



# Statistical literacy and environmental awareness: Challenges and opportunities for teaching





# Online questionnaire

- $n = 7$
- Students from Proseminar: "*Data Science*"
- **Implementation:** 04/17/2023
- Questionnaire consists of 32 statements:
  - 10 questions on statistics
  - 22 questions on the environment:
    - 7 questions on environmental knowledge
    - 10 questions on environmental attitude
    - 5 questions on environmental behaviour
- **Goal:** To obtain students' basic knowledge and attitudes about the environment and statistics

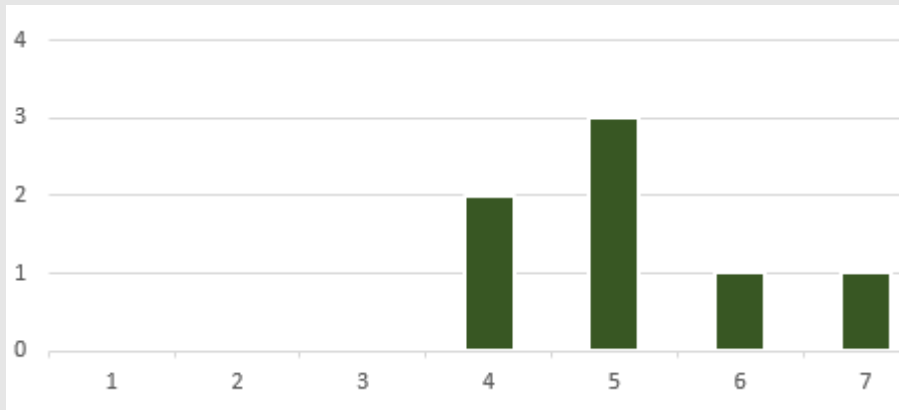




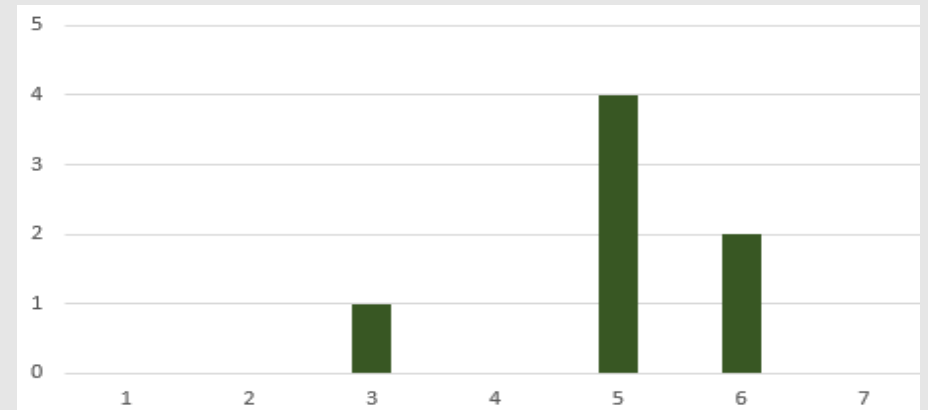
# Online questionnaire

→ Students think that statistical skills are important

As a responsible citizen, you need knowledge about statistics.



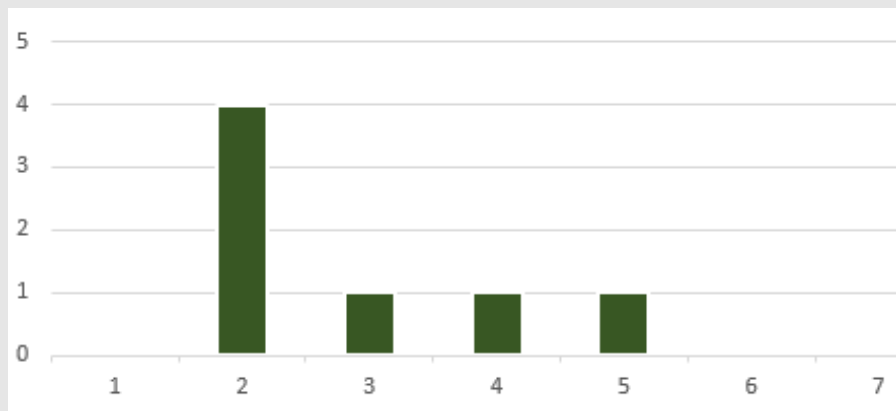
Working with probabilities and statistics play in increasingly important role in socially. The ability to work in those fields may become as crucial as the abilities to add and subtract.





# Online questionnaire

I find it difficult to extract information from statistics.



I would like to improve my understanding of statistics and probabilities.

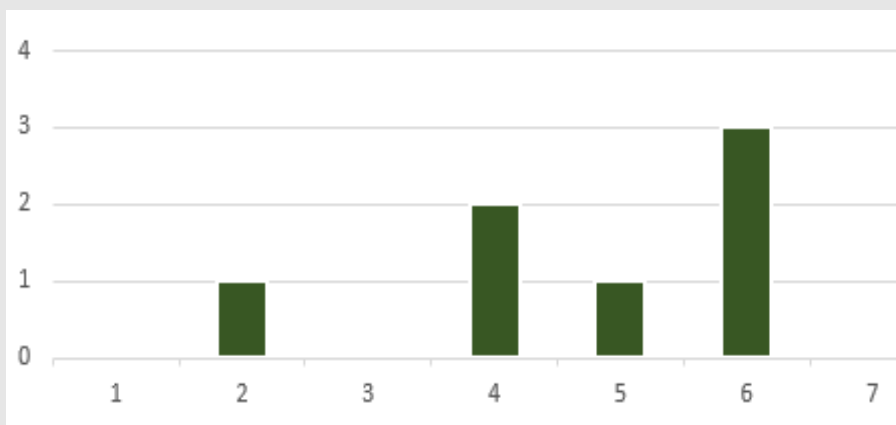




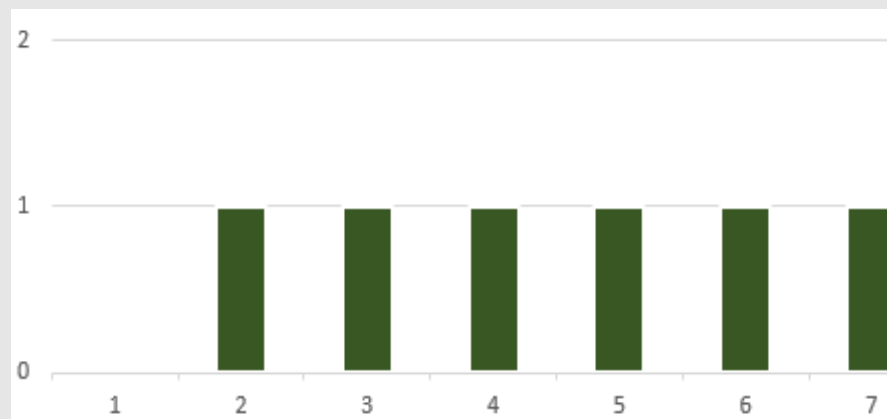
# Online questionnaire

→ Compared to the students understanding of probability, their statistical knowledge performs worse.

Statements about probability (such as the odds of winning the lottery) seem very clear to me.



I can understand almost all statistical terms that I come across in newspapers or on television.

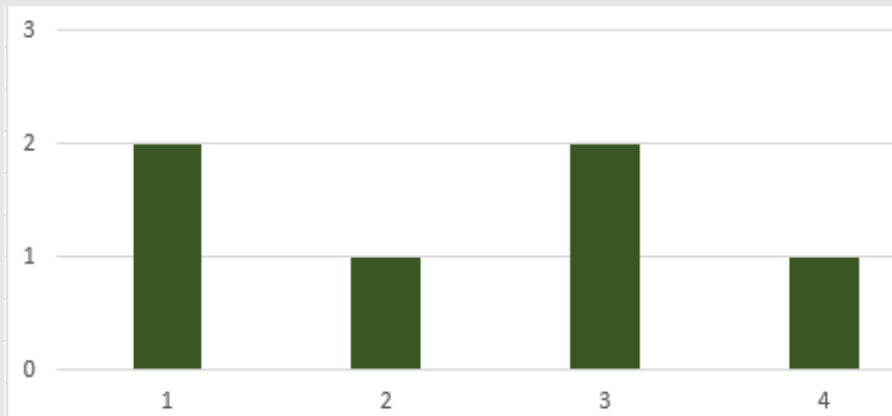




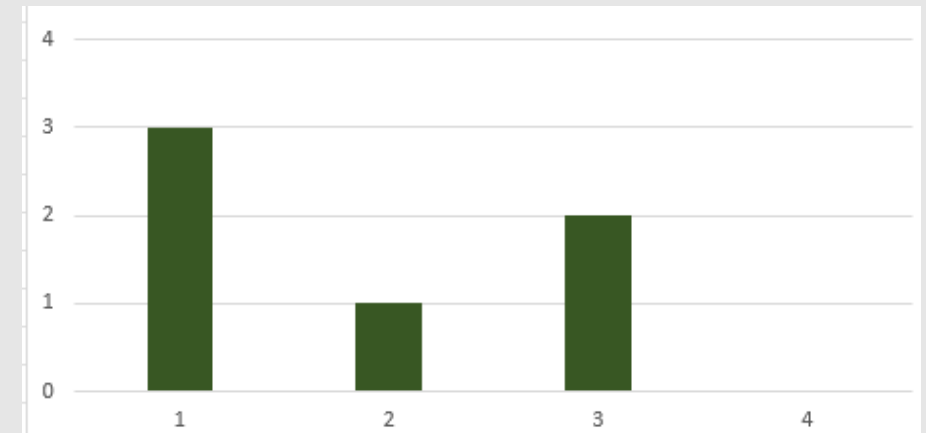
# Online questionnaire

→ Students show rather low knowledge on environmental issues.

I can explain the relationship between rising temperatures and rising sea levels.



Participating in conversations about climate change is easy for me.





## Most serious consequences of climate change:

1. Increasing temperatures / extreme weather conditions
2. Dying breeds
3. Rising sea levels

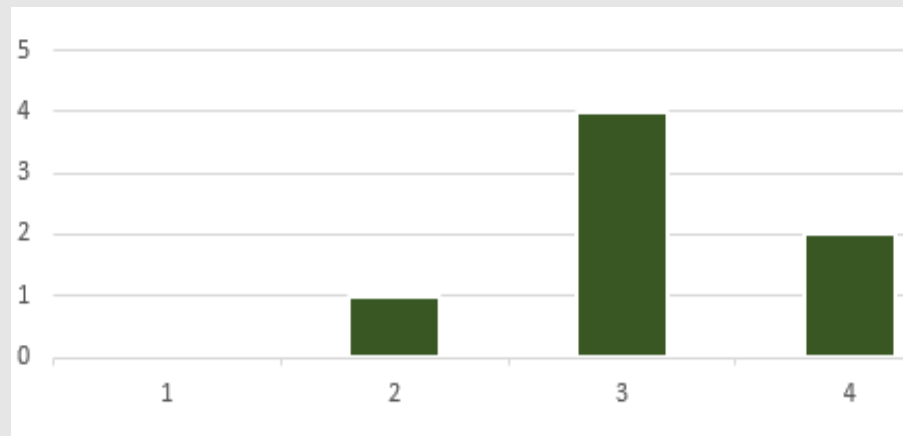




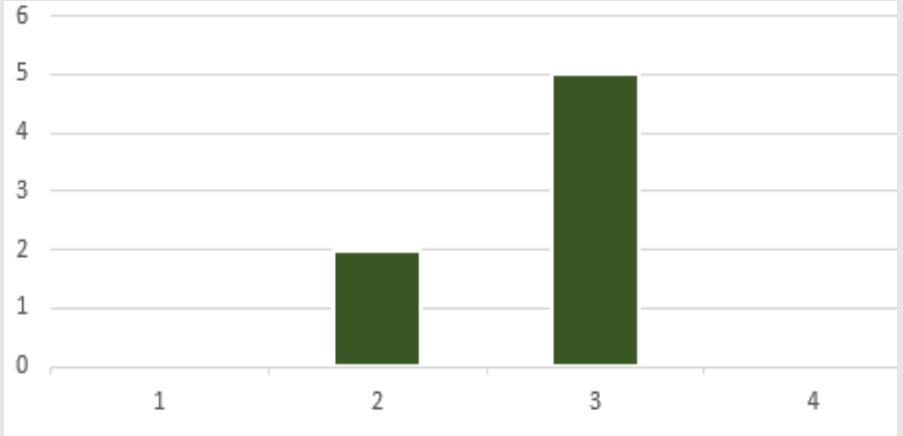
# Online questionnaire

→ Results show climate crisis worries students.

I get worried when I think about the environmental conditions in 30 years.



It angers me that too little is being done to stop climate change.

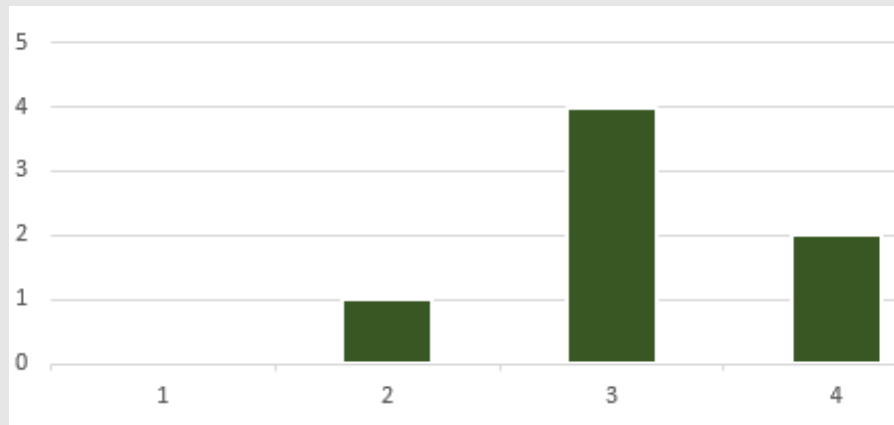




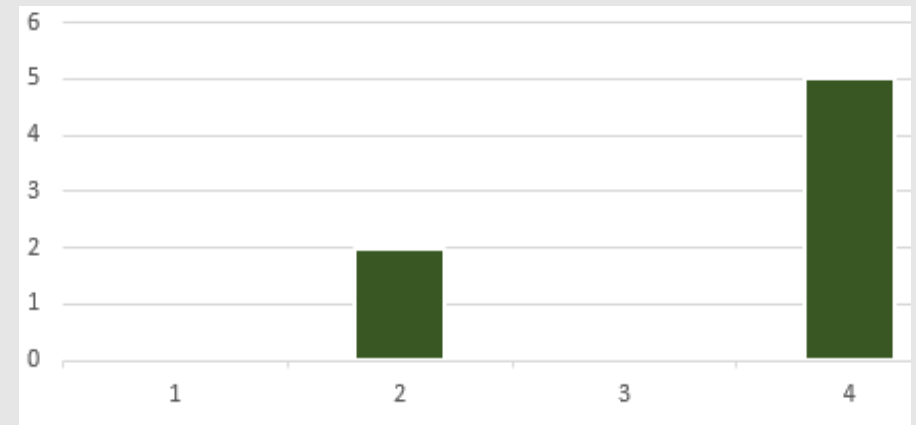
# Online questionnaire

→ Students behave environmentally friendly.

I try to contribute to climate protection with my own actions.



I separate my waste and regularly take old batteries to a collection point.





# Homework

**Key question:** Increasing temperatures in Germany over the years?





## All students recognize that ...

- ... temperatures in Germany are rising.
- ... temperatures fluctuate.
- ... in average the temperature increases by  $0.016^{\circ}\text{C}$  per year.

## Two students recognize that ...

- ... August 2021 was a colder month, but it was still warmer than the temperature in many other Augusts during the 19th and 20th centuries.





## All students can ...

... explain the term “*Ausgleichsgerade*” (line of best fit) in the context of climate change.

→ The line of best fit shows that temperatures increase at a rate of 0.016 per year in the period from 1881 to 2022.

## Some students

... used the tool “*residual squares*” and realized that more squares lie above the line of best fit.

... argued with  $r^2$





# Homework

## All students ...

... can transfer the boxplot to the given situation.

... recognize that the arithmetic mean is higher today than at times before.

- Two students chose the periods from 1881 to 1950 and from 1951 to 2002 because both periods the same amount of data.

→ They recognize that temperatures increased by approximately 1 °C.

- Today the temperatures scatter more.
- Today, extreme cold temperature conditions occur less than in the past.





# Homework

2005-> 17,89 heute; früher 16,56  
2010-> 18,29 heute; früher 16,57  
2015-> 18,89 heute; früher 16,6

- Temperatures rose by  $1^{\circ}\text{C}$  within the last 15 years.
- Conclusion: Temperatures will probably continue rising rapidly if citizens continue to not pay attention to the environment.
- A student explains the slope of the temperature with the slope of the greenhouse concentration.
- A student recognizes a negative slope at  $d = 1890$  and traces it back to the fact that in the period from 1880 to 1890 the month of August was very rainy.





# Homework

- Critical reflection of the number of data and the measurement of the data.
- Some students looked at the future: Temperatures will continue to but you have to expect fluctuations.





## Requirements:

- Dealing with numbers and sizes.
- Reading, understanding and interpreting charts.
- Knowing of the parameters of the line of best fit and including them into the context.
- Statistical parameters and boxplot.
- Contextual knowledge of global warming and climate impacts.





## Learning Goals:

- Understanding of climate changed in recent decades.
- Learning to use CODAP.
- Analyzing and interpreting data.
- Interpreting linear functions and using them for predictions.
- Formulating statistical statements with the help of statistical parameters of data.
- Understanding how measurement data can be manipulated for personal benefit.





## Difficulties:

- Understanding the relationship between temperature and time.
- Interpreting data in the scatter plot.
- Understanding, interpreting and applying linear functions to different contexts.
- Temperature rise is not perceptible.
- Texts about climate change are often difficult to understand.





# Homework

## Ideas:

- Short introduction to the topic.
- Review of boxplot, median and arithmetic mean.
- Introducing to CODAP.
- Exploring CODAP and working with it.
- Realise that people can manipulate data in texts and statements for their own benefit.
- Discussing the significance of findings for climate change and actions to take.
- Making predictions.





# Conclusion

- Heterogeneity in school
  - Students learn quickly how to use CODAP.
  - Students are aware of the climate crisis and reflect that.
- There are major differences between high schoolers and college students in reasoning and in critical inquiry.

