From Real World to Derivative – How to Effectively Include Mathematical Modeling and **GeoGebra in Mathematics Education**

Abstract

Direct application of innovative teaching method based on principles Direct application of innovative teaching method based of mathematical modeling is illustrated by example of the first does and provide the introducing the concept of the first does and provide the mathematical modeling as teaching method and concept of the first does and provide the mathematical model ing as teaching method and the mathematical model and drawing conclusions from it. The positive effects of mathematical modeling and the application of mathematical model is and the application of mathematical thinking, and the application of mathematical the mathematical thinking and the application of mathematical theory of the application of the appl

Mathematical modeling and GeoGebra The mathematical model is a mapping between reality and mathematics. The purpose of the mathematical model is reflected in drawing conclusions about reality based on the model. The crucial thing for any mathematical model is that it has to lead to something, meaning that mathematical model is the basis for drawing conclusions about reality which can then be tested experimentally. The central point in mathematics education should be creation of students ability to apply mathematics in a variety of situations in real Mathematical modeling is connected to one of the main goals of education, which is related to the understanding of real-world phenomena and their connection with mathematics. SITUATION Mathematical modeling consists of several phases, which REPORT selection of real-world situation that will be modeled, based on the selected real situation the real world problem is observed, mathematical model based on the EXEPTOR real-world problem is made and REVISE mathematical solution is derived SOLUTION from mathematical model. If the solution is accepted, we make a report about it. If not, we can do revision of the modeling process, and mathematical model itself. GeoGebra is chosen in this study as a software package that will accompany the process of mathematical modeling for several

reasons. GeoGebra is a free software package, very easy to use and teachers do not need any special training for its application. Mathematical modeling is already quite a demanding process, speaking in terms of teacher training and in terms of its application, so that simplicity of use GeoGebra, and its power, at the same time

comes very nicely.



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Introducing the Concept of the First Derivative using Mathematical **Modeling and GeoGebra** File Edit View Options Tools Window Help

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The Story

One interesting story was presented to the students, about animals, who built a wall to protect themselves from lion. They had a task to calculate the grade of the wall, but, every animal saw a different grade, according to its height.

The Calculations

ht of the wall = 4 m center of the wall distance = 8 m

Giraffe's stride = 8 r

Vertical progres = 4 mGrade = 50%

Zebra's stride = 4 m

I Stride: Vertical progres1=3 m Grade = 75%

II Stride: Vertical progres2=4m-3m=1 Grade = 25%



REAL

WORLD

PROBLEM

MATHEMATICAL MODEL

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2) and the

Giraffe

Gazelle

Zebra

The Mathematical Model

 $\lim_{step \ size \to 0} \frac{vertical \ progress}{horizontal \ progress} = 100\%$

$$grade(x) = \lim_{h \to 0} \frac{f(x+h) - f(x)}{h}$$

$$f'(x) = \frac{df}{dx} = \lim_{h \to 0} \frac{f(x+h) - f(x)}{h}$$

What did Animals find?

Animals built the wall and wanted to know its grade. Actually, they calculated its SLOPE.

Each animal, starting at the base of the wall, found a straight line that intersected the parabola (wall), at two points.

We discovered that, as you bring the two points of intersection closer and closer together, the slope of the resulting line approaches its limit.

At the limit, we have a line that is TANGENT LINE to the wall.

Derivative f'(x) gives us the slope of the line that is tangent to that same curve at x.

Differential Calculus By its very nature, the differential calculus is an abstract, fairly Sy its very nature, the universities were served and demanding theory. Because of the presence of highly abstract concepts, students find it difficult to understand the true meaning of the calculus, and especially to See a little further, i.e. to recognize the situations where this Differential calculus is one of the most important tool for future engineers. That is the main reason for learning Differential Calculus with understanding, because mechanical knowledge Application and implementation requires understanding and possibility of manipulation with Differential Calculus concepts. GeoGebra can be used as very usefull tool in teaching and learning Calculus, due to its dynamic nature. Organizing teaching process, as shown, students had the impression that they did something fun and interesting, and, at

Mathematical modeling can undoubtedly be widely used in Conclusions mathematics education. The greatest contribution of this method is reflected precisely in linking the real world with the formal world of mathematics, because it opens up great opportunities for the application of mathematics in real

Studies have shown that the effects of this method in mathematics education are extremely positive.

On the other hand, GeoGebra has proved to be a very convenient tool for the application and implementation of computers in mathematics education, especially due to its dynamic na

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