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# THE METHOD OF FLIPPED CLASSROOM - CASE STUDY

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**Abstract:** Within the project of "Supporting teaching mathematics at the Technical School based on modern information technology", which is carried out in cooperation between Gromar Company and Lodz University of Technology, we have produced training materials in Mathematics. In this article we will present the possibility of how to use the training in the flipped method. We will also present the case study of the training module "Quadratic inequalities".

**Keywords:** flipped classroom, e-learning, teaching of mathematics**.**

## 1. INTRODUCTION

The idea of a flipped classroom assumes that the students learn individually assisted by multimedia materials given by the teacher before the proper classes. During the classes the students get the answers to all the questions from the teacher. If it is possible, it is important for the student to keep asynchronous contact with the teacher during his individual work. (see example "Mathematical Emergency E-services Project"), [1-3].

During classes the students learn mainly by asking questions, analyzing a variety of examples as well as posing hypotheses and building other strategies of solutions.

Certainly the success of the teaching process with the use of the flipped classroom method depends on how much the students get involved. The method will never prove to be successful if the students will be little interested in a given topic.

In the next paragraph we will suggest how to use the created training materials in teaching practice within the flipped classroom method.

## 2. QUADRATIC INEQUALITIES – CASE STUDY

Before they begin, it is important for the teacher to answer himself the question:

- Are you prepared?
- Have there ever been any models like this in teaching process?
- How students prepare themselves individually for the "Quadratic inequalities" Module?

- The student gets acquainted with the definition of quadratic inequality (fig. 1)

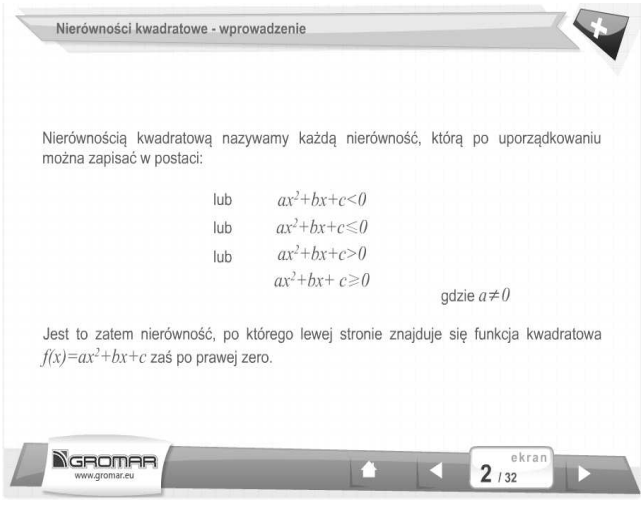


Figure 1 - The definition of quadratic inequality

- The system checks if the student has understood the content of the definition.

The student gets a few inequalities in turn and has to answer the question if they are quadratic inequalities (fig. 2).

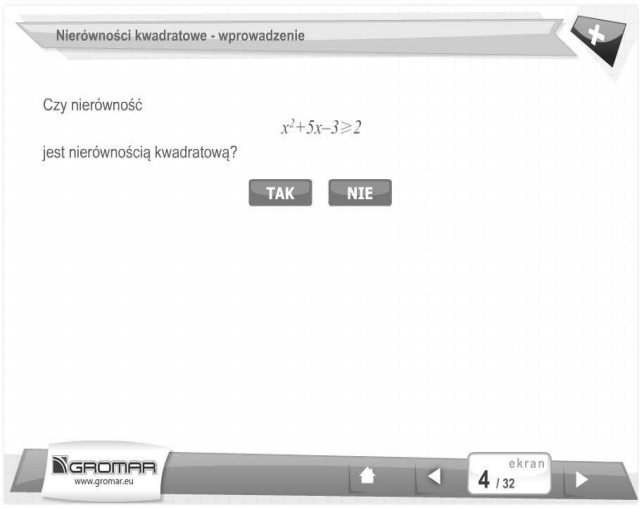


Figure 2 - Verification of definition understanding

- The student gets a full justification why the inequality is or is not quadratic.

There appears a justification in the case of the right as well as the wrong answer. It gives an opportunity to establish the understanding of the definition (fig. 3).

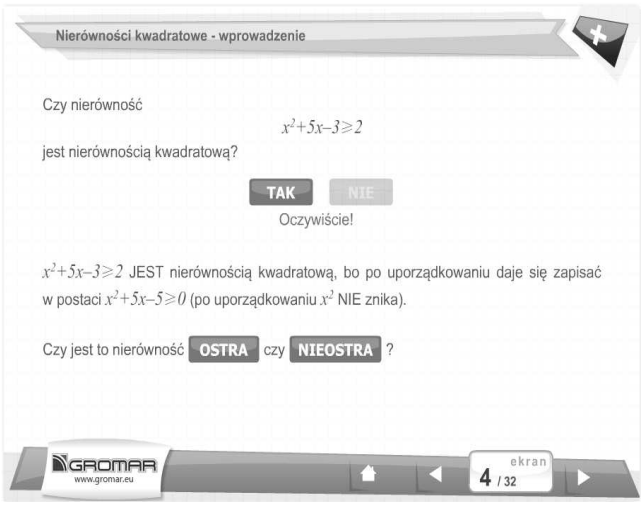


Figure 3 - Justification of fulfillment / lack of fulfilled conditions of the definition

- The student gets acquainted with the method of solving the quadratic inequality by examples.

They consider two examples of inequality with an intuitive solution and geometric interpretation (figs. 4, 5).

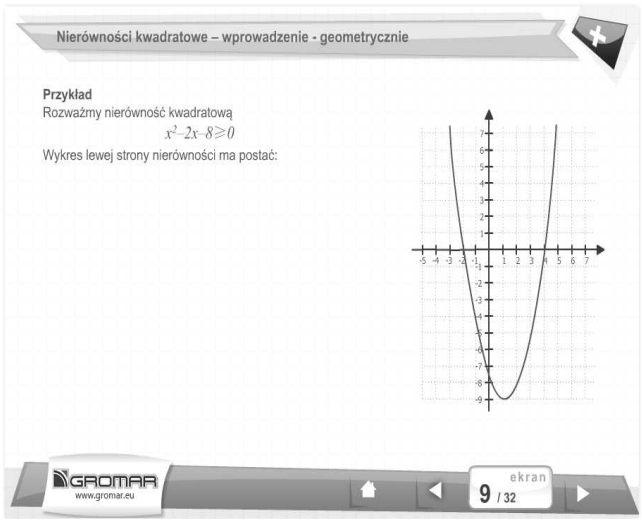


Figure 4 - Quadratic inequality - example - part 1

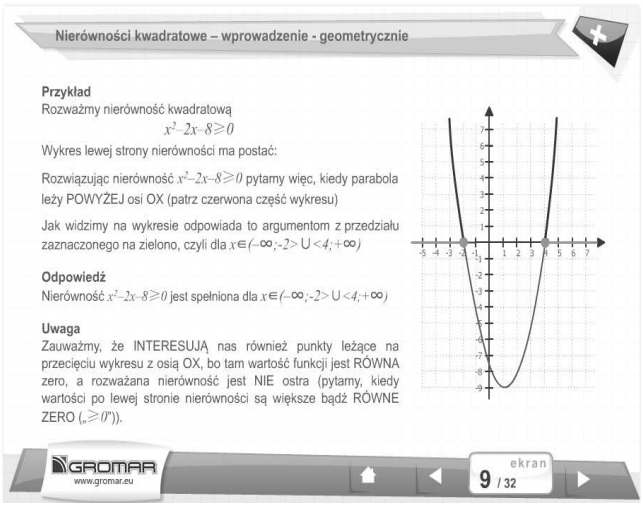


Figure 5 - Quadratic inequality - example - part 2

- Taking the examples into consideration, the student is given an algorithm of solving quadratic inequalities. It results from generalized observations made by the student while analyzing the previously presented examples. The algorithm is created, so to say, in front of the student's eyes (figs. 6, 7).

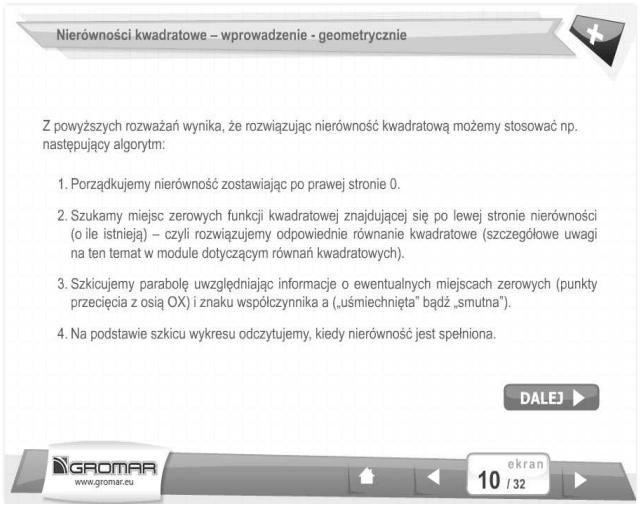


Figure 6 - Algorithm of solving quadratic inequalities – part 1

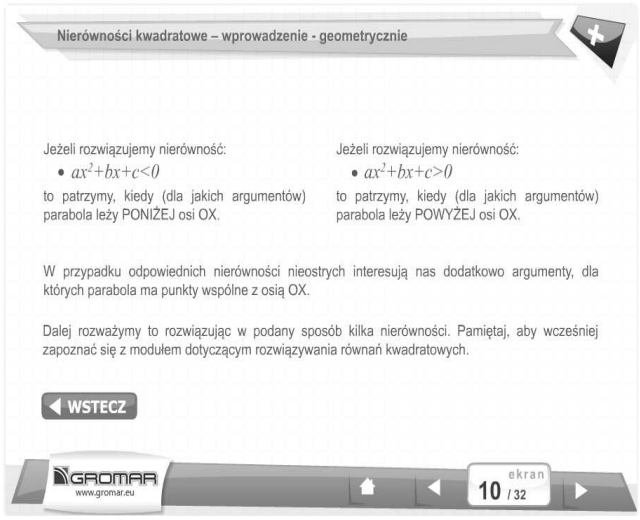


Figure 7 - Algorithm of solving quadratic inequalities – part 2

- The student moves on to analyzing the solutions of subsequent quadratic inequalities based on the given algorithm.

The student can use a few tasks with complete solutions strictly according to the previously created algorithm. The tasks are ordered by level of difficulty: from the easiest to the most difficult ones. The particular elements of the solutions appear subsequently for the student to give him a chance of individual analysis (fig. 8).

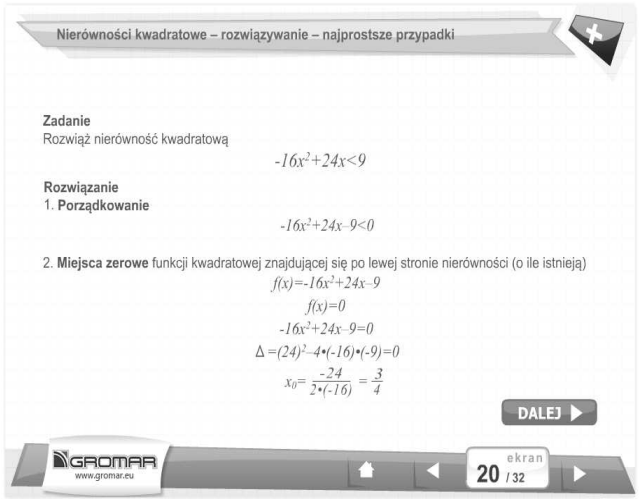


Figure 8 - Quadratic inequality - task with a solution - part 1

The geometric interpretation is a very important element of solving a quadratic inequality (fig. 9).

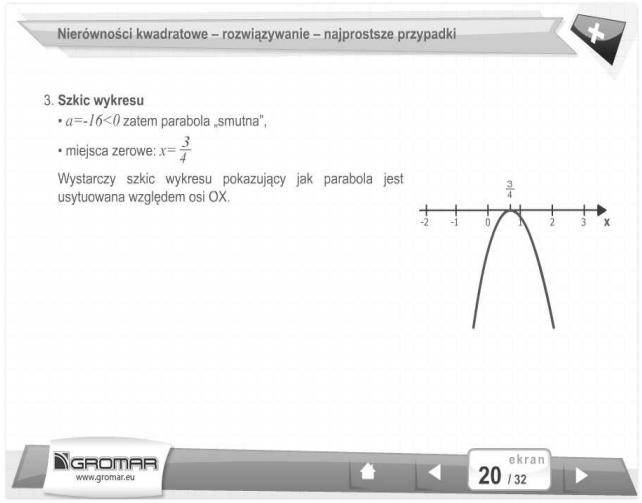


Figure 9 - Quadratic inequality - task with a solution - part 2

The student reads the solution of the task on the basis of the geometric interpretation. We boil the answer to the question "When is the inequality fulfilled?" down to the answer to the question " When the graph of the function is on the left of the inequality and lies respectively above or below OX axis (the straight line described by the right-hand side of the inequality)". The relevant part of the graph is highlighted in red. The appropriate set of arguments - the solution of the inequality - is drawn in green (fig. 10).

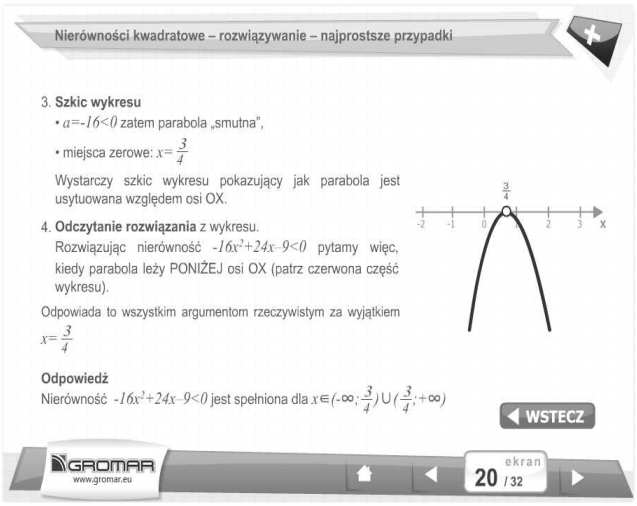


Figure 10 - Quadratic inequality - task with a solution - part 3

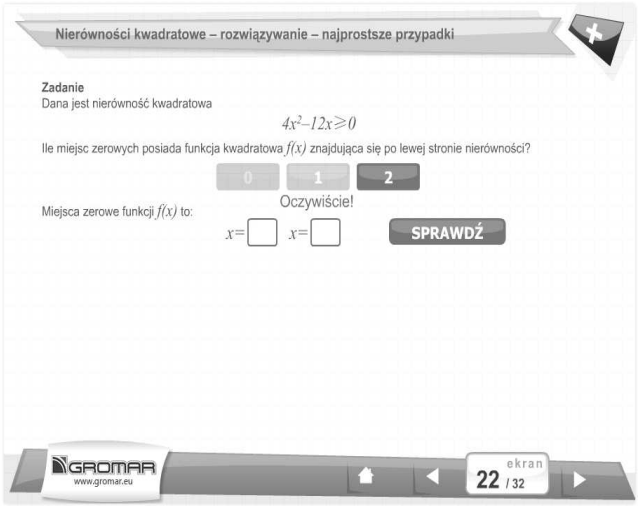


Figure 12 - Quadratic inequality – task for individual work part 2

- The student moves on to the final stage: the system checks if the realized material has been mastered.

The verification of the knowledge and skills does not only boil down to marking the given answer. First, the student must determine how many zeros the function, which is located on the left of the ordered quadratic inequality has (fig. 11).

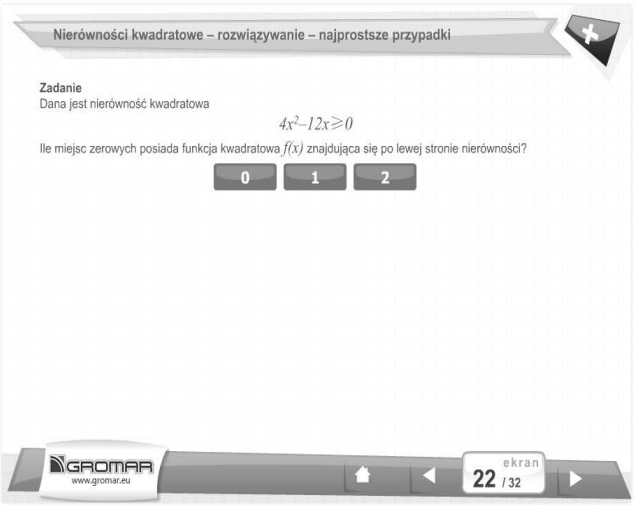


Figure 11 – Quadratic inequality – task for individual work part 1

Next, the student must give what zeros the function on the left of the inequality has (provided they have found any) (fig.12).

It is important to recognize the shape of the parabola, being the graph of the quadratic function in point.

In the end, the student must choose the right answer. The system suggests four options:

- the whole set of real numbers;
- the range, whose limits are the previously found zeros;
- the sum of ranges whose proper limits are appropriate zeros;
- empty set.

The correctness of each given answer - especially solving the inequality - is verified by the system (fig. 13).

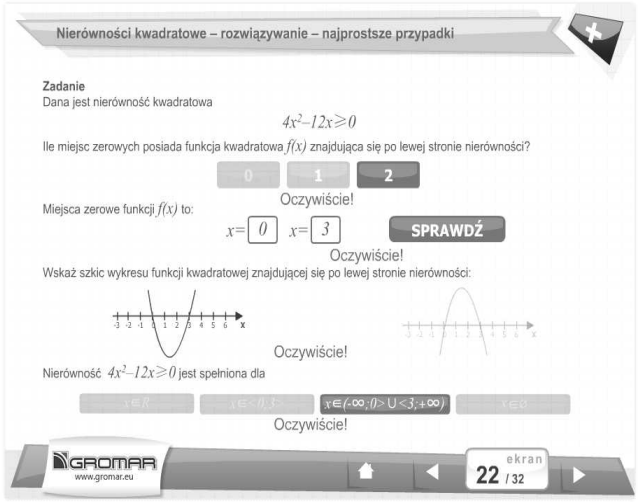


Figure 13 - quadratic inequality – task for individual work – part 3

The system of reporting on the platform allows for tracking the students activities and, particularly, monitoring their activities when they are solving evaluation tasks. The tasks for individual work which are included in the

evaluation part of the module and, therefore, can be successfully used as homework.

## 3. CONCLUSIONS

The omnipresent revolution of ICT has tremendously affected education. Computers and the Internet are widely available, which results in rapid development of new methods and forms of teaching. E-learning, which means computer-aided distance learning, is gaining more and more popularity. The e-learning platform made by Gromar is a typical tool for distance learning. It has many functions: to manage the participants of the trainings, run the chats, forum, provide didactic materials, carry out surveys etc. The material prepared for learning Mathematics put on this platform enables the students to use modern learning methods such as flipped classroom and many others.

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# METODA ODWRÓCONEJ KLASY - STUDIUM PRZYPADKU


W ramach projektu „Wspomaganie nauczania matematyki w Technikum w oparciu o nowoczesne technologie informacyjne" realizowanego w partnerstwie przez firmę Gromar i Politechnikę Łódzką zostały wytworzone materiały szkoleniowe z matematyki. W artykule przedstawiamy możliwość wykorzystania szkoleń do metody odwróconej klasy. Idea odwróconej klasy polega na tym, że uczniowie uczą się samodzielnie z materiałów multimedialnych wskazanych przez nauczyciela. Podczas zajęć uczniowie uzyskują od nauczyciela odpowiedzi na wszystkie pytania. Jeśli jest taka możliwość, to warto, aby uczeń dodatkowo podczas samodzielnej pracy miał możliwość asynchronicznej komunikacji z wykładowcą.

Oczywiście, powodzenie procesu nauczania z zastosowaniem metody odwróconej klasy zależy przede wszystkim od dużego zaangażowania się uczniów. Multimedialny i interaktywny charakter przygotowanych materiałów na pewno wpływa korzystnie na zainteresowanie uczniów tematyką lekcji.

Prezentujemy studium przypadku dla modułu szkoleniowego „Nierówności kwadratowe". Jest to propozycja użycia wytworzonych materiałów szkoleniowych w praktyce szkolnej w modelu odwróconej klasy. Oprócz własności samych materiałów istotną praktyczną rolę odgrywają również funkcjonalności platformy e-learningowej, w kontekście której są one osadzone.



**Słowa kluczowe:** odwrócona klasa, e-learning, dydaktyka matematyki.