PPP -

Autora textu: Ing. Beata Ľubová, SŠ Nižná, asociovaná škola projektu Goerduio

Mathematical Modeling in the Hands of Students

The goal of mathematical modelling is to show students how to thoroughly analyze given problem in real circumstances and how to create a symbolic abstract model built upon mathematical and logic relationships between its parameters. Students can only learn how to model by their active participation in class. The historical source of modeling tradition stems back into past and is connected mainly with development of algebraic and geometric models (Egyptian tasks –acha, that tried to determine a model – linear equation, to determine an unknown quantity of wheat, Diofantic exercises and a considerable amount of other assignments can be found on the internet).

By mathematical modelling, we develop following key competences in students:

1. Capabilities to solve problems – creating of hypotheses, designing a solution of a problem with the sequence of its solution, taking into account different possibilities of solution, proving the hypothesis by a real research and activity
2. Critical thinking
3. Creativity, sense for innovation and resourcefulness

Classes that implement mathematical modelling motivated us to apply principles of integrated thematic education (e.g. looking for links between the information that student learned from physics class and professional subjects, which are then implemented into mathematical context)

Transformation of problems into mathematical form is based upon identification of variables that describe a problem and describing the relationships between them. The results gathered from the mathematical model must be interpreted back into the real world, where the degree of their correctness and suitability can be judged. Mathematical modelling can encompass different particular activities in the educational process:

- Researching the finished model by the virtue of changing of input information with the aim of understanding the model and relationships between its components
- Creating of models based on iteration and recursion, allowing systematic changes of input parameters a gradual improving of gathered results from the researched problem.
- Improving the model so it would be as similar as possible to real world situation.

The mathematical modeling provides students with a more effective and and deep knowledge of mathematics.

Modeling is a method that fully satisfies all the parameters of innovative education. It is then a way of education that uses approaches of situational methods, simulations and problem solving, all of which can be called activity methods, or education concentrated on student and his activity.

Use of sensors in mathematical modeling, construction of natural sciences laboratory.

By adding sensors into the mathematical modeling, students become researchers who search for relationships and causes between scientific occurrences. After the obtained data is evaluated, students then proceed to search for a dependency between the values and try to confirm or reject the original hypothesis. The advantages of using sensors in mathematical modelling are based on my experience:
- The development of ability to evaluate and synthesize information
- Development of team work and responsibility for the common output of the team
- Development of ability to experiment
- Promoting the consciousness of moral, ethical, social, economical and environmental implications of scientific knowledge and technology
- Presenting links between science and vast possibilities of application of its methods in real world

Linear optimization and modelling

Linear optimization problems represent an area where the mathematical modeling can be applied in real world problem solving. Linear optimization is considered to be one of the most researched areas of mathematical programming and is often used when searching for an optimal solution in limiting conditions. When solving the optimization tasks, it is needed to mathematically explain the relationships between objects that influence the solution of the problem. Identification of variables and description of relationships between them stand for a base of the mathematical model. The finishing function characterizes the dependency of researched quantitative feature from the input data.

This designed mathematical model is the base for any other research that is using a graphical representation to explain the dependency between data.

An example on how to design a model:

- Word assignment, formulation of the task
- Formalization of notation

- Designing of a mathematical model task that encompasses two basic parts

    1. Purpose function and the way of its optimization
    2. An array of limiting conditions in form of inequations (equations)

- Evaluation of the optimal solution for the task.

Solving problematic assignments with mathematical modeling is an interesting way for students to develop their mathematical thinking. The model stands for a real object or a situation and makes possible for students to understand many different scientific events and relationships between values. The activity on a lesson is overtaken by student and teacher becomes a coordinator of lecture.

List of bibliographical sources

1. Algoritmy v každodennej matematike[online]. 2013. Dostupné na:

<*http://www.everydaymath.edu/*>

2. Blomhoj, M. Vzdelávacie výskumy zamerané na matematické modelovanie [online]. 2013. Dostupné na: <*http://www.tsg.icme11.org/*>

3. Carlson, M.,Larsen,S. 2003.Integrating a Models and Modeling Perspective With Existing Research and Practice.ISBN:978-8058-3822-0

4. Dantzig,G.B. 1996. Lineárne programovanie a jeho rozvoj, SNTL, Bratislava ISBN: 80-210-**1996**-2.

5. Demkanin,P. a kol. 2006. Počítačom podporované prírodovedné laboratórium, 1.vydanie. FMFI UK Bratislava. 2006 ISBN: 80-89186-10-6