. Games as a learning format prove to be an effective means of activating students' educational activities and developing their cognitive and professional skills. The use of games in the educational process improves the quality of learning, making it more engaging and productive.

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МЕКТЕП ГЕОГРАФИЯСЫНДА СУДЫ ҚОЛДАНУ САУАТТЫЛЫҒЫН ҚАЛЫПТАСТЫРУ – ТҰРАҚТЫ БОЛАШАҚТЫҢ КІЛТІ

Аңдатпа

Мақалада су ресурстарын тиімсіз пайдалану салдарынан пайда болған мәселелерді білім беру арқылы шешу жолдары қарастырылады. Су – жердің негізгі табиғи жүйелерінің бірі және адамзат үшін алар орны бөлек. Қазіргі таңда суды қолдану сауаттылығын қалыптастыру, еліміздің ең басты мәселелерінің біріне айналып отыр. Бұл зерттеудің мақсаты – елімізде мектеп қабырғасында оқитын оқушылардың су ресурстарына байланысты сауаттылығын анықтау мақсатында әлеуметтік әсерін зерттеу. Мақалада 1900 жылдан 2025 жылға дейінгі суды тұтыну динамикасы талданып, суды қолдану сауаттылығы ұғымы кеңінен ашылды. Су ресурстарын тұтыну сауаттылығын қалыптастыру, әсіресе мектеп қабырғасындағы өскелең ұрпаққа су ресурстарына байланысты ақпараттармен қамтамасыз ету жайлы ұсыныстар жасалынды. Су тапшылығы мен суға сұраныстың артуы жағдайында, білім беру ресурстарын тұрақты басқаруға ықпал ететін құндылықтар мен әдеттерді өзгерту ұсынылады. Жас ұрпақтың су ресурстарына деген дұрыс көзқарас, сауаттылығын қалыптастырудың бірнеше тиімді жолдары сызба-нұсқа түрінде талданды. Суды қолдану сауаттылығына байланысты шетелдік тәжірибелер қарастырылды. Қазақстанның әр аймағындағы оқушылардан күнделікті тұрмыс тіршілігінде қолданатын су сауаттылығы бойынша сауалнама алынып, жұмыс жүргізілді. Зерттеу нәтижелері көрсеткендей, оқушылар судың маңыздылығын, оны үнемдеудің қажеттілігін, таза судың жетіспеушілігінің салдарын жеткілікті түсінбейтіні сауалнама барысында анықталды. Сондықтан, мектеп бағдарламасына суды қолдану сауаттылығына байланысты тақырыптарды енгізу, әсіресе суды үнемдеу, су ресурстарын қорғау, суды тазалау және қайта пайдалану мәселелері қарастырылуы қажеттілігі, оқушылардың практикалық тәжірибесін арттыру маңыздылығы дәлелденді. Бұл шаралар, болашақ ұрпаққа таза суды қамтамасыз ету, экологиялық тепе-теңдікті сақтау үшін маңызды.

Кілт сөздер: *Суды қолдану сауаттылығы, функциональды білім, гидроәлеуметтік білім, су үнемдеу, экологиялық мәселелер, жаһандану*