The use of technology to motivate, to present and to deepen the comprehension of math

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Abstract
The aim of the workshop is to present and discuss several ideas which relate to technology as well as to creative teaching. Educational experience, common sense and educational research have all proven how important for comprehensive understanding different cognitive representations are. We will present and discuss several elementary mathematical ideas of which mechanical realisations mean ingenius technological inventions (for example: 'car differential' and 'digital sound technology'). Technological insights can provide deep intuitive understanding of otherwise abstract mathematical concepts and therefore yield also better comprehension of mathematics. Besides that we will use and present the technology in the form of *dynamic geometry programs* to show, provoke and motivate rethinking and deeper understanding of several elementary mathematical concepts.

Introduction

The discussion and explanations within the workshop will focus on several simple mathematical ideas which have an incredibly intuitive and useful meaning in modern technology. In each case we will start by posing real life (technical) questions which seem to have nothing in common with abstract mathematics, as we know it. While researching the problems, we will go ever deeper and closer to simple and abstract mathematical formulations. All the problems will be addressed by clear and elementary mathematics with an emphasis on the deepness of meaning that already a simple mathematical ideas can carry. In the second part we will focus on the use of dynamic geometry programs and computers in general. The technology can be used to elegantly present intuitive mathematical ideas and concepts and probably most importantly, to deepen the comprehension by different representations. Furthermore, by its technical challenges to prepare smart dynamic representations it offers enhanced awareness of the mathematical meanings. We will show some smart applets with simple and elegant outputs but with a rich array of mathematical challenges in the background, which can be an ultimate challenge and motivation for a devoted teacher.
We will gradually develop the workshop discussion and exploration adjusted to the knowledge and interest of audience along these titles and questions:

Car differential

- How is a bicycle powered?
- How is the rotation from the pedals transmitted to the powering wheel?
- How can two wheels welded to the same axes rotate and move?
- Why such pair of wheels can only move straight (on a plane)?
- How would such a pair of wheels move on an arbitrary (not plane) surface?
- How is a three or four wheel vehicle powered?
- How do we turn?
- What happens with a power transmission on the left and right wheels while turning?
- Can we explain 'the danger' of snow driving?
- And several other more sophisticated but real life questions related to the movement of a car. The discussion will get us even to a very intuitive understanding of a mathematical concept as abstract as *geodesics*. And the beauty of the whole discussion will reach its climax in the realisation that all the multi faceted meanings of our

discussion is hidden in the understanding of a simple math formula of the arithmetic mean.

Bicycle gears

- How do we shift gears on a bicycle?
- How many gears do we have? How many do we use?
- How different are the gears?
- Ordering the gears.
- Explaining 'smart gear shifting' on a bike.
- Clog's teeth ratio as gears and slopes.
- Very intuitive view of a line slope.

Car lights, satellite dish and the ancient concept of a parabola

- Classical geometrical properties of a parabola will be analysed by the use of computer simulations.
- Insights into preparation of the applets will reveal interesting elementary mathematical challenges which are no easy task even though they require only the basic math knowledge, but skill and precision, which is a true treasure of mathematical thinking.
- We will challenge ourselves to reach the same results analytically and geometrically and compare the two. Comparison will be an interesting provocation of our 'neglect geometry – promote calculus' approach.
- The abstract geometric properties of a parabola will be challenged and given intuitive meaning in a computer simulated 'parabola shaped billiard table'.
- The shape of a satellite dish will be analysed (after knowing the parabola shape ax^2, why a is not bigger, why not smaller?).

Communication technology

- Intuitive understanding of an analog and digital signal.
- How can several conversations be transmitted over one line by digital signal?
- How sensitive are human senses?
- What defines the quality of a sound?
- The idea of a sound as an intuitive function
- The idea of a discrete function
- Where is the limit? How many conversations can be squeezed into a single wire?
- Computer animated simulation of a 'miracle of transmission of several conversations through one wire'

Computer technology as a teacher of understanding

- Computer animations will be presented, where problem is understood visually.
- Simple questions like 'What is going on' will guide us through the fruitful jungle of understanding and comprehension.
- Answers to self posed questions will reveal several otherwise unnoticed mathematical meanings, which will deepen and enhance understanding.

References

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