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Cognitive Load During First Contact With Mixed Reality Learning Environments

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Quelle: Eigene Darstellung

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Research Question & User Study Design

What influence does Mixed Reality (MR) have on cognitive load and how should MR Learning Environments be designed accordingly?

- Verbal instruction and brief explanation of the interactions.
- Experiment with physical enlarged playing dice in the natural environment.
    - Task 1: Position the dice on the marked areas.
    - Task 2: Turn the dice so that the number six points upwards.
    - Task 3: Position the dice according to the template. Pay attention to the dice numbers as well.
- Questionnaire 1: Cognitive Load and Spatial Awareness.
- Interview 1: Difficulties during the performance and prior knowledge about digital realities.
- Experiment with virtual enlarged playing dice in MR.
    - Task 1: Position the dice on the marked areas.
    - Task 2: Turn the dice so that the number six points upwards.
    - Task 3: Position the dice according to the template. Pay attention to the dice numbers as well.
- Questionnaire 2: Cognitive Load and sense of presence.
- Interview 2: Difficulties during the performance and a comparison between both runs.

Collected Data

- Two semi-structured interviews
    - Difficulties
    - Prior knowledge
    - Comparison
- Two Questionnaires
    - Cognitive Load
    - Spatial Awareness
    - Sense of presence
- Thinking Aloud
- Eye-Tracking
    - Direction of view
- Audio recording
- Mixed Reality capture

Results, Discussion and Future Work

The study has so far been carried out by ten participants, each of whom has successfully completed the tasks. The total amount of cognitive load is reported with an average of M = 3.00 (SD = 2.00) in the non-MR run and M = 6.20 (SD = 1.32) in the MR run, according to the nine-point scale of Paas et al. Thus, the cognitive load roughly doubles with high significance when switching from physical to virtual dice even though the participants already know the tasks in the MR run. On the seven-point scale according to Klepsch et al., the participants indicate their cognitive load on eight additional items so that intrinsic, extraneous and germane cognitive load can be determined. In all three types cognitive load increases but the differences are not as expected.

After the second run using virtual dice, the participants report several challenges and few technical problems. The main aspect that has been named is the unkown handling of the Head-Mounted Display used (Microsoft Hololens2). Although the basic interactions are basically known after the verbal instruction, the implementation of the possibilities in the virtual environment seems to be difficult at first. At the same time, participants report that the interactions became easier and easier the more practice they had.

In order to investigate the reasons for the results in intrinsic, extraneous and germane cognitive load it is necessary to systematically analyse the qualitative semi-structured interview data and the audio recordings of the Thinking Aloud method with regard to problems and difficulties encountered. This data can then be used to evaluate why the expected increase in extraneous cognitive load compared to intrinsic and germane cognitive load is lower than assumed.