INTERACTIVE AND TECHNOLOGY-BASED MATH LEARNING METHODS IN HIGH SCHOOL. REPORT ON DAILY EXPERIENCE

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Abstract. The article delves into innovative approaches to teaching mathematics in high school environments, emphasizing interactive, action-oriented, and technological methods that incorporate real-life relevant content. The pedagogical experience presented underscores the importance of student engagement in the learning process and the utilization of technology to augment interactivity and comprehension. By aligning mathematical content with student's everyday experiences, this approach aims to render the subject more accessible and captivating for students.

Keywords: innovative teaching, high school mathematics, pedagogical interactivity, educational technology, everyday relevance.

Introduction. In today's education landscape, where competency and social integration are paramount, implementing the fourth generation of the high school mathematics curriculum calls for a fresh and innovative approach. This approach aims to not only engage students actively in the learning process but also to equip them with the skills necessary to adapt to the evolving demands of society. Mathematics serves as a cornerstone in various academic fields, from sciences to engineering, technology, and economics. Therefore, a strong grasp of mathematics in high school lays the groundwork for student's success in higher education and beyond. Moreover, the study of mathematics cultivates essential skills such as logical thinking, critical reasoning, and problem-solving, which are invaluable assets in both personal and professional spheres.

The ability to use math in everyday life is crucial for everyone. Students who learn how to apply mathematical concepts in different situations develop practical skills that help them manage their personal finances, make better decisions, and solve real-world problems. Many careers, like those in technology, engineering, finance, and science, rely heavily on a strong understanding of math.

Teaching mathematics effectively in high school means understanding each student's needs and providing equal opportunities for everyone to succeed. It can also help bridge gaps in learning and careers based on gender and race, ensuring that all students have the support and resources they need to thrive in this particular field. Ultimately, good mathematical education in high school sets students up for success in both their academic and professional lives, and it contributes to building a society that values knowledge and innovation.

Introduction of the concepts of interactivity, action, and everyday relevance in the educational process

Within the educational process, interactivity, action, and everyday relevance stand as indispensable elements for fostering effective and engaging learning experiences. Interactivity entails the active engagement of students in the learning journey, achieved through participation in discussions, practical activities, and collaboration with other students. This symbiotic interaction between students and learning materials serves to solidify their understanding and cultivate critical and creative faculties.

Action is another crucial component that involves practical activities and hands-on experiences that allow students to apply theoretical knowledge in practical situations. Through action, students become active participants in their own learning process, which motivates them and helps them acquire knowledge more deeply. Thus, while action refers to the physical and cognitive activity of individuals in the learning process, interaction refers to the exchange and collaboration between individuals or between individuals and their environment in this process. Both are essential components of learning and contribute to the development of individual knowledge and skills. Learning through action and interaction are the keys to

shaping pragmatic individuals prepared to successfully integrate into social life. The pragmatism of education emphasizes practical activity and problem-solving as the primary means of acquiring knowledge and preparing for integration into society. Everyday relevance signifies the correlation between learning content and student's daily experiences. It is imperative for learning materials to resonate with real-life situations, enabling students to comprehend the applicability and significance of knowledge in practical contexts. By integrating examples and challenges from everyday life into the classroom, students can more effectively grasp the relevance of their learning and become more engaged in the process. By bridging these concepts with our daily experiences, we can enhance our understanding of their importance and applicability in real-life scenarios.

For example, combinatorics can be applied in situations such as choosing combinations of clothing or menu items at a restaurant, forming a class schedule for any day of the week, seating arrangements, etc. Statistics can be used to analyze survey results or understand trends in social and economic data, or analyze user ratings of a film, etc. Probability is present in decision-making, calculating chances of success in various scenarios, or in gambling games, for example: deciding whether to take an umbrella with you before leaving for school or work, considering the probability of rain on that day based on the weather forecast and previous experiences. While playing a dice or card game with friends, you use probability concepts to calculate the chances of obtaining certain results or combinations in the game.

Purpose and objectives of the article

A rigorous analysis of the requirements of the technological society, the modernization of the mathematics curriculum, and the ultimate goal of the educational process, guides us towards the implementation and development of interactive and relevant strategies, aiming to improve the teaching-learning experience.

The purpose of this article is to explore the importance and methods of implementing the concepts of interactivity, action, and everyday relevance in the educational process, with a focus on teaching and learning mathematics in high school.

Specific objectives include:

1. Emphasizing the advantages of interactivity in the learning process and introducing a variety of interactive methods and techniques applicable to teaching mathematics.
2. Exploring ways to involve students in practical activities and action-based experiences to reinforce understanding and application of mathematical concepts.
3. Analyzing the importance of everyday relevance in the teaching and learning of mathematics, including presenting strategies for bringing mathematical examples and problems into real-life contexts for students.
4. Suggesting practical methods and approaches for integrating interactivity, action, and everyday relevance into the planning and conduct of high school mathematics lessons.
5. Exploring the influence of these concepts on student's engagement and achievement in mathematics, and identifying directions for future research and developments in the field of mathematics education.

Methods of teaching and learning involving interactivity, action, and everyday relevance

In an educational environment that aims for increased relevance, it is important to develop learning strategies that encourage student's active involvement in society through direct action. Researcher Ausubel states that it must be known the student's areas of interest, and in teaching activities, examples should be chosen, establishing connections with these areas of interest [2].

A truly motivating educational activity, however, should actively engage students and capture their interest [3, p. 63].

Rolland Viau, in turn, offers a series of suggestions for making teaching

activities motivating and engaging for students, but he approaches it in a more analytical manner, considering that the teacher should devise teaching strategies based on the knowledge they need to impart to students, both declarative and procedural knowledge [3, p. 64].

The principles outlined by Viau are fundamental in promoting an interactive and relevant educational environment, where innovative methods integrate these components, facilitating active student participation and stimulating their curiosity through action and interactivity[3], [1, p. 71].

Therefore, the teaching staff must arouse students' curiosity through elements of novelty, by creating cognitive conflicts, through originality, rethinking, and improving teaching strategies. The correct selection of teaching methods, educational digital tools, as well as their skillful use by the mathematics teacher, will facilitate the teaching-learning process of mathematics in high school, contributing to the development of specific competencies and increasing motivation towards the subject. Online educational tools facilitate access for both teachers and students to interactive, modern digital content, created in correlation with educational, computer science, and psychological standards. It is crucial for digital tools to align with the purpose, age, content, and didactic functions of the digital means. Choosing student-centered activities within high school mathematics lessons and beyond, through the use of ICT tools, will diversify educational content, the mode of perception, and assimilation of information, thereby enhancing student motivation.

The description of interactive teaching methods in mathematics and the integration of technologies (ICT)

Now, I will present several innovative methods developed to create an interactive and relevant environment in mathematics teaching, highlighting the effectiveness of these methods in improving learning outcomes and stimulating students' motivation and interest in the mathematics discipline.

The method called "**Triple Curiosities in Learning and Applying Concepts**" is an interactive and challenging approach to teaching and learning mathematics.

Students are encouraged to find three distinct domains of application for the concepts learned as homework, and the next lesson begins with exploring these curiosities, giving students three minutes to share them. Subsequently, for homework, students must identify three uses of the same concepts in everyday contexts. These examples will be presented during the "Attention Grabbing" stage of the next lesson for three minutes. At the end of the hour, in addition to the homework tasks, students are instructed to reflect on how they could personally apply the concepts addressed in their lives, which in turn will be presented as curiosities in the first three minutes of the next lesson. The method becomes highly engaging and interactive when using the digital technology Padlet in the classroom. Connected to the classroom projector, Padlet allows for the distribution of a link to students, giving them access from their mobile phones to respond in real time. Thus, all students can contribute simultaneously, and their responses are visible on the projector screen, facilitating discussions and collaboration in the classroom. Furthermore, through Padlet, students have the opportunity to upload and share audio, video, or image sequences relevant to the topic being discussed, providing an additional and more interactive dimension to the learning process.

The **"Triple Curiosities in Learning and Applying Concepts"** method aims to encourage students to explore and apply learned concepts in various contexts, providing a dynamic and interactive framework for the exploration and consolidation of mathematical knowledge. This method emphasizes active involvement of students in identifying and practically applying acquired knowledge, which can stimulate critical and creative thinking, as well as relevance in learning for their daily lives. It's an engaging way to bring academic content closer to student's experiences and interests.

An innovative method applied within problem-solving and investigations, emphasizing collaboration and communication, is the **"Interdisciplinary Problem-Solving Method"** This name underscores the essential elements of the method, namely problem-solving from both mono-disciplinary and interdisciplinary perspectives, while encouraging teamwork. Participating in the proposed activities,

students integrate knowledge and skills from diverse domains, fostering a comprehensive understanding of the subjects being studied. This method can incorporate a wide range of digital technologies, customized to address the specific problems at hand, such as interactive educational platforms, video sequences, audio clips, images sourced from YouTube, games, and so forth.

Another active-participatory method that involves students collaborating with great enthusiasm is the **"Multiple Intelligences-Based Projects Method in Learning Mathematics"**. This exciting process begins by forming teams of students, who are guided to choose their areas of personal interest based on the diversity of multiple intelligences. Each team, with its own enthusiasm and creativity, approaches the given topic in a way that best suits them, adapting methods and approaches to enhance the individual strengths of each team member. By encouraging students to put their imagination to work and explore various perspectives in solving mathematical problems, collaboration and critical thinking development are promoted, utilizing their strengths.

The method called **"Pictographic Generalization Method"** captivates students, involving them in active participation. It consists of using simple and quick drawings to synthesize the key concepts learned in class and to create a visual image of the topic or subject discussed. Through this method, students are encouraged to actively participate, use their imagination and creativity, and contribute to building a visual conceptual map that synthesizes important information. The method can facilitate understanding and retention of knowledge, providing an interactive and engaging way to reinforce learning. After analyzing and generalizing knowledge, students are proposed to create a conceptual map as homework, using the digital tool Mentimeter.

An interesting method that involves the use of digital tools for researching and selecting relevant content, as well as actively engaging students in the learning process through interactive games and creating interactive activities is the **"Digital Exploration and Interactive Engagement Method"** The implementation of this method will be ensured by the three stages of execution:

- *Lesson 1*: For homework, students will search for and pick out relevant information on the teacher's chosen topic using different media sources. (The teacher's topic will be taught later.)
- *Lesson 2*: The teacher delivers the topic, proposing interactive activities or games created by them, using educatieinteractiva.md. Students practice.
- *Lesson 3*: Students demonstrate in class the games and interactive activities they have created.

The digital exploration and interactive engagement method has a significant impact on high school mathematics learning, providing students with opportunities to access and select relevant content from a wide range of digital resources. Through interactive games on devices, students are motivated to practice mathematical topics in an engaging and interactive environment, which can improve understanding and retention of mathematical concepts. This method encourages students to become more autonomous in their learning process, developing their research, selection, and evaluation skills for mathematical information.

Presenting case studies and practical examples of implementing the discussed methods and strategies in various school environments.

Example I: Here's an application example of the Interdisciplinary Problem-Solving Method within the chapters "Combinatorial Elements" and "Mathematical Statistics," considering the teacher's proposed topic "Healthy Nutrition" from the perspectives of chemistry, biology, mathematics, physics, and history:

Problem: Students aim to develop strategies for promoting healthy eating habits in their school and community, considering interdisciplinary aspects such as food compositions, harmful effects of chemicals and excess sugar/nitrates, biological aspects of nutrition and hygiene, mathematical calculations of daily nutrient requirements, physical processes related to calorie burning and energy, as well as statistical data analysis of food preferences. Students can be divided into teams, each addressing the proposed topic from the perspective of their chosen discipline while simultaneously applying appropriate combinatorial and mathematical statistical problem-solving methods (*Table 1*).

Table 1. *Team Formation within Interdisciplinary Problem-Solving Method*

Team 1. Analysis of Food Compositions from a Chemistry Perspective: Students study the compositions of foods, focusing on chemicals such as water, sucrose, fructose, and nitrates. They analyze the impact of these substances on health and identify risks associated with excessive consumption.
Team 2. Exploration of Biological Aspects of Nutrition: Students discover and learn about the roles of carbohydrates and proteins in bodily functions, as well as the importance of proper hygiene and balanced nutrition. They explore concepts of metabolism and absorption and understand the connection between diet and health. They can solve simple genetic problems that can also be resolved through combinations.
Team 3. Calculation of Daily Nutrient Requirements from a Mathematical Perspective: Using their mathematics knowledge, students calculate the daily nutrient requirements for a balanced and healthy diet. They use nutritional value tables and mathematical formulas to determine optimal quantities of carbohydrates, proteins, fats, and vitamins. They solve combinatorial problems that provide answers about combining healthy products and the diversity of healthy menus.
Team 4. Study of Physical Processes Related to Calorie Burning: Students learn about the physical processes underlying calorie and energy burning. They explore concepts of basal metabolism, physical exercises, and energy balance and understand how these processes influence body weight and health.
Team 5. Statistical Analysis of Food Preferences from a Historical Perspective: Students collect and analyze statistical data on the food preferences of their community. They use diagrams and charts to visualize trends in food consumption and identify healthy and unhealthy eating habits over time.

Through the interdisciplinary approach to healthy nutrition, students gain a holistic understanding of this subject and develop practical and critical skills in combinatorics, probabilities, statistics, chemistry, biology, mathematics, physics, and history. This integrated approach prepares them to become informed and responsible citizens capable of making informed decisions and promoting a healthy lifestyle in their community.

Example II. Application of the **"Triple Curiosities in Learning and Applying Concepts"** method in a twelfth-grade combinatorics class.

Table 2. *Steps in Using the Triple Curiosities in Learning and Applying Concepts Method*

Stage 1: For homework, students are guided to find three distinct areas of application for combinatorics in everyday life. They are encouraged to explore different media sources. **Stage 2**: Presentation of curiosities at the beginning of the next lesson. At the start of the next lesson, students are invited to share the three areas of application of combinatorics they have identified, such as Cryptography, Computer Networks and Communications, Optimization, and Game Theory. Students will have three minutes to share these curiosities with their classmates on the interactive Padlet board. Subsequently, for homework, students are suggested to find ways to use these selected areas in their daily lives, for example: Personal data security, Wireless communications, Daily routine planning. These reflections are presented as curiosities in the first three minutes of the following lesson. **Stage 3:** Students solve problems created using their knowledge of counting problems: permutations, arrangements, combinations, and are then encouraged to engage in debates.

Example III. The **"Multiple Intelligences-Based Projects in Mathematics Learning"** method used in the combinatorics, statistics, and probability chapter, 12th grade, real profile (*Table 3*).

Table 3. *Steps of Team Formation in the Project: Exploring Multiple Intelligences in the Context of Combinatorics, Statistics, and Probability*

Stage 1: Team Formation: Students are divided into small teams and are asked to choose their areas of personal interest in combinatorics, statistics, and probability, based on the diversity of multiple intelligences. For example, one team may choose to explore combinatorics in the context of logical-mathematical intelligence, while another may approach statistics in relation to verbal or visual-spatial intelligence. **Stage 2: Project Implementation and Results Presentation:** Teams work together to implement their project and collect the necessary data. They apply the selected research methods and analyze the results to draw relevant conclusions. At the end of the project, each team presents their findings to their peers and teachers, using creative and interactive methods to share their knowledge.

Table 4. *The teams formed using the Multiple Intelligences-Based Projects in Mathematics Learning method*

Team 1: "**Exploring Logical-Mathematical Intelligence in Combinatorics**" ● Objective: To explore the concepts of permutations, arrangements, and combinations using interactive methods. ● Activity: Creating a presentation in Canva or Genially. ● Presentation: The team will present their presentation in front of the class and invite classmates to participate in discussions and debates. **Team 2**: "**Analysis of Visual-Spatial Intelligence**" ● Objective: Creating tasks to draw diagrams and graphical representations to illustrate mathematical concepts from combinatorics and probability theory. ● Activities: Analyzing and selecting concepts of permutations, arrangements, combinations to create a diagram on a sheet of paper. Comparing and contrasting permutations, arrangements, and combinations in a diagram trains pattern recognition skills and spatial analysis. ● Organizing activities to explore geometric space, such as identifying and analyzing geometric shapes, in the context of combinatorial and probability problems. ● Presentation: The team will present the diagrams discussing their conclusions with classmates and teachers.

Team 3: "Analysis of Bodily-Kinesthetic Intelligence"

- Objective: To represent and simulate mathematical concepts: permutations, arrangements, combinations through physical movement, involving the activation of kinesthetic intelligence.
- Practical activities involving the manipulation of objects and models to understand combinatorial and probability concepts.
- Sorting, classifying, and experimenting with objects by providing tangible materials such as cubes, balls, or other manipulable objects to explore combinatorial concepts, as well as to develop coordination and fine motor skills.
- Organizing activities where students manipulate physical objects to better understand mathematical concepts, such as extracting probabilities from a bag of colored balls.
- Practical activities such as building three-dimensional models or creating spatial diagrams can reinforce combinatorial and probability concepts in a tangible way.
- Presentation: The team will present and demonstrate the final products of the activity in front of classmates, encouraging discussions.

This method promotes collaboration, creativity, and critical thinking, encouraging students to utilize their individual strengths to approach and solve mathematical problems efficiently and innovatively. It also encourages them to explore and share diverse perspectives in solving mathematical problems. It is worth mentioning that all activities proposed within the teams will contribute to the development of various intelligences: verbal-linguistic, logical-mathematical, intrapersonal, interpersonal (Table 4). The use of applications and online resources that offer simulations and interactive activities for exploring spatial concepts associated with combinatorics and probability can enrich the learning experience (Geogebra, PhotoMath, interactive video activities, educatieinteractiva.md).

Example IV "Digital Exploration and Interactive Engagement Method"

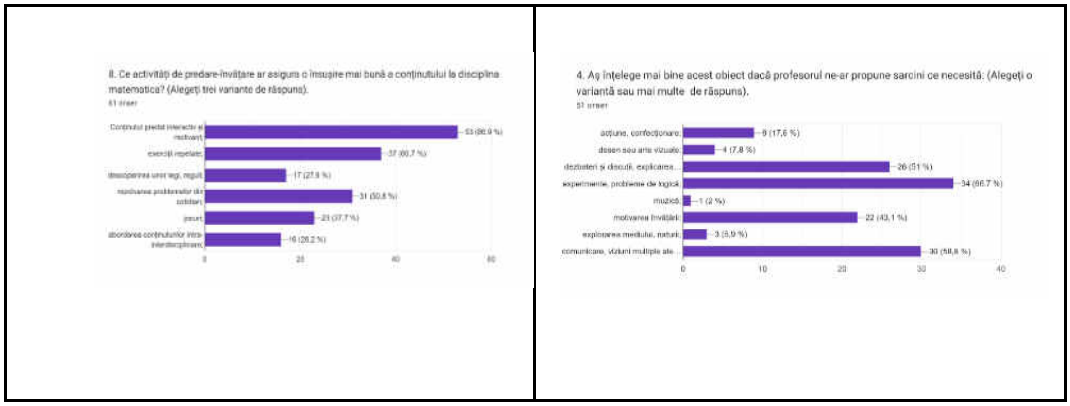
Table 5. *Steps for implementing the Digital Exploration and Interactive Engagement Method*

Lesson 1: Searching and Selecting Relevant Information; The topic proposed by the teacher for information search is "Basic Principles of Combinatorics and Its Applications in Everyday Life." Students are guided to search and select relevant information about combinatorics from various media sources, such as websites. **Lesson 2: Teaching the Topic and Practicing Using Interactive Activities;** The teacher presents the basic principles of combinatorics and its applications in everyday life, using digital resources and interactive materials available on the interactive educational platform, such as educatieinteractiva.md. Students are engaged in practical activities and interactive games that help them reinforce their understanding and practice the presented concepts. **Lesson 3: Demonstration of Interactive Activities Created by Students;** Students are encouraged to create their own games or interactive activities on the topic of combinatorics and present them to the class. Each student will demonstrate a game or interactive activity they have created to share their knowledge and engage their peers in their learning process. Examples of interactive activities and games can be found on the educatieinteractiva.md platform.

These methods are also motivated and effective, credibly supporting educational progress and student development in a validated and researched manner. Based on the information obtained from statistical analysis (52 students) regarding the use of information and communication technologies (ICT) during mathematics classes and their preferences for learning and presenting material, we can deduce the following inferences:

- Interactive and stimulating teaching is the preferred method to a large extent (86.9%), followed by real-life problem-solving (50.8%) and recurring exercises (60,7%).

- Students show a clear preference for tasks that involve experimentation and solving logical problems (66,7%), as well as for communication and approaching various perspectives on situations (58,8%).
- Exercises and elaborated problems that require critical analysis are definitely preferred by the majority of students (71,2%), followed by interactive digital materials (46,2%) (*Pic. 1*).



Pic. 1. *Examples of responses from students involved in the pedagogical experiment*

The student's responses regarding the use of technology in mathematics classes highlight a significant degree of interest and expectation on their part. The results indicate that information and digital technologies are perceived as beneficial tools for the learning process and for the development of mathematical competencies. Thus, the use of these technologies in mathematics classes proves to be an efficient strategy for facilitating understanding, consolidation, and application of content, while also contributing to the faster integration of students into society and increasing their level of interest and motivation in learning activities. Therefore, they are valuable tools for improving the quality and effectiveness of the educational process.

In summary, the results indicate that students prefer an interactive and diversified learning process in mathematics lessons, which includes the use of

information and communication technologies, practical activities, and various presentation modalities of the content. These preferences could serve as a guide for the development and implementation of teaching strategies aimed at stimulating student's engagement and performance in this discipline.

Conclusions. The methods outlined here aren't just effective – they're like power-ups for teaching and learning. They are relevant to the established learning objectives, coherent with the course content and objectives, and adapt appropriately to the specific needs and characteristics of the students and the learning situation. Additionally, they promote interactivity and inclusivity, providing equitable opportunities for all students and encouraging them to take an active role in their own learning process. The use of digital tools within this method contributes to the formation and development of students' digital competence. They learn to utilize various digital applications and platforms to search and organize information, solve mathematical problems, and create their own interactive activities. This experience prepares students for the demands of a continuously evolving digital world and equips them with the skills necessary to navigate efficiently and responsibly in the environment.

For mathematics teachers, implementing this method can be an opportunity to expand their repertoire of pedagogical approaches and creatively integrate technology into the teaching process. By providing appropriate guidance and support, teachers can learn how to effectively incorporate digital activities into their lesson plans, thereby contributing to the development of students' digital competence.

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