Mathematics Education -
Relevant, Interesting and Applicable

New MERIA scenarios

In this newsletter we present the scenario in which students are investigating how the braking distance relates to speed just before braking. We find the situation extremely rich as it opens the potential to discuss summation as discrete integration, while at the same time could lead to subtle discussion about average speed in physics.

Scenario Braking distance

Target knowledge: Quadratic relation
Broader goals: Quadratic functions and their characterization by constant second derivative (second differences for quadratic sequences, that is, quadratic functions on integers), or by constant decreasing or increasing first derivative (differences for quadratic sequences).
Interdisciplinary skills: students have to work with variables from physics and make sense of what is going on (bridge the two worlds of notations and procedures).
Inquiry skills: analysing data and looking for patterns in the tables. Justifying their findings (argumentation) during the presentations (the calculations dominate the process and they have to summarize their approach to others).
Problem: In a city area with primary schools, parents complain about the set speed limit, considering it inadequate for the area with school children. A group of reckless drivers say that they do not need to worry because they brake in time. Now you (the students) are asked to investigate how the braking distance relates to speed just before braking.

Consider a car braking in such a way that the speed decreases by 10km/h every 0.4 seconds.
You can use the tables below to organize calculations and make observations, then justify your answer as you best can.

Scenario is designed for two lessons of 45 minutes as introduction into Quadratic function chapter. It contains the standard phases of the TDS scenario: devolution, action, formulation, validation and institutionalization. At the beginning of the lesson, the teacher divides students into groups and poses the problem. In the action phase, students will calculate the braking distance for the concrete initial speeds. In the formulation phase they will generalize their calculations and considerations. During the validation phase the students will present their group's solutions, listen to the presentation of other groups, ask questions and discuss strategies and solutions. The students will discover relationships that are not linear, quadratic

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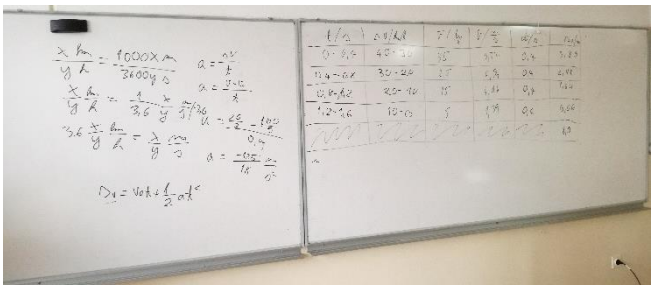
relationships. Finally, in the institutionalization phase, the teacher comments and connects to each other all strategies that appeared in the classroom and introduces the quadratic function.

Implementation of the scenario

Scenario *The braking distance* was tested in two schools in Croatia and one school in Slovenia, and in the Netherlands and Denmark testing will be carried out later.



Students didn´t have problem with understanding the task, and they used different strategies for solving it. Some students calculated the braking distance for concrete speeds, using the proposed tables to organize the data. After that they generalized and got a quadratic relationship. Other students had displayed graphically the obtained data and noticed that the relationship is not linear. Some groups had applied facts and formulas of physics and quickly obtained the required quadratic relationship. The teachers emphasized that the scenario was very interesting, and there was no problem in the implementation, the students were thinking independently and solving the problem. It was noticed that the group that used the facts of physics, solved the task faster than it was predicted. Therefore, instructions were added in the module so that the scenario can be supplemented with new tasks for students who quickly solve the problem.

Further observations

The students pointed out that they had more time for creative approach to the problem, they derived formula by themselves, worked in groups and collaborated more. They were solving the problem task where they used the knowledge of math and physics. They said they like the integrated model of work in math. Describing the lesson in one word they wrote: independent, collaboration, research, physics, interesting, resourceful, creative, great.

The MERIA survey shows that after this lesson, 67% of students think that math is related to real life, 63% of students think that the lesson was interesting or much more interesting than the usual lesson and evaluated it by an average rating of 4.2. Even 93% of students would like to have this lesson at least once a month, and 63% of students at least every two weeks.

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