РОЗДІЛ 1. АКТУАЛЬНІ ПИТАННЯ ПІДВИЩЕННЯ ЯКОСТІ НАВЧАННЯ ДИСЦИПЛІН ПРИРОДНИЧО-МАТЕМАТИЧНОГО ЦИКЛУ В ШКОЛІ ТА ЗАКЛАДАХ ВИЩОЇ ОСВІТИ РІЗНИХ РІВНІВ АКРЕДИТАЦІЇ

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D. V. Boykina
ORCID ID 0000-0002-4920-3736
University of Plovdiv «Paisii Hilendarski»

THE GAME IN MATHEMATICS EDUCATION

The problem of motivating students is of significant importance in nowadays educational process. Teachers must search new, modern and effective methods, techniques and approaches in teaching to activate students' thinking. The article suggests some ideas for using games in the mathematics lessons as a means to motivate the learning activity of students.

The change of focus from teaching to active learning changes the role of the teacher as well. From an instructor who just gives knowledge and information the teacher becomes into a mediator of the information flow in the conditions of the changed interactions in the classroom, into a facilitator who organizes activities that will allow the acquired knowledge to be put into practice more concretely. One of the means to achieve the pedagogical purposes of learning is mastering the game.

The value of didactic games is in the fact that students independently acquire new knowledge to a large extent and actively help each other. With this active help, they establish contact with each other and can give an assessment and self-assessment of the work they have done.

Another positive thing in using didactic games in the classroom is that children who usually find it difficult to communicate with others, who find it difficult to cope in traditional situations, can be included in the game. Performing such lessons leads to develop skills for purposeful attention, concentration, independent thinking, curiosity, develops imagination, increases students' self-confidence, their motivation, develops habits for group and team work, improves students' attitude to mathematics and its study. The use of strategic mathematical games creates an opportunity to develop students' argumentation and logical skills during the analysis of the game strategy and search for a winning strategy. The skillful use of appropriate didactic games leads to the successful realization of the ideas for inclusive education.

Our pedagogical experience shows that students like learning through games and are motivated to participate actively in classes in which game elements are integrated.

It is also noticed that in the lessons with games the speech-communicative skills of the students are developed, their skills to argue, skills of attention, concentration, independent thinking, curiosity are built, imagination and logical thinking are developed, students' self-confidence increases and skills for group and team work are formed.

And as we well know, some of these skills are key competencies that are aimed to be develop in education. Skillful organization and performance of effective game activities leads to increased interest and motivation of students, and is one of the most successful ways to achieve the goals of learning not only in mathematics.

Key words: *games, didactic games, business games, learning, competence approach, learning mathematics, educational process.*

Formulation of the problem. The century we live in is a century of constant large-scale changes, transformations and continuous development of the information society. The transformations in the society seriously affect the educational system as well. Now the problem is not just to achieve learning of the student, but to build a person with a whole system of knowledge and skills that determines his individual perception of the world, readiness for creative transformation of

reality based on personal values and inner statements. The emphasis of the training is directed from the informing to the stimulating and motivating function of the educational activity, to the diagnosis and forecasting of the tendencies of the personal development of the learner. Therefore, personalities must be formed in school, with their uniqueness, individuality, spirituality, independence and creativity. Building such personalities is one of the main tasks of school education. To do this, one must have a wide range of competencies in order to be able to adapt quickly to the changing realities. 21st century students need to be taught how to be flexible, proactive, how to be leaders when needed, and to be able to create something new and useful. The realization of such educational purposes requires the use of such forms of learning to ensure the acquisition and interpretation of educational content, to stimulate mental activity of students, to provide motivation in them and desire to learn. By teaching mathematics, a large part of the educational purposes of modern society can be achieved.

The change of focus from teaching to active learning changes the role of the teacher as well. From an instructor who just gives knowledge and information the teacher becomes into a mediator of the information flow in the conditions of the changed interactions in the classroom, into a facilitator who organizes activities that will allow the acquired knowledge to be put into practice more concretely. One of the means to achieve the pedagogical purposes of learning is mastering the game.

Analysis of current research. There are many interpretations of the term «**game**» in the pedagogical literature.

According to V. S. Zaitsev, «The game is a type of activity in situations, aimed at recreating and mastering a social experience, which forms and improves the self-management of behavior» [7, p. 156].

I. Ivanov defines the game as a «kind of simulation that allows the application of the acquired knowledge and skills. It requires the active participation of students» [4].

Even Confucius had said, «I hear and I forget. I see and I remember. I do and I understand», and later the French pedagogue Célestin Freinet added «in order to learn something, it must be experienced". The purpose of the game is to form skills and habits for real action. According to I. Ivanov «the effectiveness of the game is 4-5 times higher than traditional teaching methods» [4].

Games «are a great way for students to express in a small group their own attitude to a problem for learning purposes … the method is suitable for developing skills for adequate response in a given situation» [1, p. 63].

The scientific literature talks about role-playing, didactic and business games.

Role-playing games stimulate independence, critical thinking, emotional and cognitive development of the personality. They can be used in teaching, consolidating and systematizing the learning content, as it is presented within a sequence of situations, rules and images. In this way, the learning process takes place in conditions of high motivation for action, combined with elements of entertainment in students. The main components of these games are: game role, game plot, game content, game action and game rules [2, pp. 43–47].

A. Epitropova offers five stages in the development of the role play: setting the parameters, determining the main structural elements of the role play, making a complete prototype (model) of the role play, approbation in a group, use of the role play in training [3, p. 32] For the learning process the last stage is important.

Didactic games differ significantly from games in general. In essence, these are games in which the developmental and cognitive value is in synchronous with the high degree of independence, self-organization and self-management of students in their own activities. The term «didactic game» emphasizes its pedagogical orientation. The game is not the purpose of the lesson, but it’s a means of teaching and education, a means of intensifying the student's learning activities.

What is the specificity of the didactic game?

According to V. G. Kovalenko, «the didactic game has a stable structure that distinguishes it from all other activities» [5, p. 12].

The main structural components in the didactic game are: game design, game actions, game rules, cognitive content or didactic tasks, game tools (equipment), the result of the game.

Unlike the game in general, the didactic game has an essential feature – the presence of clearly defined learning objectives and the corresponding pedagogical results.

When using a game in mathematics education, it should be organized so that we adhere to the following positions. For this purpose, we have used modifications of V.G. Kovalenko [5, p. 20]:

1. The rules of the game should be simple. Otherwise, the game does not arise interest.
2. The game must provide «food» for mental activity. Otherwise, the game does not arise interest.
3. Each student must be an active participant in the game.
4. If there are several games in the lesson, they should alternate according to the degree of difficulty, etc.

Our practice shows that didactic games contribute also to the development of students' communication and social skills.

Randall, Maurice, Wetzel, and Whitehill stated that «the use of didactic games in mathematics education can help motivation and presence of students during lessons» [6]. The active participation of students during the games determines the need for better understanding and memorization of the taught mathematical knowledge.

The value of didactic games is in the fact that students independently acquire new knowledge to a large extent and actively help each other. With this active help, they establish contact with each other and can give an assessment and self-assessment of the work they have done.

Another positive thing in using didactic games in the classroom is that children who usually find it difficult to communicate with others, who find it difficult to cope in traditional situations, can be included in the game. Performing such lessons leads to develop skills for purposeful attention, concentration, independent thinking, curiosity, develops imagination, increases students' self-confidence, their motivation, develops habits for group and team work, improves students' attitude to mathematics and its study. The use of strategic mathematical games creates an opportunity to develop students' argumentation and logical skills during the analysis of the game strategy and search for a winning strategy. The skillful use of appropriate didactic games leads to the successful realization of the ideas for inclusive education.

Another kind of game is the business game which is a model of real decision-making processes in a real situation, with a real structure.

According to VG Kovalenko, the business game allows to create «a situation in which the learner must find the right lines of behavior, the optimal solution to the problem posed or arisen, etc.» [5, p. 12].

The aim of business games in education is to make students to study, master and test certain models and solutions and relevant actions to them, which simulate situations with the choice of their optimal option. The use of business games in the educational process is an effective means of increasing the preparation of students in a given field. They offer a rich opportunity for active research of serious intellectual and social problems. They contribute to the development of creative thinking in solving real problems, i. e. problems related to the preparation for the professional activity of the person. In the course of the game, each participant makes the most of all his knowledge, skills, experience, imagination, as a result of which the skills to think systematically, productively, creatively are built. All this leads to a higher and more lasting perception of the learning content.

The games can also be used to discover new knowledge, to develop skills, to consolidate knowledge. It is appropriate to use them as a form of summary or revision before a test or class work.

The purpose of the article. In this part of the article we suggest some ideas from our practice for using games in the learning process in mathematics in the secondary school.

Presenting main material. The game is one of the most attractive forms of activity for children, for example the use of a «magic» square. This is a square table constructed so that the

sum of the numbers (expressions) in rows, columns and diagonals is the same (depending on the material studied by the children).

Example 1. Place the natural numbers from 1 to 9 inclusive in the squares of the figure, so that the sum of every three numbers in horizontal and vertical order, and on the diagonals is the same.

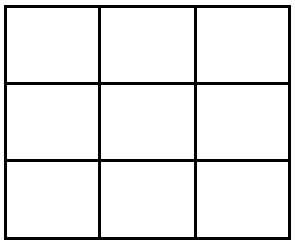

Fig. 1.

Divided into groups, students must create a magic square or find the rule by which it is created. Thus, by contacting the group, they can solve the task set by the teacher. The dialogue that takes place between them allows students to master the material studied and consolidate their knowledge.

An analogue of the «magic square» is the puzzle, which is also often used in math classes.

Example 2. Place the numbers from 1 to 9 in the circles of the figure, so that the sum of the three numbers located on each straight line is 15. Which number should be placed in the middle circle?

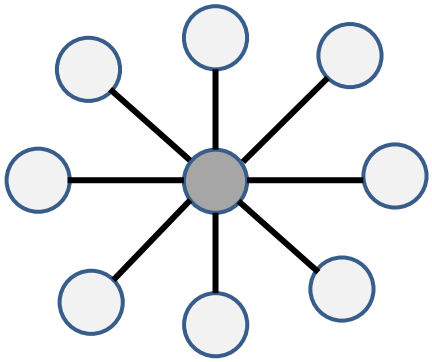

Fig. 2.

Example 3. Arrange the numbers 1 to 9 in the circles of the figure, so that the sum of the numbers on each side is 17.

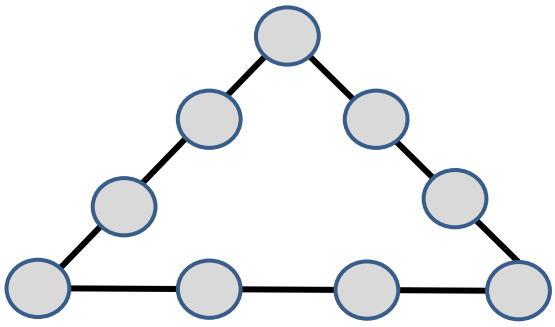

Fig. 3.

Another type of puzzle is presented in example 4.

Example 4: Recover the missing numbers in the multiplication.

$$\begin{array}{r} 27\times\ ** \\ \hline +\quad 5* \\ \quad ** \\ \hline \quad *** \end{array}$$

Fig. 4.

Solving such logical problems, in the form of a game, contributes to create interest in students and develops their logical reasoning and critical thinking. (Koleva, 2021)

Games can be successfully used as a means to create a problematic situation when learning a new mathematical content.

Example 5: When studying a triangle with the students from 5-th grade, the following game can be performed:

All students from the first desks are ask to construct a triangle of three sides, namely AB = 7 cm, AC = 2 cm and BC = 3 cm. The students from the second desks are ask to construct a triangle with sides AB = 4 cm, BC = 3 cm and AC = 7 cm. And students on the third desks – with sides AB = 3 cm, BC = 2 cm and AC = 8 cm, etc.

In the process of performing the given tasks and the communication between students, they are convinced that such triangles don't exist.

In addition, students grouped in the same way may be asked to construct triangles with certain angles:

a/ $\measuredangle A = 37^0$, $\measuredangle B = 28^0$, $\measuredangle C = 90^0$

b/ $\measuredangle A = 72^0$, $\measuredangle B = 50^0$, $\measuredangle C = 110^0$

c/ $\measuredangle A = 23^0$, $\measuredangle B = 50^0$,$\measuredangle C = 38^0$

Again, by working together and communicating with each other, the students find out that the given angles do not fulfill the condition of the sum of the interior angles in the triangle. A problematic situation has been created. After reflection, students raise the hypothesis: a triangle can be constructed only if the sum of its interior angles is equal to 180^0.

Example 6: In a similar way, a game can be organized when studying the theorem for the midsegment of a triangle.

The students of the first, second and third desks are given the task: "Construct a triangle and one of its midsegments. Compare this segment with the opposite side of the triangle. The other students (standing on the desks of the fourth and fifth rows) are given the task to measure the angles α and α_1 of the triangles given on the figure, for e.g. Fig 5 and compare them.

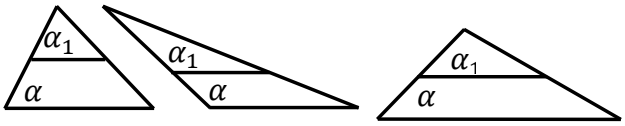

Fig. 5.

Thus, performing an independent work in groups and communicating with each other, students come to the conclusion that the midsegment of a triangle is equal to the half of its opposite side and from of the equality $\alpha = \alpha_1$ they have verified in it is concluded that the midsegment is parallel to its opposite side.

The dialogue between the students, when they are solving the problem, gives them the opportunity to think, to listen reflexively, to analyze their own thoughts and to observe themselves. These activities of the students contribute to the realization of dialogical reflection.

Example 7: «Mathematical dominoes» – for this game an even number of cards, containing formulas, expressions, graphs, drawings, concepts, statements, etc. have to be prepared. The purpose of the game is to connect the cards in their logical sequence. It can be

played in pairs /in threes/ or individually. The team or the student who manages to arrange all the dominoes correctly wins.

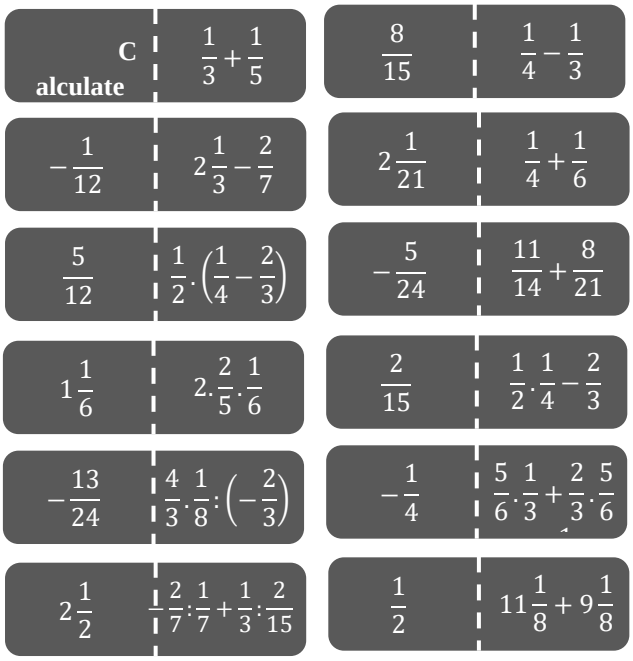

Fig. 6.

The game «Mathematical Domino» is suitable for use as a form of summarizing, revision and consolidating knowledge before a test or a class work. It can be also realized as a competitive game between several teams in the class, which is a great way to motivate students for learning activities and thus achieve many learning goals.

When using a didactic game, it is very important to ensure that students are not losing interest in the game.

The game in the university education. Games and especially business games can be widely used in teaching university students in methodology of teaching mathematics to prepare them for their pedagogical practice in school.

Example. Students are given the task to recreate a real situation in a math class – such as introducing a new mathematical concept, or teaching a new theorem, or solving a geometric problem and etc. The aim is each student to be involved in the role of a teacher and to teach the relevant knowledge to the other students. He must choose the right approach for the introduction of the certain knowledge, having in mind the studied theoretical formulations; to apply the teaching methodology from the lectures in practice; to select appropriate questions, explanations, comments; to prepare appropriate didactic materials and to perform the prepared situation in front of his colleagues from the group.

The rest of the students may take the role of learners during the presentation of the given situation.

An important point in the use of games in learning is to perform a reflective activity, which can be achieved by asking «strategic» reflective questions about the cognitive and affective moments in the game.

Such questions may be: What approaches did you use in the game process? Which moment of the realization turned out to be the most difficult for you? What did you learn? Did you learn something new? etc.

Therefore, after completing the task it is advisable to conduct an analysis of the situation in which all students express their own views on how the task is implemented, give ideas for other ways of conducting the situation, discuss the gaps and mistakes of the "teacher" from the point of view of the studied teaching methodology in mathematics.

Using such a business game, also called simulation, helps students to apply the methodological and pedagogical theory they have studied in a real situation, develops their

analytical skills, their critical thinking, self-awareness and self-organization. In this way the social and communicative skills of the students are enriched.

Such training activities in the form of business games help students feel much more prepared and confident in their activities in the pedagogical practice at school.

Conclusions and prospects of further scientific investigations. As a conclusion, we will note that the use of games in the learning process, not only at school but in the university as well, should not be the purpose of the lesson, but a means to achieve the learning aims. The game should not be seen as fun, but as a creative activity related to mastering and consolidating certain mathematical knowledge.

Our pedagogical experience shows that students like learning through games and are motivated to participate actively in classes in which game elements are integrated.

It is also noticed that in the lessons with games the speech-communicative skills of the students are developed, their skills to argue, skills of attention, concentration, independent thinking, curiosity are built, imagination and logical thinking are developed, students' self-confidence increases and skills for group and team work are formed.

And as we well know, some of these skills are key competencies that are aimed to be develop in education. Skillful organization and performance of effective game activities leads to increased interest and motivation of students, and is one of the most successful ways to achieve the goals of learning not only in mathematics.

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Бойкіна Д. В. Гра у навчанні математики.

Анотація. *Проблема мотивації студентів є важливою у сучасному освітньому процесі. Вчителі повинні шукати нові, сучасні та ефективні методи, прийоми та підходи в навчанні для активізації мислення учнів. У статті запропоновано деякі ідеї використання ігор на уроках математики як засобу мотивації навчальної діяльності учнів.*

Зміна фокусу з навчання на активне навчання також змінює роль учителя. З інструктора, який просто дає знання та інформацію, вчитель перетворюється на посередника інформаційного потоку в умовах зміни взаємодії в класі, на фасилітатора, який організовує діяльність, яка дозволить більш конкретно застосувати набуті знання. Одним із засобів досягнення педагогічної мети навчання є оволодіння грою.

Цінність дидактичних ігор полягає в тому, що учні значною мірою самостійно здобувають нові знання і активно допомагають один одному. При цій активній допомозі вони встановлюють контакт один з одним і можуть дати оцінку та самооцінку виконаної роботи.

Позитивним моментом використання дидактичних ігор на заняттях є те, що до гри можна залучити дітей, яким зазвичай важко спілкуватися з оточуючими, яким важко впоратися в традиційних ситуаціях. Проведення таких уроків сприяє формуванню

навичок цілеспрямованої уваги, зосередженості, самостійності мислення, допитливості, розвиває уяву, підвищує впевненість учнів у собі, їх мотивацію, формує звички до групової та командної роботи, покращує ставлення учнів до математики та її вивчення. Використання стратегічних математичних ігор створює можливість розвивати в учнів аргументацію та логічні навички під час аналізу стратегії гри та пошуку виграшної стратегії. Вміле використання відповідних дидактичних ігор призводить до успішної реалізації ідей інклюзивного навчання.

Наш педагогічний досвід показує, що студенти люблять навчатися через гру і мотивовані до активної участі в заняттях, в які включені елементи гри.

Також помічено, що на уроках з іграми розвиваються мовленнєво-комунікативні вміння учнів, їх уміння аргументувати, навички уваги, зосередженості, самостійності мислення, розвиваються допитливість, розвивається уява та логічне мислення, самостійність учнів, підвищується впевненість і формуються навички групової та командної роботи.

І, як ми добре знаємо, деякі з цих умінь є ключовими компетенціями, які мають розвиватися в освіті. Уміла організація та виконання ефективних ігрових дій призводить до підвищення інтересу та мотивації учнів, є одним із найуспішніших шляхів досягнення цілей навчання не лише з математики.

Ключові слова: *ігри, дидактичні ігри, ділові ігри, навчання, компетентнісний підхід, навчання математики, освітній процес.*

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A. Saltykova
ORCID ID 0000-0001-8010-267X
D. Saltykov
ORCID ID 0000-0001-8589-9788
M. Kalenyk
ORCID ID 0000-0001-7416-4233
Sumy State Pedagogical University
named after A.S. Makarenko
Yu. Shkurdoda
ORCID ID 0000-0002-8180-4574
Sumy State University

TESTING AS A METHOD OF MONITORING EDUCATIONAL ACHIEVEMENTS OF PHYSICS STUDENTS

Today, test technologies can be considered as an effective and standardized mechanism for diagnosing students' educational achievements, which optimally fits into the organizational process of educational classes. Tests make it possible to qualitatively measure the level of students' knowledge at each stage of their learning. At the same time, the necessary accuracy and objectivity of the inspection is ensured.

The purpose of the article is to investigate the peculiarities of testing as a method of monitoring the educational achievements of students in physics and to summarize one's own experience of its use. The hypothesis of our research can be formulated as follows: the correct, reasonable and effective use of test control of knowledge during physics education enriches the educational process and prepares students for future life exams

The article shows the essence of test technologies and their use in the educational process, substantiates the organizational and didactic conditions for their implementation in the study of physics. A complete system of test tasks in physics has been developed and put into practice, which contributes to increasing the objectivity of diagnosing the quality of students' knowledge