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INNOVATIVE TECHNOLOGY FOR MASTERING MATHEMATICAL CONCEPTS AND MATHEMATICAL TERMS

ABSTRACT

This article presents pedagogical experience in the use of numerical and verbal crossword puzzles in a math-lesson in primary school. They are one of the many enigmatic tools that find a place in learning, but their effective application requires extensive pedagogical experience. The technology for the realization of crossword puzzles is very plentiful and the teacher can choose the most suitable one for his students. The idea of their application is to support the learning process on the one hand by providing students with a higher level of understanding, more lasting memorization, and application of mathematical knowledge in practice, and on the other hand diversification and enrichment of teaching methods and tools. For students to acquire skills for applying the acquired mathematical knowledge in practical situations, it is first necessary to master a stable level of theoretical knowledge - a condition that depends primarily on the work of the teacher. The success of a teacher is the result of the variety of tools and methods he applies in his work and the ability to present them to students in a way that will intrigue and provoke them.

The review of the existing textbooks, collections, and books for the math teacher shows that the number of mathematical crossword puzzles in them is very small and they are only numerical. The analysis of the teaching practice shows that the possibilities of these tools are underestimated, on the one hand, due to the lack of ready-made crossword puzzles, and on the other hand the unpreparedness of the trainers to adequately apply the crossword puzzles in a real learning environment. Our goal is to arouse interest, increase the activity and motivation of students by applying numerical and verbal crossword puzzles in the math lesson.

This pedagogical experience was tested by an experimental study, the results of which show that the proposed and applied numerical and verbal crossword puzzles in the teaching of EG (experimental group) seventh-graders contribute to improving the results of mathematics education at the end of 7th grade. Proof of this is not only the experiment conducted within the study but also the results achieved by the NEE (National External Evaluation) in June 2020 of EG.

Keywords: *crossword puzzles, mathematical concepts, mathematical terms, mathematics education.*

INTRODUCTION

Modern technological society needs intelligent people, who need to impose new requirements on education. The science of mathematics, and in particular the subject of mathematics, directly influences the development of the student's intellect. Quality teaching and thorough study of mathematics by students in school help to develop intelligence by improving the ability to develop abstract thinking, the ability to concentrate, train memory and increase the speed of thinking. Today's digital age of artificial intelligence development requires trained personnel with a high level of mathematical literacy and intelligence.

Today, education is aimed not only at acquiring theoretical knowledge and skills, but also at acquiring key competencies. The concept for the formation of the key competencies is aimed at applying specific knowledge in real-life situations.

For students to acquire skills for applying the acquired mathematical knowledge in practical situations, it is necessary to first master at a stable level the theoretical knowledge - mathematical concepts, their terms, and definitions, mathematical facts, and statements about them.

The object of the research is the process of teaching mathematics in the junior high school stage of education.

The subject of the research is the use of crossword puzzles, which are applicable in the teaching of mathematics and their role in the assimilation of mathematical concepts and their terms.

EXHIBITION

It is impossible to say exactly who invented the crossword puzzle, when and on what occasion. Something similar to today's word games was found during excavations of ancient settlements. In the Roman Corinth, for example, in 1868, a plaque with a pattern very similar to a crossword puzzle was discovered, dating back to the III-IV century. On one of the columns in the famous Pompeii in 1936 were found 5 vertically and horizontally intersecting words. This creation from 79 AD. strikes with the

fact that it can be read not only from top to bottom, but also from bottom to top, and also from left to right and from right to left. This find is rather the first acrostic – a crossword puzzle.

In 1913, the American journalist Arthur Wine published the first crossword puzzle he had created for the New York World on December 21st, which led to the opening of a completely new page in the newspaper business. Initially, it was called a word-cross puzzle, but soon the terminology changed to cross-word, and then to the crossword, which means crossword puzzle. Wine came up with the invention after he was commissioned by the newspaper's editors to invent a new game for readers. The idea was inspired by the game "Magic Squares", which was popular in Britain in the second half of the XIX century.

In Bulgaria, the author of the crossword puzzle, published in 1927, is considered to be Iliya Nikolov.

Today, crossword puzzles are used not only as useful entertainment for the mind but also for educational purposes. In many countries, various competitions are held to solve and create crossword puzzles. Besides, we decided to use them in the teaching process in mathematics with the students from the junior high school stage. For students to successfully deal with solving mathematical problems, they must first master mathematical concepts and their terms. Along with the basic and known ways to properly understand, comprehend and realize each concept, we decided to use some non-traditional means of improving these activities. Namely, we use crossword puzzles that include terms of basic concepts and statements present in the mathematics curriculum in the junior high school stage. The aim is to encourage interest through them, to increase the activity and motivation of students. One of the options for easy memorization and reproduction of mathematical terms and concepts is the use of verbal crossword puzzles. The process of filling in the crossword puzzles is interesting for the students. The use of crossword puzzles has its application in the implementation of various types of lessons. Crosswords in a lesson for new knowledge can be used to update old knowledge, but also contain information that is related to a term of a new concept in the lesson. The use of crossword puzzles as part of the update has its justification in the view of their direct connection with the formation of an appropriate psychological climate.

In Bulgaria, the author of the crossword puzzle, published in 1927, is considered to be Iliya Nikolov.

Verbal crossword puzzles are also used at the end of a lesson for new knowledge, in the revision and primary consolidation of the new concept. Numerical crossword puzzles are a good option for use in exercises and summary lessons. The tasks presented to the students in the form of numerical crossword puzzles provoke interest, increase their activity and motivation. The use of crossword puzzles in the lessons for practice and summary in mathematics can also be evaluative.

Crossword puzzles can be used in the lessons for checking and evaluating the acquired knowledge. Presentation of the test in the form of a crossword puzzle provokes great interest among the students due to the non-standard type of independent work. Furthermore, it reduces the stress of the test and increases the desire to solve the crossword puzzle to the end.

The use of crossword puzzles can be conditionally divided into several types according to the way they are set:

- **crossword puzzles with mathematical terms and concepts (verbal)** - to avoid the traditional and boring way to question students at the beginning of the lesson when updating new terms and concepts and their properties, this can be done with the help of a crossword puzzle.
- **numerical crossword puzzles** - through them, the exercise takes place in a non-standard way.
- **crossword puzzles with visual shape** - these crossword puzzles are set by geometric figures or pictures. They are interesting even to weaker students.
- **fun crossword puzzles** - these are crossword puzzles for educational purposes, but they also contain a game element.
- **crossword puzzles in reverse order** - the crossword puzzle is completed and students are required to ask the correct questions for the words in the crossword puzzle.
- **crossword puzzles with interdisciplinary links** - if the crossword puzzle is solved correctly, information about another subject is obtained.

The inclusion of verbal crossword puzzles in the math lesson allows diversifying the ways of passing through the learned concepts. Besides, the learning process becomes more interesting and fun, positive emotions are created in students, it is easier to overcome learning difficulties of the study material and the memorization of the mathematical terminology is activated. The inclusion of numerical crossword puzzles and crossword puzzles with geometric drawings in the practice lessons helps to more easily and smoothly consolidate the acquired knowledge.

At a later stage in the application of crossword puzzles in mathematics education, students may be provoked to create crossword puzzles themselves. When creating a crossword puzzle as homework, students are provoked to turn to additional literature, trying to formulate an interesting, non-traditional question or to make a crossword puzzle in a non-standard form, which leads to the development of their creative abilities. Each correctly asked question to the crossword puzzle testifies to the student's mastery of the study material.

The best crossword puzzles, which are created by students, can find a place on a board in the mathematics classroom or can be published in the section "From students to students" in an annual scroll.

Compiling crossword puzzles takes a lot of time, so teachers can use a variety of platforms and portals on the Internet, which support Cyrillic and allow the creation of didactic materials in the form of crossword puzzles applicable in the teaching of various subjects, in particular mathematics. (LearningApps.org, Armoredpenguin.com, CrosswordCreator).

Numerous studies on the application of electronic resources in education show that students perceive the presented knowledge 50% faster and more permanently than traditional learning.

The advantage of electronic resources is that they can be applied at different stages of training:

- when acquiring new knowledge;
- in the formation of mathematical skills;
- in improving mathematical skills;
- in stimulating individual and group activity;
- in controlling the learning outcomes

Solving crossword puzzles allows you to use all levels of knowledge acquisition: from reproductive activity to the main goal - creative activity.

CONCLUSION

The inclusion of crossword puzzles in different types of mathematics lessons provokes interest, increases the level of initiative, increases the cognitive horizons of students, allows them to gain lasting knowledge, provokes a competitive spirit, and last but not least, the attitude of students towards mathematics changes in a positive direction.

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ІННОВАЦІЙНА ТЕХНОЛОГІЯ ОВОЛОДІННЯ МАТЕМАТИЧНИМИ ПОНЯТТЯМИ ТА МАТЕМАТИЧНИМИ ТЕРМІНАМИ

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Анотація. *У даній статті представлений педагогічний досвід використання числових і словесних кросвордів на уроці математики в середній школі. Кросворди є одним з безлічі енігматичних засобів, які мають місце в навчанні, але для їх ефективного застосування необхідний багатий педагогічний досвід. Технології реалізації кросвордів дуже багаті і вчитель сам може вибрати найбільш вдалу для його учнів. Ідея застосування кросвордів полягає в тому, щоб підтримати процес навчання, з одного боку, забезпечуючи учням більш високий рівень розуміння, більш тривале запам'ятовування і застосування математичних знань на практиці, а з іншого боку – дозволяє значно урізноманітнити методи, засоби і технології навчання. Щоб школярі зуміли набути навичок застосування отриманих математичних знань в практичних ситуаціях, необхідно спочатку оволодіти стабільним рівнем теоретичних знань – умовою, яка залежить, перш за все, від роботи вчителя. Успіх вчителя – це результат різноманітності інструментів і методів, які він застосовує в своїй роботі, а також його здатності представити знання учням таким чином, щоб заінтригувати і спровокувати їх здатність самостійного мислення.*

Огляд існуючих підручників, збірників і книг для вчителів математики показує, що кількість математичних кросвордів в них дуже мала і вони в основному числові. Аналіз практики навчання показує, що можливості цих інструментів недооцінюються, з одного боку, через відсутність готових кросвордів, а з іншого – через замалий досвід вчителів вміло використовувати кросворди в рамках реальних умов навчання математики. Наша мета – викликати інтерес, підвищити активність і мотивацію учнів, вирішуючи числові і словесні кросворди на уроці математики.

Цей педагогічний досвід був апробований експериментальним дослідженням, результати якого показують, що запропоновані і застосовані числові і словесні кросворди в навчанні експериментальної групи семикласників сприяють поліпшенню результатів навчання математики в кінці 7-го класу. Доказом цього є результати не тільки проведених в рамках дослідження тестів, але і отримані результати в рамках проведення «Національного зовнішнього оцінювання» в червні 2020 року.

Ключові слова: *кросворди, математичні поняття, математичні терміни, математична освіта.*