Mathematics Education -
Relevant, Interesting and Applicable

Newsletter 7, May 2018

New MERIA scenarios

As we announced in our previous newsletter, new MERIA scenarios have been developed and implemented in classrooms. With the feedback provided from the implementation, the modules for these scenarios will be created by the end of the year. In this newsletter we present the scenario for modelling optimal production costs using linear functions.

Linear functions for modelling optimal production costs

Target knowledge. The construction of piecewise linear functions defined as a solution to a problem where a list of linear conditions is given. In the end the solution could be presented as a piecewise linear function. Graphical calculator or computer can be used to plot functions and solve equations, if students know about that.

Problem. You are a consultant who advises companies on where to run factory buildings for the production of bicycles (or other items), based on the table showing the costs in different areas, what would you in general guide of the companies to choose and why?
The students should write a document explaining to the director of the company how they would advise him to place his factory.

Scenario was written for a lesson of 45 minutes consisting of standard phases of TDS scenario: devolution, action, formulation, validation and institutionalisation. For the scenario, teachers prepared the classrooms for groups of two to four students. At the begging of the lesson, students are given the following table and asked to solve the problem.

Areas of location	Fixed costs for running the factory in €	The costs of producing one bicycle at the factory in €
A	300 000	120
B	450 000	110
C	660 000	60
D	680 000	80

Implementation of the scenario

The Linear functions scenario has been designed for students of age 15-16. The implementation was done in three schools in Croatia, one school in Netherlands and the scenario was also discussed with the students (pre-service teachers) at the Faculty of Science in Zagreb. The analysis of implementation in Slovenian and Danish schools will be done subsequently.

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Students used mobile phones, graphical calculator, Geogebra, Wolfram Alpha or grid paper to obtain graphs of linear functions and calculations.

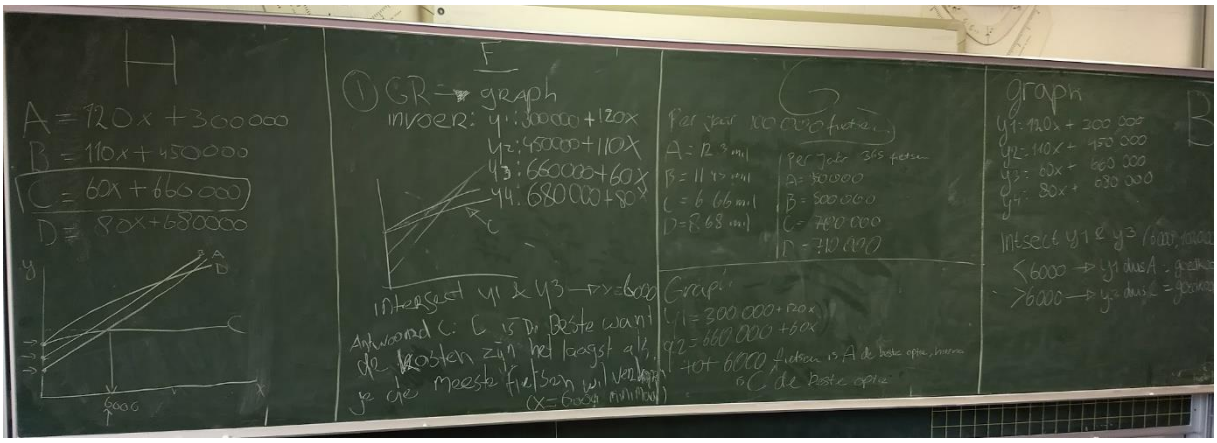
Students had some questions to clarify the problem. Some of them were thinking about the profit, instead of the costs. The students asked: *What are the transportation costs?*
In Netherlands there were no problem with understanding of the problem. The students say: *We have done similar problems at our Economics course, but with two locations. This is very similar.* Some of them realized very fast: *The one with the smallest slope is the cheapest.* According to teachers' suggestion the project team will replace *fixed costs* by *costs of building the factory in that area* in order to clarify the problem.

Further observations

Important observation from the scenario is that the teachers were trying not to teach the students during all phases of the scenario. This is nice improvement to keep the adidactical potential of the situation. During the action phase, students formulated the following approaches:

I. modelling with linear functions and drawing graphs
- I.1. drawing by hand and calculating intersections as solution to linear equations
- I.2. using technology to draw graphs and find intersections

II. Comparing pairs of areas and analyzing the results
- II.1. using linear equations
- II.2. directly from the table, comparing the fixed costs



In the formulation phase students were presenting their strategies on the blackboard in order to learn from each other's strategies in the next phase. According to MERIA questionnaire, after this lecture 73.3% students think that mathematics is related to real life, 87% say that lecture was interesting or much more interesting than usual lecture, and 91.9% students would like to have such lectures each month!

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