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The Data Case Study

A Teaching and Learning Method for AI education in schools

In order to incorporate the teaching of data concepts and practices into AI education, we recognize **two key needs**.

First, to support teachers, we need to provide them with tested, proven teaching approaches for real school settings.

Second, in order to create these teaching materials, we need to understand the mechanisms that effectively support learning data concepts and practices in real school settings.

RQ 1+2

What challenges should be considered to fruitfully implement the data case study in CS lessons on the topic of AI?

How can the data case study be adapted to address the identified challenges and meet the objectives of CS education on the topic of AI?

CHALLENGES

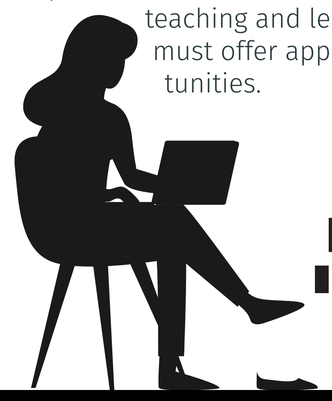
Subject-specific challenges
Students have little to no prior or competence in CS and data analysis areas.

Generating and maintaining motivation and engagement is challenging when teaching data literacy and data science topics to school students.

Domain-specific challenges
To assess the plausibility of a dataset or to interpret the results in context, domain knowledge is required.

Design challenges
Searching for a dataset and preparing it is a time-consuming task. We confirm this for secondary level education.

Educational goals
Meaningful communication among students is a central educational means and goal. Hence, the data case study as a teaching and learning method must offer appropriate opportunities.



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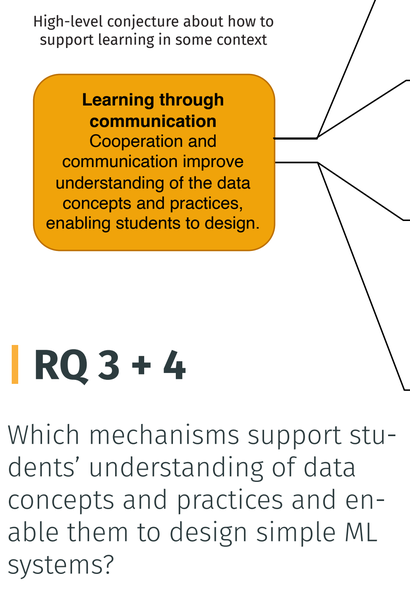
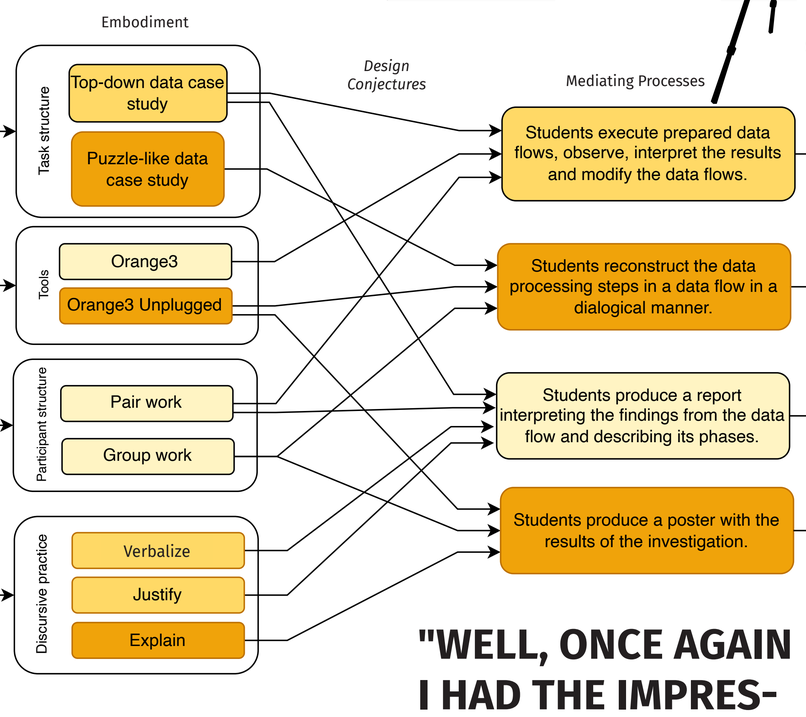


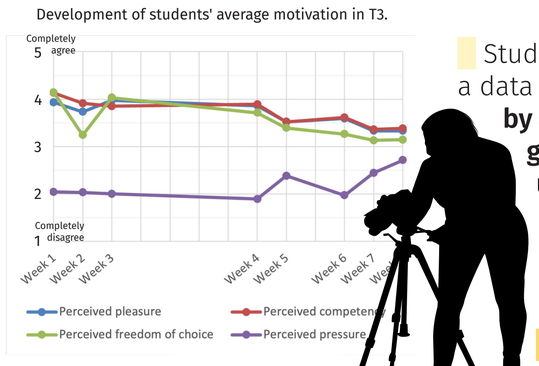
High-level conjecture about how to support learning in some context

Learning through communication
Cooperation and communication improve understanding of the data concepts and practices, enabling students to design.



In all three cycles, we observed that the students were dedicated to work on the data cases. According to the teachers, the students showed endurance and engagement.

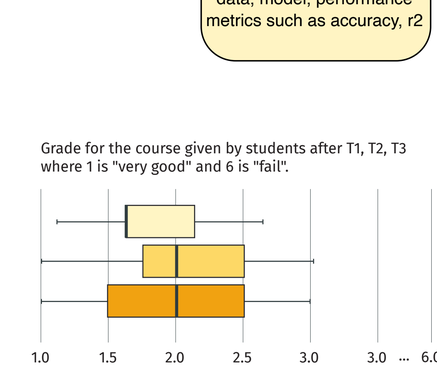
"WELL, ONCE AGAIN I HAD THE IMPRESSION THAT EVERYONE WAS ACTUALLY WORKING AND PARTICIPATING" (T3W2INT2).

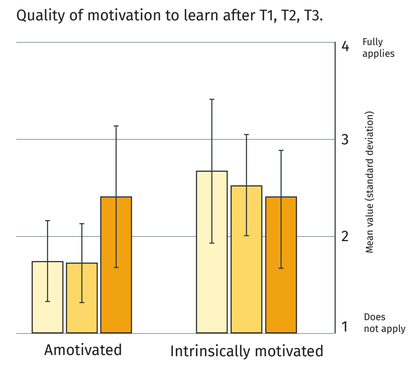


Students were able to create a data flow for a given context **by correctly ordering the given widgets** and articulating the results. Roughly half of the students created **complex data flows.**

Students were able to adequately use practices related to data understanding and preparation. The use of practices related to ML algorithms was error-prone. The **data flows** were **much less complex** as in T1.

A **third** of the students were able to create their own **data flows without guidance**. Most students created simple data flows. Those who could not create a functioning data flow could still allocate elements from the data flow to the actual data flow, and some could articulate errors. Compared to T1 and T2, we observed more difficulties and misconceptions about data concepts and practices.





T3

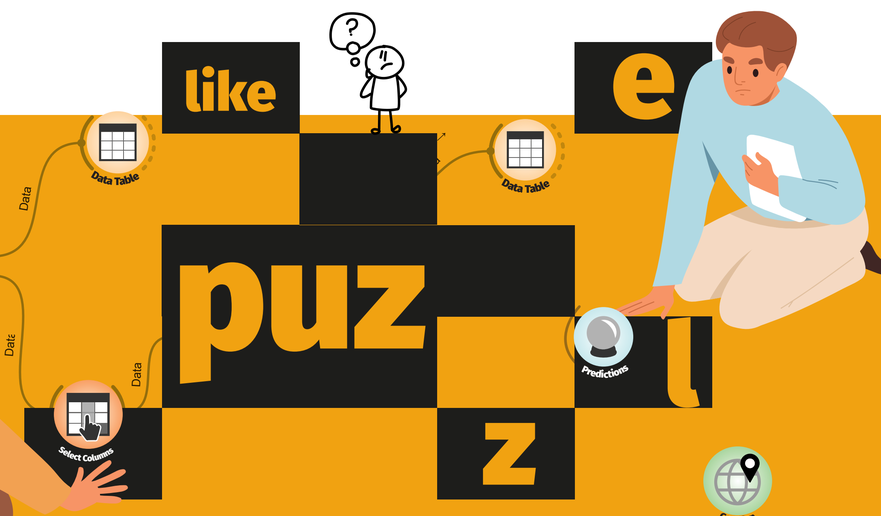
HOW TO

Students start with several puzzle pieces (widgets, tables, and templates for configuring the widgets) for a given context and **work backwards** to determine the underlying data flow and **reconstruct** widget configurations. During the reconstruction process, they intuitively discover elements that are essential for debugging data flows (e.g. amount of data entering and leaving a widget).

CHALLENGES

Students report perceiving the process as difficult.

We observed students stuggling. Did they learn more?

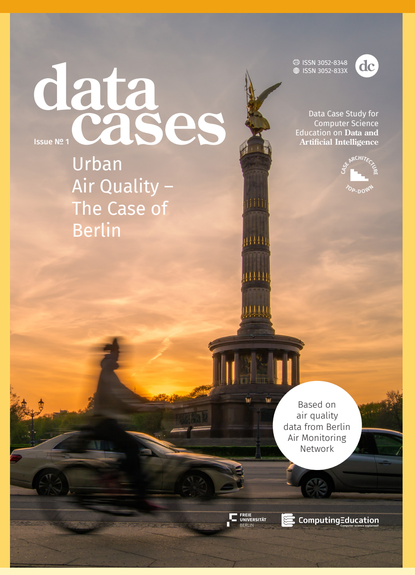


The overemphasis on concepts with many pen&paper activities significantly impacted the motivation.

HOW TO

Students are given a complete data flow and instructed to trace selected data practices and concepts in prepared scenarios and evaluate them according to criteria.

STEPS: (1) describe and interpret the results of the data flow and compare them with intuition, (2) examine intermediate steps and reflect on their significance in the data flow, and (3) identify phases in the data flow.



CHALLENGES

T2

(1) Some students had difficulty understanding the data flow concept. "One group did not understand how the connection [...] between the widgets works, that the data flows from one widget to the next" (T2W5)

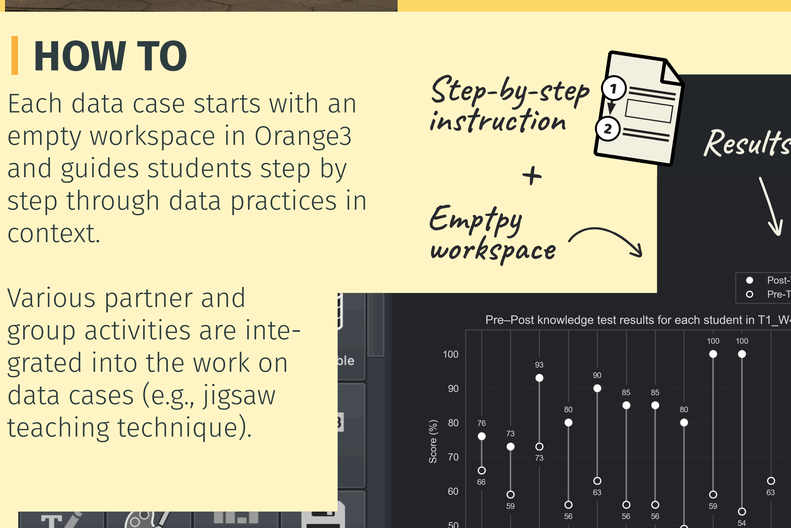
(2) Students lacked debugging strategies: "For example, they also had problems with doing this data discovery [...]. They lack debugging strategies" (T2W5)

(3) Still relevant: Data cases offer few opportunities for discussion: "Where I really need to say something to someone else, where I really (...) get into a real conversation" (T1W3)

HOW TO

Each data case starts with an empty workspace in Orange3 and guides students step by step through data practices in context.

Various partner and group activities are integrated into the work on data cases (e.g., jigsaw teaching technique).



T1

CHALLENGES

The necessary overemphasis on the operation of Orange3 in the first cycle caused more important skills to be neglected, such as reflection on the process and the transition to the abstract level.

"This idea that I have to incorporate knowledge from previous tasks into the new task is difficult for me as a student" (T1W3)

ARCHITECTURE