

# University courses for mathematically interested high school students

Peter Lesky (University of Stuttgart)

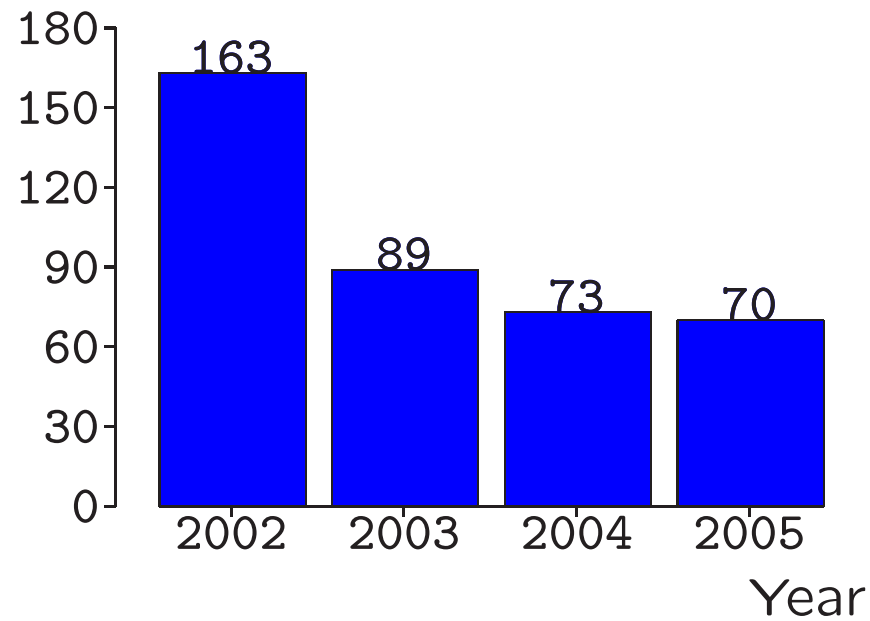
Rethinking the Mathematics Curriculum  
for Engineering and Science Students

April 29, 2006

## Students giving up their studies

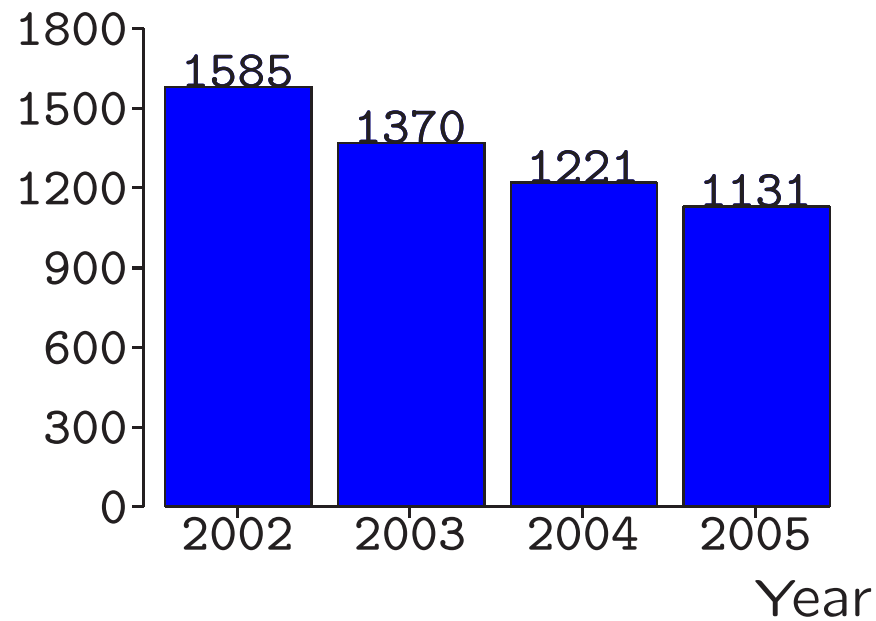
Number of students in **mathematics**, who started in 2002:

Number of students



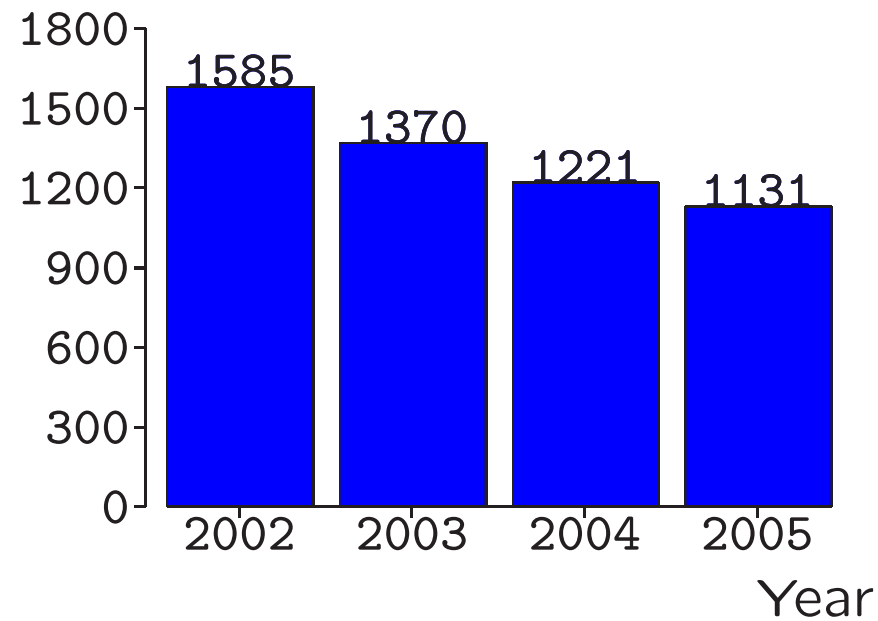
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Many of those, who have to give up their studies, fail in mathematics.

## Mathematics at high school in Germany

Good topics in mathematics:

- Basics of Linear Algebra in  $\mathbb{R}^3$
- Differentiation
- Integration
- Investigation of functions
- Differential equations

## Mathematics at high school in Germany

Missleading picture of mathematics

## Mathematics at high school in Germany

Missleading picture of mathematics

Teaching mathematics typically:

- Teacher demonstrates the solution of a problem
- In the homework the same problem with modified numbers has to be solved

## At which point can we start?

- Aims:**
1. High school students should understand mathematics, not just solving variations of the same problems
  2. Support their interest in mathematics
  3. Attract good high school students and link them to our university



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  2. Future high school teachers in mathematics.

## Our program

### Mathematics day:

- For high school students of the 7th year till 13th year.
- Program of last year:
  - Lecture: About Odysseus and Ants - the salesman problem
  - Lecture: Can elections be fair?
  - Lunch (Pizza)
  - Workshops about topics of lectures
  - Computer workshops
  - Coffee and tea
- About 50 participants.

## Our program

### Correspondence course in mathematics:

- In three groups (7th, 8th / 9th, 10th / 11th – 13th year).
- Six letters per year.
- Each letter contains:
  - Short paper about a mathematical topic
  - short internet exercises
  - written exercises
  - one or two mathematical riddles.
- Last year 125 persons got our letters, 33 of them sent us their solutions

## Our program

### Correspondence course in mathematics:

- Topics: Magic squares, combinatorics, ruler and compass constructions, mean values and inequalities, graph theory, prime numbers, Classical problems of constructive geometry, complex numbers
- Riddle: A fresh cucumber has a weight of 500 g and consists to 90% of water. After lying in the kitchen for some days, it consists to 80% of water. What is the weight of the cucumber now?

## Our program

### Seminars:

- In two groups (8th – 10th / 11th – 13th year)
- Topics: cryptography, linear systems of equations and linear optimization, complex numbers and fractals, differential equations.
- 29 participants last year.

## Our program

### **High school students attending university courses:**

The offer for exceptional students.

4 students this year.

## Future high school teachers

- Half of our math students plan to become high school teachers.
- They attend a subset of the lectures for diploma students.
- After finishing university, they get additional training at school.



## Future high school teachers

- Teaching in our seminars: Teaching real mathematics to interested high school students.
- Preparing mathematical topics for the correspondence course, grading solutions of the high school students: Get a feeling, which level is right. Learn how to evaluate the performance of a student.
- Work in small groups to learn from each other
- Seminar “Mathematics and public”

## Next project

### **Internet courses preparing for university studies:**

1. Mathematical topics of school for self studies
2. Exercises
3. Examinations for self control