

# Using Technology to Discover and Explore Linear Functions and Encourage Linear Modeling

Tanja Soucie MSED

Matka Laginje Elementary/Middle School, Zagreb, Croatia

[tanja.soucie@zg.t-com.hr](mailto:tanja.soucie@zg.t-com.hr)

Nikol Radović M.S.

Faculty of Geodesy, University of Zagreb, Zagreb, Croatia

[nradovic@geof.hr](mailto:nradovic@geof.hr)

Renata Svedrec

Otok Elementary/Middle School, Zagreb, Croatia

[renata.svedrec@zg.t-com.hr](mailto:renata.svedrec@zg.t-com.hr)

Helena Car

Otok Elementary/Middle School, [helenacar52@gmail.com](mailto:helenacar52@gmail.com)

Zagreb, Croatia

## Abstract

In our presentation we will show how technology enables us to improve the teaching and learning of linear functions at the middle school level. Through various classroom activities that involve technology such as dynamic geometry software, graphing calculators and Excel, students explore functions and discover basic facts about them on their own. Students then work with real life data and on real life problems to draw graphs and form linear models that correspond to given situations as well as draw inferences based on their models. Participants will receive complete classroom materials for the unit on linear functions.

## Introduction

One of the *National Council of Teachers of Mathematics* (NCTM) principles states:

“Technology is essential in teaching and learning mathematics; it influences the mathematics that is taught and enhances students' learning.” In order to meet the new demands placed upon teachers, thoughtful changes should be made in regards to curriculum and the way we approach teaching and learning. Some of the critical problems we have to address are students' inability to see the application of mathematics in real life, the belief they will never use mathematics outside the classroom, and the belief that mathematics is difficult and boring. It is crucial to convince students otherwise through the use of various classroom activities. We believe the use of technology can help bridge some of those gaps. The use of technology makes mathematics accessible to more students and enables the use of real life data which in turn puts mathematics in a context for students. When students see the application of mathematics in real life they begin to understand its importance and beauty as well as gain more appreciation for the subject. In addition, the use of technology allows students to work at their own pace, make mistakes and correct them on their own, as well as feel free to take risks.

## Model of instruction

After a brief introduction to linear functions, students explore linear functions on their own using dynamic geometry software. They discover how parameters  $a$  and  $b$  relate to the equation  $f(x) = ax + b$ , how to find the  $x$ - coordinate of a zero of a linear function, how to determine whether the graphs of the functions are parallel or perpendicular from the equation and how to solve systems of linear equations graphically. Next, students engage in a mini-project about medicine. Students determine the linear equation that describes a dosage based on body mass and draw graphs

(using Excel) as well as interpret them to answer questions such as: Why shouldn't we skip dosages?, Should we take a double dosage if we did not take our medicine on time?, etc. Next, students engage in a study of their choice. While working on their project, students can use a graphing calculator or Excel.

1. Vitruvian man – students take various measurements and discover the relationships between e.g. height and shoulder length, ear length and face length, etc. as well as describe these relationships using functions. Students compare their equations with human proportions recorded in Book III of the treatise *De Architectura* by the ancient Roman architect Vitruvius and used in Leonardo da Vinci's drawing of a man.
2. Cost of living – students describe the costs of a gas bill, phone bill, internet bill, etc. using functions and answer various questions using these equations as well as determine the best phone and internet provider for their consumer needs.
3. Exploration in physics – students take measurements and explore relationships between mass and force recorded on the spring scale, mass and volume, the radius and height of a cylinder, the volume and height of a cylinder to determine whether these relationships are linear. If a relationship is linear, students determine the equations of the function.
4. Math in sports – students shoot baskets from various distances and describe the number of baskets made based at each distance from the basket using linear functions and answer various questions based on this model. Students also graph data about long jump world records and determine linear equations that predict the length of the jump based on the year. Students will try to answer questions such as: How far can a man jump? Will women ever jump farther than men?
5. CAT/ RAT simulation – students use a computer simulated experiment to investigate the actions of standard drugs on the cardiovascular system. They inject drugs into an animal's circulation and explore relationships between drug dosage and the values of heart rate and blood pressure.
6. Food and water in the animal world – students explore relationships between body mass and the time of digestion and body mass and the velocity of losing water for different kinds of animals. Using graph data students will try to answer questions such as: How long does a rabbit take to digest its food? How fast does a rabbit lose water from its organism?

Rubrics for assessments are provided.

### **Transfer of the model to different environments**

Sometimes the lack of technology is an issue in schools. In classrooms where computers are not easily available, teachers can show presentations using dynamic geometry software and students can explore linear functions as a class through discussions. All of the graphs and equations can be found using Excel if no graphing calculators are available. In case there is neither a computer nor a graphing calculator available, students can draw graphs by hand and use scientific calculators to arrive at linear models (by using two variable statistics).

### **Conclusion**

The strategies used in our model create a motivating and engaging environment where technology allows students to discover mathematics on their own as well as model real world data. The use of technology allows students to work at their own pace, make mistakes and correct them on their own, and feel free to take risks. The choice of topics and the choice of technology used empowers students to make their own decisions based on their own interests and personal preferences. We believe this model is superior to traditional lecture based instruction because it requires active engagement of students and encourages higher level thinking.