Explore and Experience:
Mobile Augmented Reality fo Medical Training

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In medicine, the use of real patients in courses often leads to ethical problems and concerns.

These problems are especially evident for subjects such as legal medicine:

- Survivors of crimes would be re-traumatized if they were integrated into classes.
- Without real cases, the quality of education potentially suffers.

Possible workaround: (mobile) simulation of the desired cases based on augmented reality with mARble®.
Mobile Augmented Reality

Real world

Augmented Reality

Marker

triggers

Virtual object
mobile Augmented Reality blended learning environment (mARble)
Please define the characteristics of an entrance wound

Features of entrance wounds: circular skin defect, abrasion rim or collar, presence of soot soiling, powder tattooing, stippling, etc.
6.2.2 Einenschwärze

Preliminary Evaluation – Study Design (RCT)

RQ:
1. Learning Efficiency?
2. (User-) Experience?
3. Emotional State Change?

n=10  3rd year medical students, f:4, m:6:
Results on Learning Efficiency

Before learning period

After learning period

10 SC-Questions, pre-tested on comprehensibility, solvability and time consumption and item analysis on difficulty, item discrimination, and item selectivity (pre- and post-randomization).

Stratified for the learning method, the improvement in the results is higher in the mARble group with 4.7 questions ($\sigma=2.9$) as within the control group with 3 questions but with smaller dispersion ($\sigma=1.5$).

The difference in improvement within the mARble®-group is statistically significant (Wilcoxon, $Z=-2.232$, $P<0.032$).

Difficulty: $P=0.768$ ($\sigma=0.09$)
Discrimination of $rpb=0.2$
Results on (User-) Experience

In comparison to the **pragmatic quality**, the textbook performs better than mARble. The difference is however statistically insignificant (M-W-U, Z= -1.616, P<0.110).

Regarding **identity aspect** mARble performs significantly better than the textbook (M-W-U, Z= - 2.825, P<0.005).

In regards to the **stimulation aspect**, mARble performs much better than the textbook. The difference is statistically significant (HQ-S (M-W-U, Z=-6.506, P<0.0001)).

This results in a difference in the recognition of the **attractiveness** (ATT (M-W-U, Z=-5.179, P<0.0001) that is in favour of mARble, too.
Results on Change of Emotional States

When comparing pre- and post-tests, the mARble® group showed a statistically significant decrease of fatigue ($Z=-2.214$, $P<0.027$) and numbness ($Z=-2.07$, $P<0.038$); vigour rose slightly. Irritability did not increase significantly. In the control group, there were no significant changes.

Due to the low sample size, the results were carefully interpreted. mARble has an activating impact on the user without any irritating effect on her. Also, the assumed irritating content (gun shot wounds) was not disturbing to the study population of medical students.

Validated instrument: POMS (Profiles of Mood States) used to determine the emotional state of the participants (McNair et al. 1981).
Conclusion

1. There was an increase in learning in both methods.

2. Both methods compared, mARble® showed a statistically significant better improvement in learning. **Efficient!**

3. The pragmatic quality of both methods was rated average by the users.

4. mARble® is rated very attractive by the users compared to the textbook, also its hedonic quality is rated significantly stimulating. The same goes for the hedonic quality identity. **Attractive!**

5. Compared to the textbook, mARble® reached significantly higher ratings for vigor, and less for numbness and fatigue while there is no indication for irritation in both learning methods. **Activating!**

→ The described method to evaluate a mobile AR learning environment in the respect of usability, experience and emotions proved suitable and will be applied for a large sample size.

The MC-test quality should be improved, hence the relative low difficulty with an acceptable item discrimination.
Effects of Mobile Augmented Reality Learning Compared to Textbook Learning on Medical Students: Randomized Controlled Pilot Study

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Thank you very, very much!

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