



Technische
Universität
Braunschweig



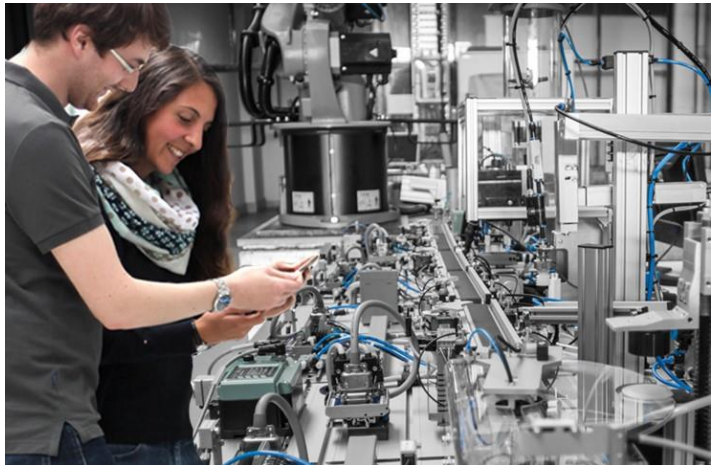
Federal Ministry
of Education
and Research



Introducing AR in factory-related engineering education in the project ILehLe

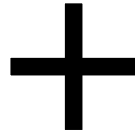
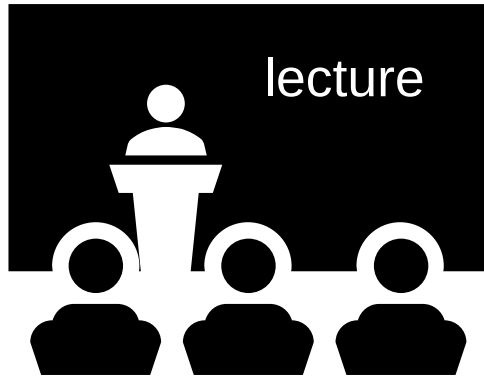
Nine Reining, Bastian Thiede, Frank Höwing, Christoph Herrmann, and Simone Kauffeld
5th International AR VR Conference Munich | June 14th, 2019

Project ILehLe: The Intelligent Teaching-Learning Environment

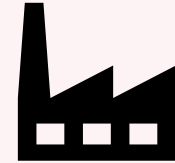


Sponsored by the **Federal Ministry of Education and Research of Germany** within the framework “Bringing technology to the people”, a research programme on human-machine interaction.

Learning factories in engineering education



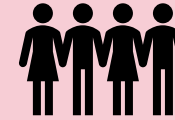
team
project



problem-based
task

Learning factories in engineering education

- students learning with a learning factory in addition to lectures have a **significantly higher increase in professional and methodological competences** than students learning only with a lecture
(Aymans, Horn, & Kauffeld, 2018)



team
project



Lernfabrik TU Braunschweig (WF)

Learning factories in engineering education

- practically oriented learning environment
- aim: develop broad variety of competences
- learning factory at TU Braunschweig focuses on energy and resource efficient manufacturing
- **“Experience lab”**: a physically scaled modular model of a real factory process chain
→ offers realistic processes and scenarios



Lernfabrik TU Braunschweig (WWF)

Learning Factory is located in the Research Lab

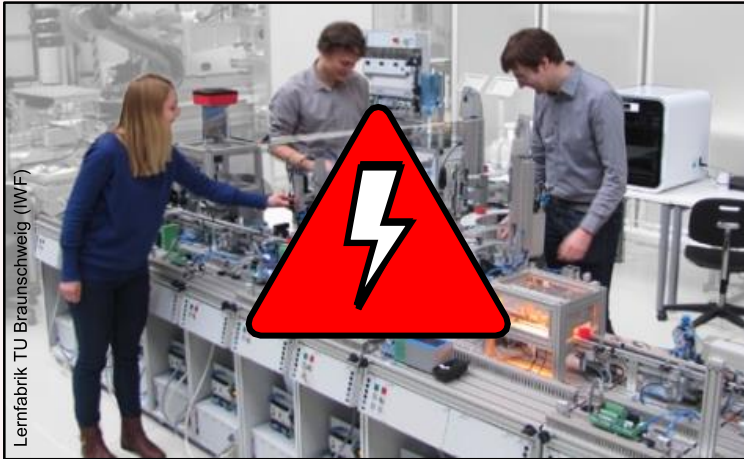


- real factory environment
- all dangers and safety issues of any shop floor

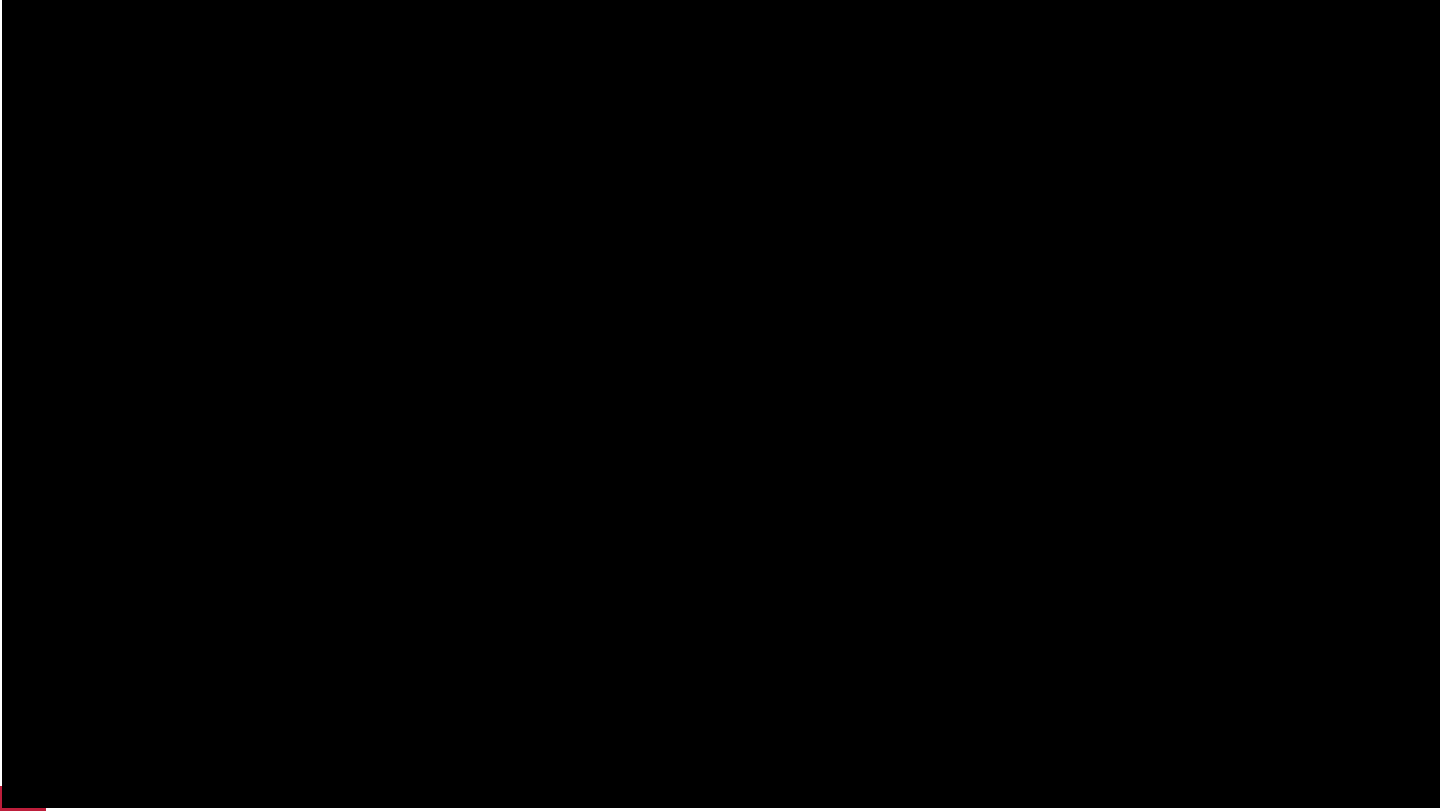
Augmented Reality



team
project

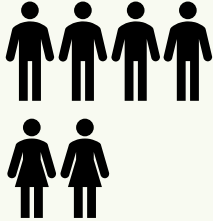


- **AR safety instructions**
(both shop floor and learning factory)
- **AR introduction** to the learning
factory
- technology:
 - Google Tango
 - handheld devices (Smartphone)

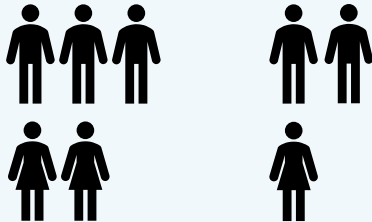


Studies

usability

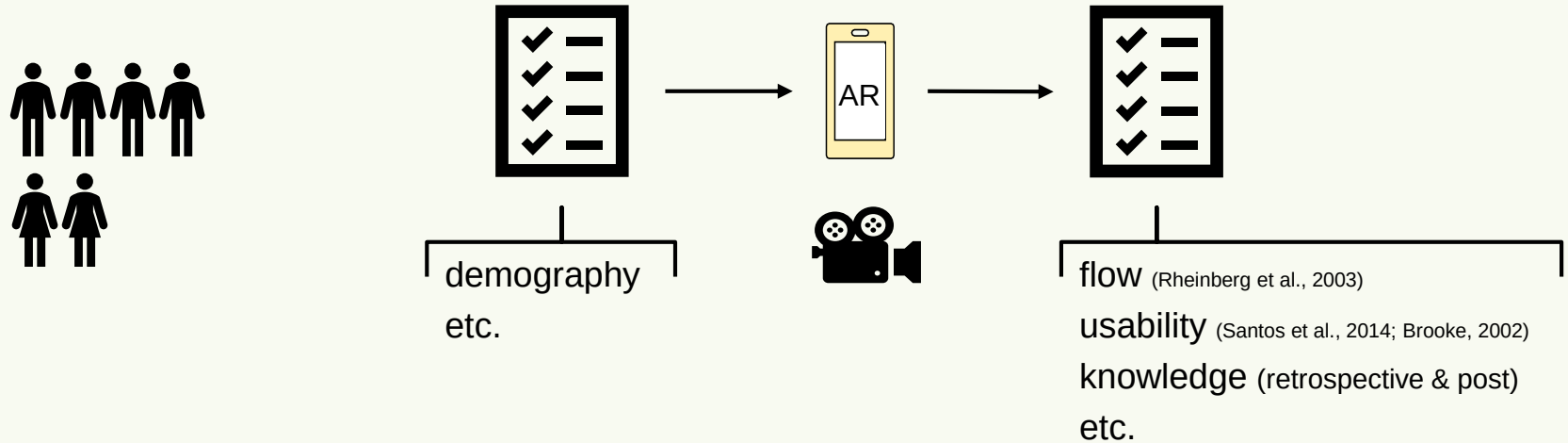


AR vs.
tablet



- engineering students from the master lecture
- voluntary participation
- never worked at the experience lab or in the research lab before
- no incentives
- no negative consequences

Study 1: usability



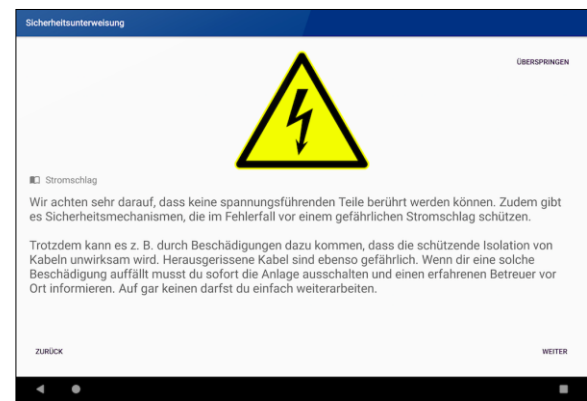
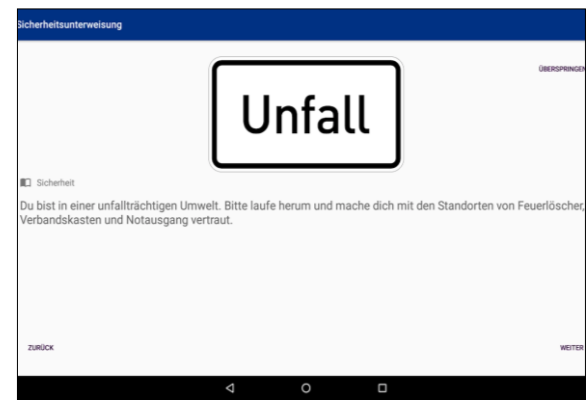
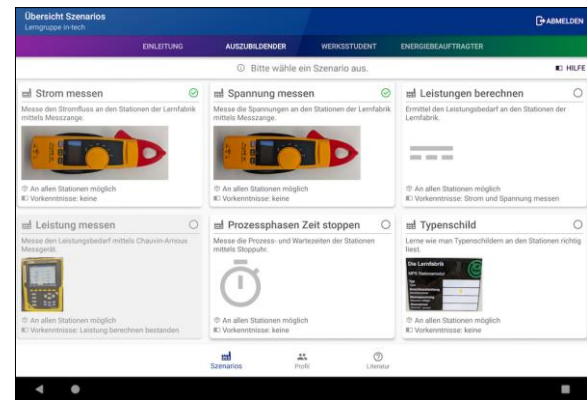
Study 1: results (selection)

- + trading is very sensitive
- + orientation in space is good → supports well
- + coloring is intuitive: emergency = red, other = green
- augmented elements are too real looking and cannot be distinguished from the real world
→ wish: make augmented elements more distinguishable (e.g. emphasize signs brighter so that it is clear that it is AR)
- AR is perceived as distracting, as the environment is rather ignored while searching for further AR elements

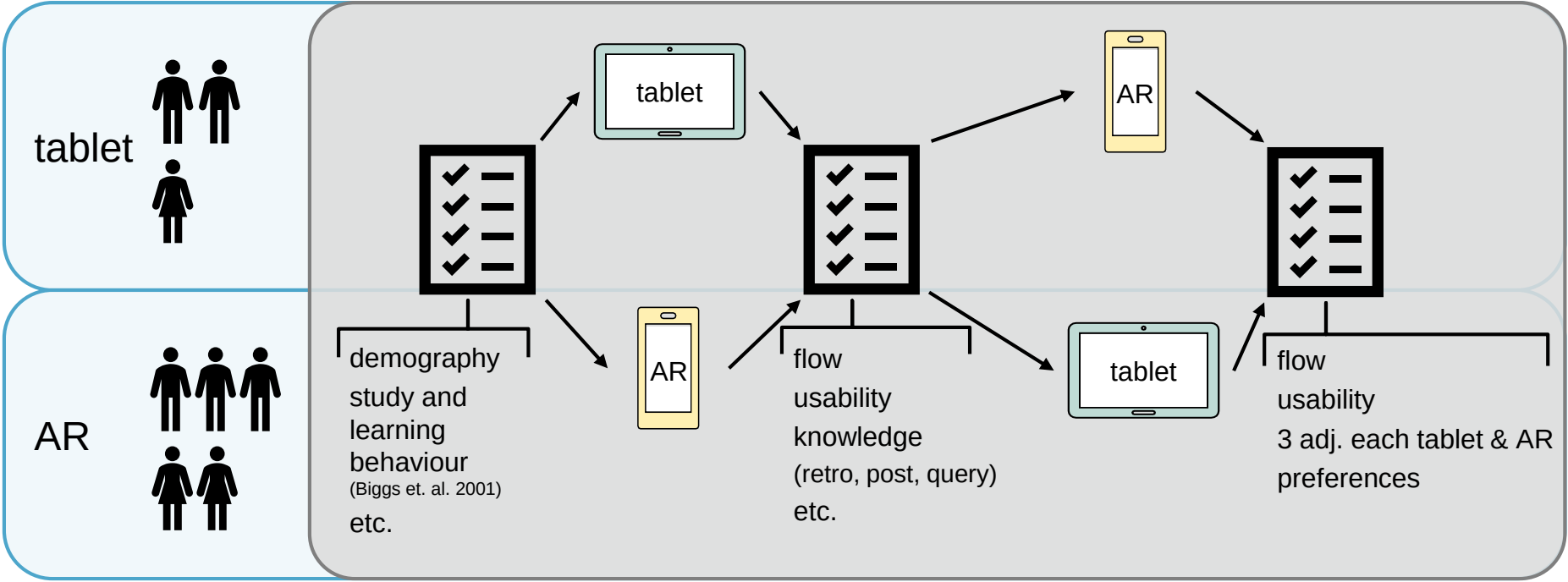
Augmented Reality



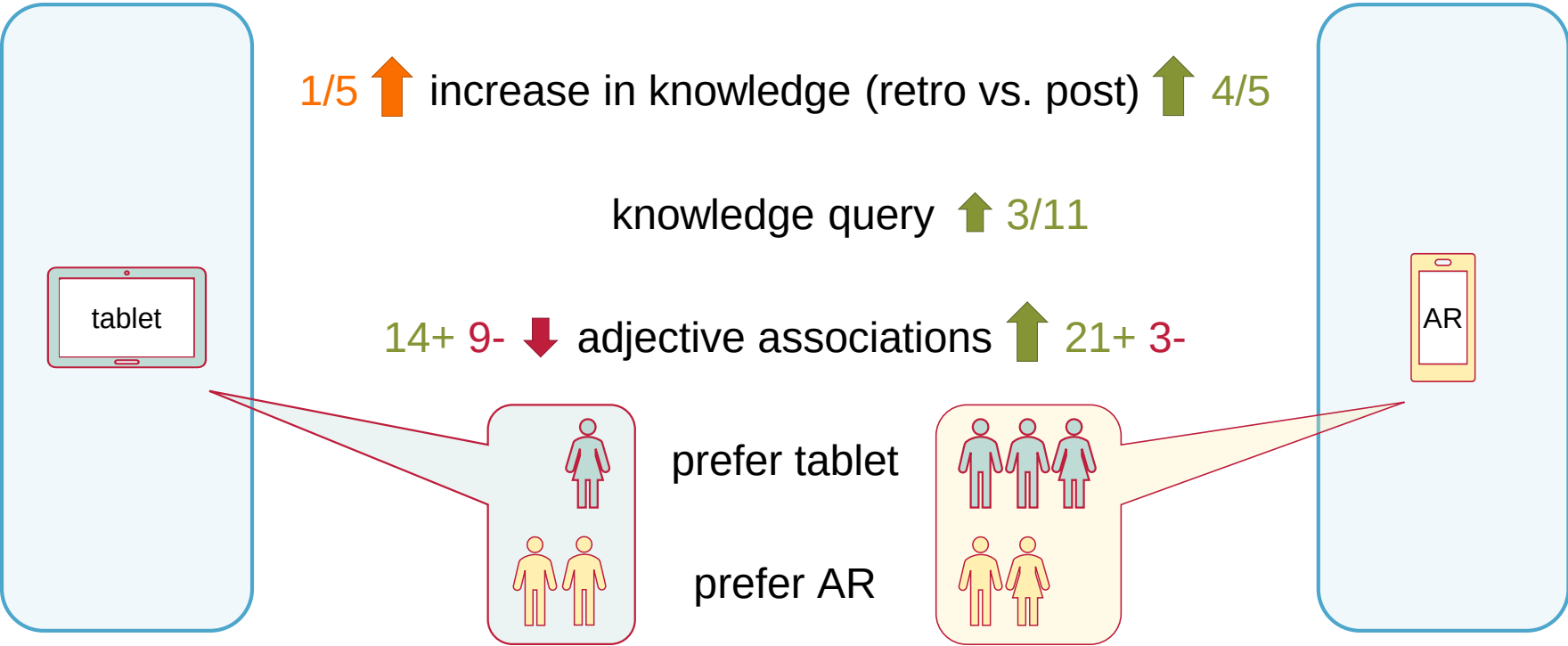
Tablet application



Study 2: tablet vs. AR



Study 2: descriptive results



Study 2: results preferences – AR preferred

- + “With a distance description one is shown where what is located. One is not as disoriented as with the tablet app.”
- + “In the AR application, you become personally active so that the learning content is effectively received.”
- + “The localization of different security-relevant objects is crucial and is improved by guided searches with the AR application.”
- + “By walking around and looking at the screen, the stations of the factory can be viewed much more closely. It is more fun and therefore more motivating to learn in a playful way. But you are very distracted and concentrate only on the screen.”

Study 2: results preferences – tablet preferred

- “In the AR application it was clearer which items were meant, but the focus was more on finding the items than on the information.”
- “Due to the familiar operation of the tablet app, I felt that it was easier for me to absorb information.”
- “I am familiar with the use of a tablet and can concentrate fully on the content of the learning material.”
- “The AR application is a bit confusing. With the tablet you know exactly what to do in which step.”

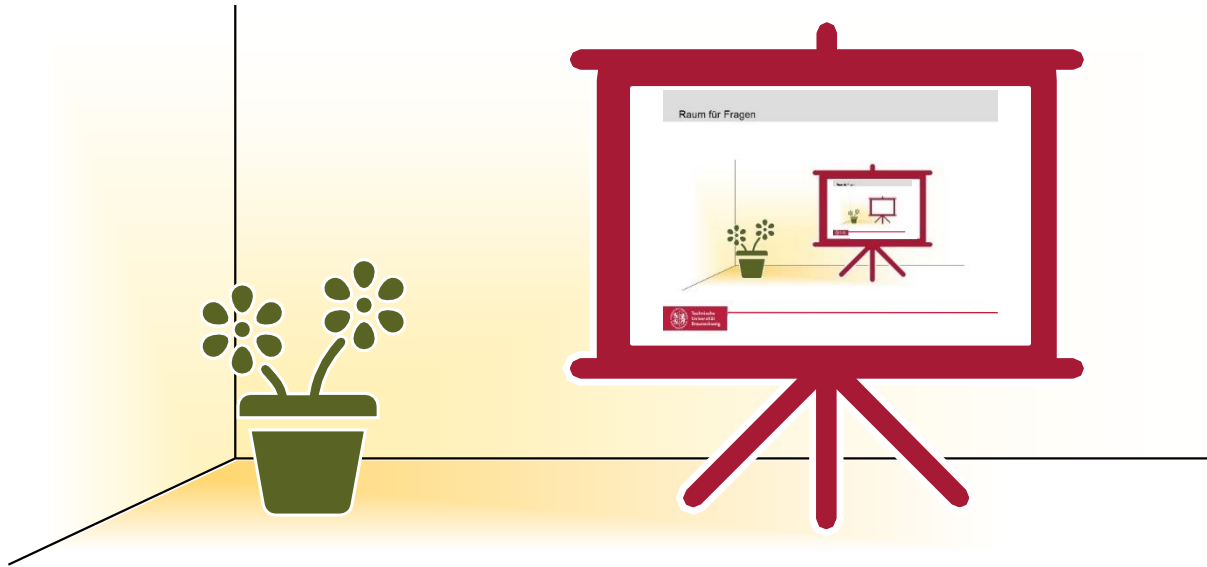
All eight participants of the study indicated that they would have preferred to have the learning content taught by a lecturer rather than via AR or tablet.

→ They want to be able to ask questions and hear side stories.

Our learnings

- AR via **handheld device is easy to use** for students without being introduced to the technology.
- **tunnel vision**: AR concentrates attention on learning content/screen, while the surrounding environment fades into the background.
- The additional visual impressions of AR can be **exhausting/overwhelming** for students.
- The **most real looking** AR elements are **not always the best choice in learning settings**. → students want to be able to distinguish between augmented and real world

Room for questions





Thank you for your attention.



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