



The Programming-experimenting cycle

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Introduction

Every study program in mathematics should equip students with the skills needed to understand and practice mathematics independently. Programming is one such skill that can enhance the learning process and help acquire a higher level of mathematical understanding. It makes some complex concepts accessible, it enables students to engage with challenging problems, and stimulates their creativity. However, integrating these components into a course is didactically challenging. We present in this poster a didactical model we have developed to achieve this, and we demonstrate how it can be implemented in practice.

Research & Methods

We aim to answer the following question:

Does the Programming-experimenting cycle (PEC) lead to a higher understanding of mathematical concepts?

Methodology: Compare anonymized student project reports of 2022 (no intervention with the PEC), of 2023 (PEC first time), and of 2024 (PEC improved) and see if there is a significant difference in the level of their analysis. All reports are evaluated independently using a tool based on Bloom's taxonomy of understanding.

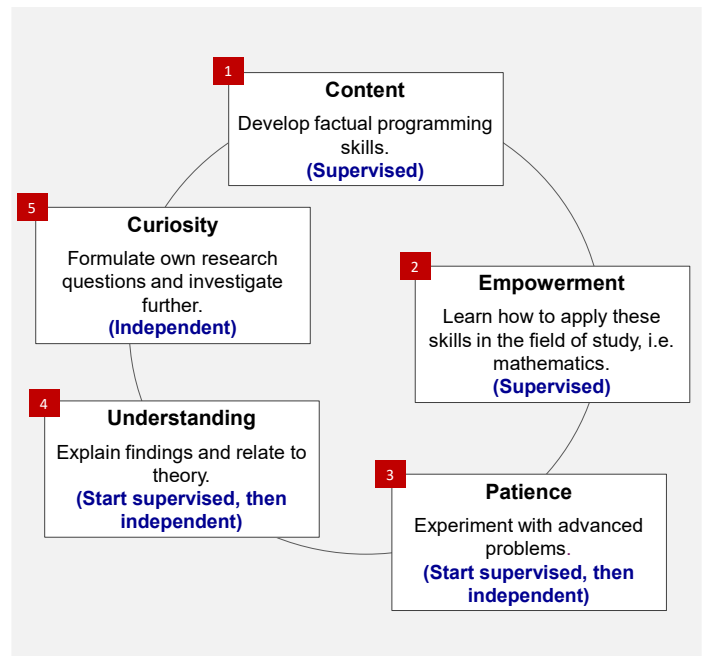
Investing in curiosity

Programming and Experimenting (first year programming course): a balance between three intended learning goals:

- Develop programming skills.
- Apply them in exploring mathematical problems.
- Engage and experiment with the mathematical problems and investigate own research questions.

A didactical model has been developed (on the right) to guide course development when both hard skills, like **programming** and **analytical problem-solving**, and softer skills, like **experimentation**, **creativity**, **written and oral expression**, must be combined.

Interplay between: factual knowledge, guided and free experimentation, language, creativity.



From a didactical model to daily practice

The educational method to realize this didactical model in the first year programming course is the *Programming-experimenting cycle (PEC)*. Such a didactical model, and a concrete learning activity to implement it, are novelties within the field of mathematics education.

Programming-experimenting cycle

Content: work individually and build programming skills.

Empowerment: how to apply this knowledge in their own field.

Patience: experiment with mathematical problems and gather data.

Understanding: explain their results in their own words.

Curiosity: formulate own questions and analyze them.

Focus

on factual knowledge and skills
developing learning strategies
structuring experimentation process
interpret findings
apply the PEC on own research questions