Presenting person

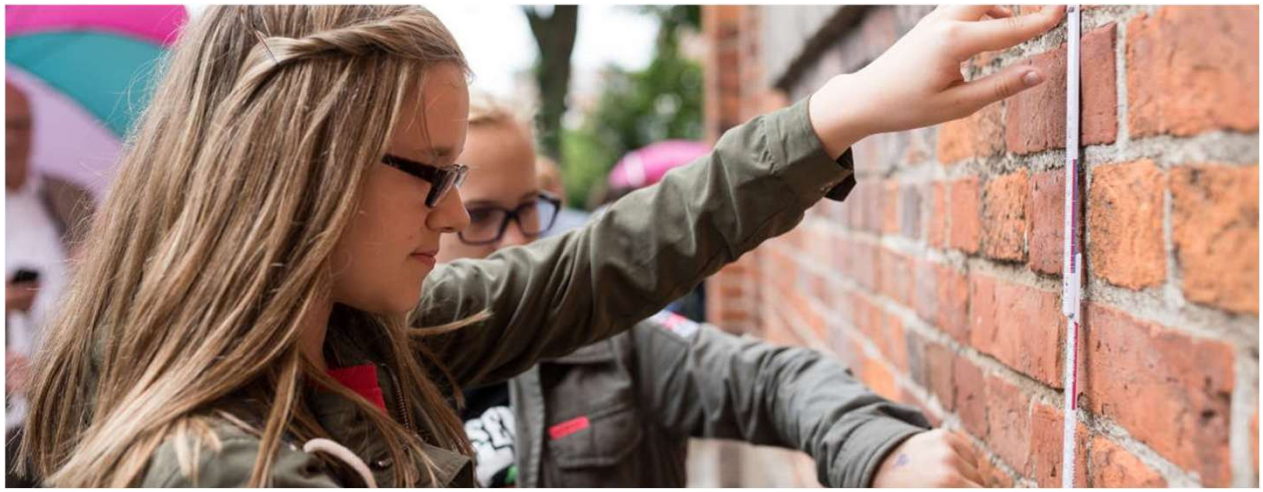
Module 3: Problem Posing

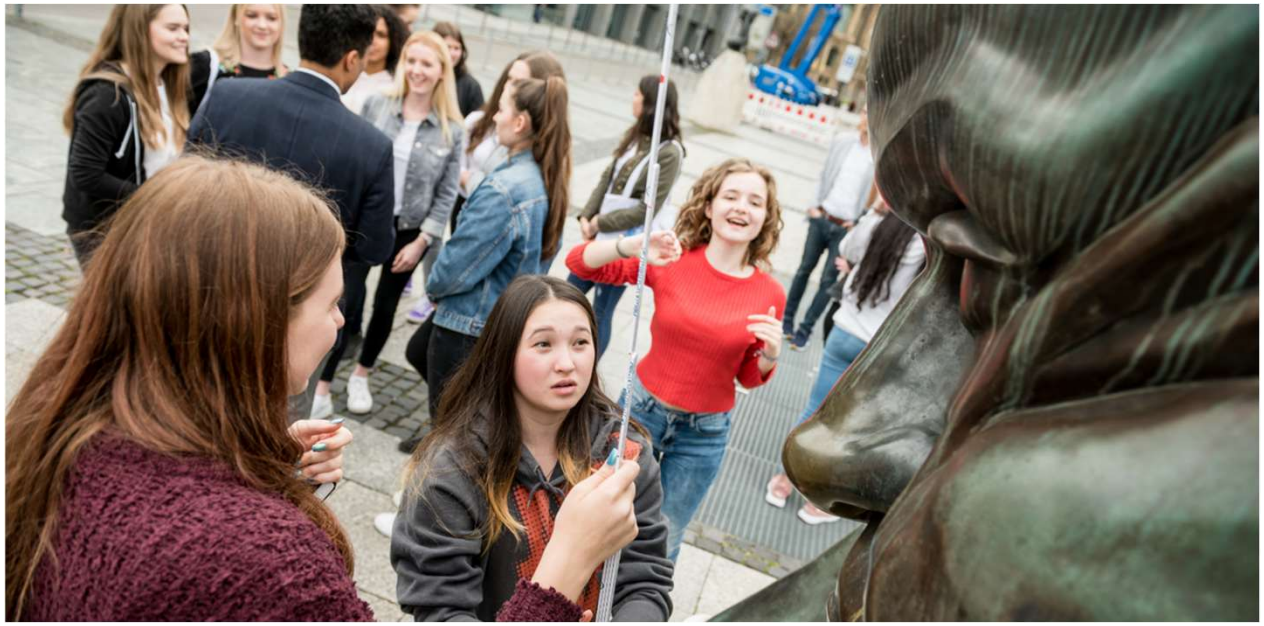
Introduction to Problem Posing

Two situations outdoors…

…students could do both:

Problem Solving and Problem Posing





"Galileo formulated the problems of determining the Velocity of light, but did not solve it. The formulation of a problem is often more essential than its solution, which may be merely a matter of mathematical or experimental skill. To raise new questions, new possibilities, to regard old problems from a new angle, requires creative imagination and marks real advance in science." (*Einstein*)

(Sarikaya et al., 2023, p.3)

Definition: Problem Posing (Hartmann, 2023)

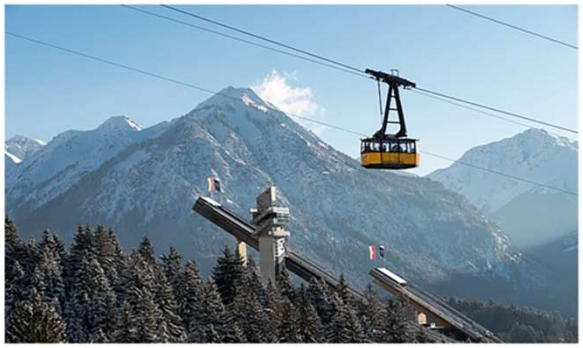
- Problem posing is a process by which students pose problems themselves or develop their own task
- Two types of Problem Posing (cf. Baumanns & Rott, 2021):
  - structured prompt: learner gets a task and reformulates/develops the task, solves the given task
  - unstructured prompt: less limitation, initial situation (e.g. description of a situation), learner should create a suitable task and solves it
- Close relation to problem solving (Sarikaya et al., 2023) and mathematical modelling (Hartmann et al., 2023)

What are your experiences with Problem Posing? Which advantages and challenges do you see?

Example (Hartmann et al., 2023)

Cable Car

For more than 90 years, the *Nebelhorn* cable car has taken numerous guests up into the heights. Now it can go into well-earned retirement. Beginning in the summer of 2021, a new cable car will transport enthusiastic outdoor fans to the Nebelhorn mountain. The aim of the project is to avoid long waiting times, provide seated transportation with an optimal view from every seat, and increase carrying capacity.



Technical data for the old cable car:

Model:	Large-cabin aerial tramway
Weight empty cabin:	1600 kg
Weight full cabin:	3900 kg
Height valley station:	1933 m
Height top station:	2214.2 m
Horizontal difference:	905.77 m
Speed:	8 m/s
Carrying capacity:	500 people/h
Power Unit:	120 PS

Pose a mathematical problem based on the given real-world situation.

What are your ideas to pose a mathematical problem here?

We will summarize your strategies!

1 Ana: We think the information included may not be sufficient for teachers. It could be useful to provide some strategies for problem posing and a few examples before inviting teachers to formulate their own tasks.
Simone Jablonski; 23.10.2025

Problem Posing Strategies
(Patsiala & Papadopoulos, 2022)

- Reversing known and unknown information
  - Answer to the original problem part of the given data; given information partly unknown
- Change the context/numbers/question
  - Problem has similar structure, but different context, numbers or question
- The answer is a method
  - Original question remains, but numerical data is left out search for method to solve the problem
- Frontless/Tailless problem
  - Only the question is retained; figure out information/method needed or question is omitted; find out what information could be used for

Problem Posing Strategies
(Patsiala & Papadopoulos, 2022)

What-if-not

- Problem‘s attributes are negated with what-if-not questions
- What would happen if these attributes were different?

What-if-yes

- Add attributes to the problem instead of removing

Advantages

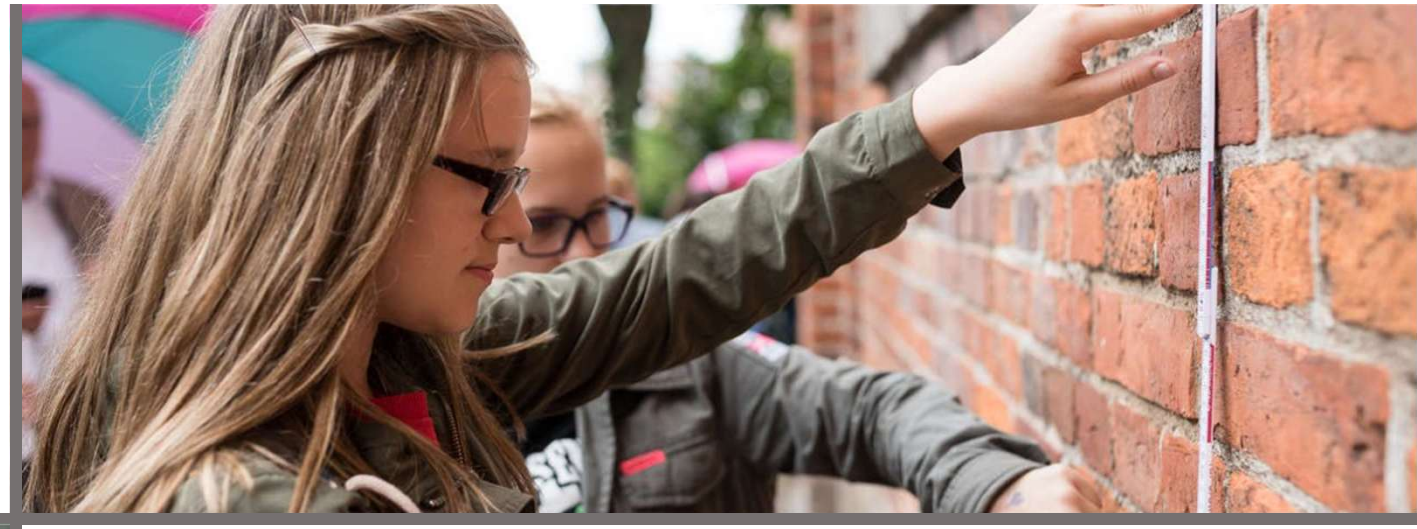
- **Flexible thinking** and **understanding of mathematical contents** (Sarikaya et al., 2023)
- Central **skill** for mathematicians (Sarikaya et al., 2023)
- Affects the problem solver's **motivation** to solve problems (Sarikaya et al., 2023)
- **Cognitive activity** through selection, understanding and translation of quantitative information (Hartmann, 2023)
- Mathematics in the **real world** (Hartmann, 2023)
- **Authentic** picture of mathematics (Baumann & Rott, 2020)

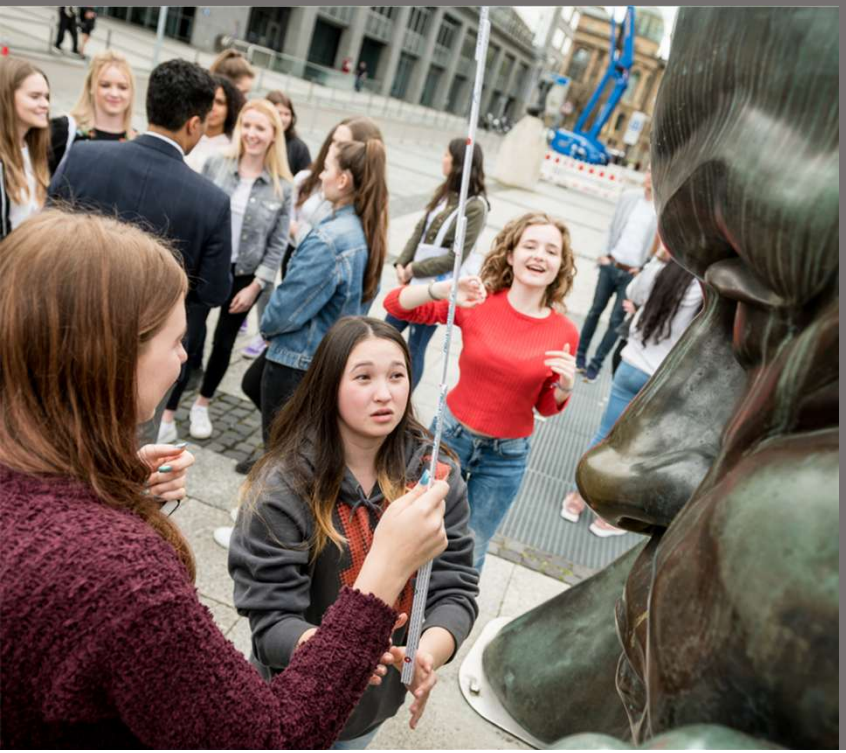
Problem Posing can be both the goal or the tool of mathematics education
(Hartmann, 2023)

Challenges

- Mainly associated with mathematical **creativity and giftedness** (Sarikaya et al., 2023)
- **Range of requirements** (Hartmann, 2023)
  - Particularly problematic for low achieving students
- **Unknown** activity to the students and less represented in textbooks (Zhang & Cai, 2021)
- Depends whether **routine** problems or non-routine problems are posed (Baumann & Rott,2020)

Problem Posing outdoors with MathCityMap





- Let students find their own tasks in the outdoor environment!
- The Student Accounts of MathCityMap will guide this learning experience ☺

Bibliography

- Baumanns, L. (2022). Rethinking problem-posing situations: A review. In: Mathematical Problem Posing. Kölner Beiträge zur Didaktik der Mathematik. Springer Spektrum.
- Hartmann, L. (2023). *Prozesse beim Problem Posing zu gegebenen realweltlichen Situationen und die Verbindung zum Modellieren*. Springer Spektrum.
- Hartmann, L., Krawitz, J. & Schukajlow, S. (2023). Posing and Solving Modelling Problems—Extending the Modelling Process from a Problem Posing Perspective. *Journal für Mathematik- Didaktik,* 44, 533–561.
- Patsiala, N., & Papadopoulos, I. (2022, February). Developing an instrument to connect problem-posing strategies and mathematical habits of mind. In *Twelfth Congress of the European Society for Research in Mathematics Education (CERME12)* (No. 13).
- Sarikaya, D., Baumanns, L., Heuer, K., & Rott, B. (2023). *Problem Posing and Solving for Mathematically Gifted and interested Students.* Springer Spektrum.
- Singer, F. M., Ellerton N. F., & Cai, J. (2015). *Mathematical Problem Posing*. Springer.
- Sriraman, B., & Lee, K. H. (2011). *The Elements of Creativity and Giftedness in Mathematics.* Sense Publishers.
- Zhang, H., & Cai, J. (2021) *Teaching mathematics through problem posing: insights from an analysis of teaching cases.* ZDM-Mathematics Education, 961-973.