



Open questions - helpful tool in mathematical basic subjects like statistics?

SUMMARY: In the winter semester 2021/22 the format of the R projects in statistics was changed from standard tasks to open tasks in order to amplify the learning outcome and help prepare the students for real world problems. The reception was mainly positive, hence we will aim for a mixture of the two task types in the future.

1. INITIAL SITUATION

- ❖ Course: Statistics, Winter term 2021/22
- ❖ Study program: Computer Science, Data Science, Logistics and Mobility (all B.Sc.)
- ❖ Number of students: 8
- ❖ Learning outcomes: Students know basic concepts in statistics and are able to solve statistical problems with the help of concepts studied in this course. They are able to use the statistical software R.
- ❖ Learning activities: Lecture and exercise class where we compare homework.
- ❖ Assessment: Exam + R projects for bonus points

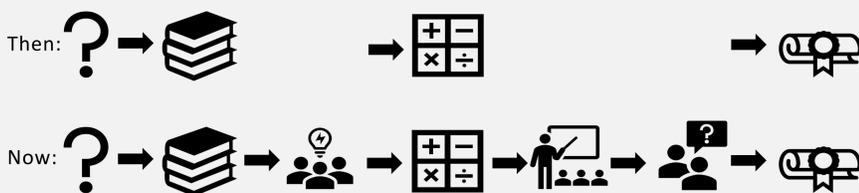
2. CHALLENGES & GOAL

- ❖ In the stochastics evaluation (summer term 2021), roughly 47% of the students stated that the R-projects were not helpful for understanding the course material.
- ❖ We aim to increase the impact of the R-projects on the learning outcome of the students by implementing open questions, mainly addressing the competence "For a given problem, the students can develop and execute a suitable approach, and are able to critically evaluate the results.", specified in the Module Manual.

3. PEDAGOGICAL CONCEPT

Our concept consists of handing out open tasks on each second exercise sheet, which the students solve in groups, using R. In the following exercise class, they present not only their results, but also their approach and reasons for choosing that particular approach, followed by a discussion.

As mentioned in [1], open questions, which allow several proceedings and do not require a schematized solution, support the cognitive autonomy of the learners and are more suitable for practicing methodical knowledge than schematized tasks. A brief example for open tasks would be to phrase the task as "Choose a suitable distribution to model the data and estimate its parameters." instead of "The data follows a normal distribution, estimate its mean and standard deviation."

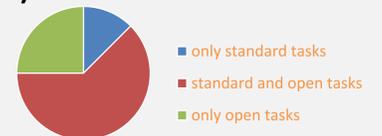


4. EVALUATION

The evaluation was carried out by means of a final questionnaire at the end, which mainly asked about the improvement of the understanding of the contents through the open questions and the comparison with standard tasks.

5. RESULTS (student's perspective)

The following responses from eight students resulted from our questionnaire.



Which variant of R tasks would you prefer?

| Statement | Strongly Agree | Agree | Neutral | Disagree | Strongly Disagree |
|---|----------------|-------|---------|----------|-------------------|
| The open R tasks of the projects helped me to understand the course content. | 2 | 4 | 2 | 0 | 0 |
| The open R tasks of the statistics projects have been more useful to achieve my learning outcome than the standard tasks such as the R project in the stochastics course or Exercise 4 on Exercise Sheet 6. | 1 | 2 | 3 | 1 | 0 |
| The presentations of the R projects by my fellow students helped me to understand the course content. | 1 | 2 | 3 | 2 | 0 |

Additional feedback:

- ❖ Encourages to think more about possible solutions and not just copy / paste something from the script / internet.
- ❖ For me the open tasks were more challenging because you really needed to dive deep into the topic [...]
- ❖ Open tasks to deep up the fun and individuality [...]
- ❖ [...] standard tasks could help to get better in the implementation [...] open tasks help to get use to the search and thinking procedure and the decision of which method fits a problem best [...].
- ❖ Only standard: Better to compare, maybe simulate exam problems better

6. REFLECTION (teacher's perspective)

- ❖ The presentations lead to interesting discussions which also gave us the opportunity to detect and address gaps in the students' knowledge.
- ❖ Our sample of students is too small to draw solid conclusions.
- ❖ The students were already used to R projects. Without prior knowledge in R, the mixture of learning R and mathematics may be too hard.
- ❖ The workload concerning correction was diminished, since their presentations were the assessment.

7. CONCLUSION & OUTLOOK

In contrast to standard tasks, more open tasks seem to support a deeper understanding of a subject, which is especially helpful for students with advanced knowledge. Standard tasks are more suitable for the introduction to a topic. Therefore, we plan to use a mixture of guided and open tasks to cover both aspects in the future.

8. REFERENCES

[1] Staatsinstitut für Schulpädagogik und Bildungsforschung München (1999): Offene Aufgabenstellungen. Available [here](#). Verified: 10.03.2022

