Photography and mobile gaze-tracking

Exploration of student's perception of mathematics

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Photography and mathematics

We conducted a teaching unit based on Dewey's theory of art, aesthetics, and experiences (Dewey, 1958), and photographer Barnbaums' writings (Barnbaum, 2014). A camera helps noticing details and, through photography, students experience mathematics in everyday life in a way that they will remembered and connect in a meaningful way. We developed a photography activity in outdoor conditions as a part of an in-service mathematics teacher course. To study the impact of the activity on students' visual attention, we used mobile gaze-tracking for two students (Meier, Hannula, & Toivanen, 2018).

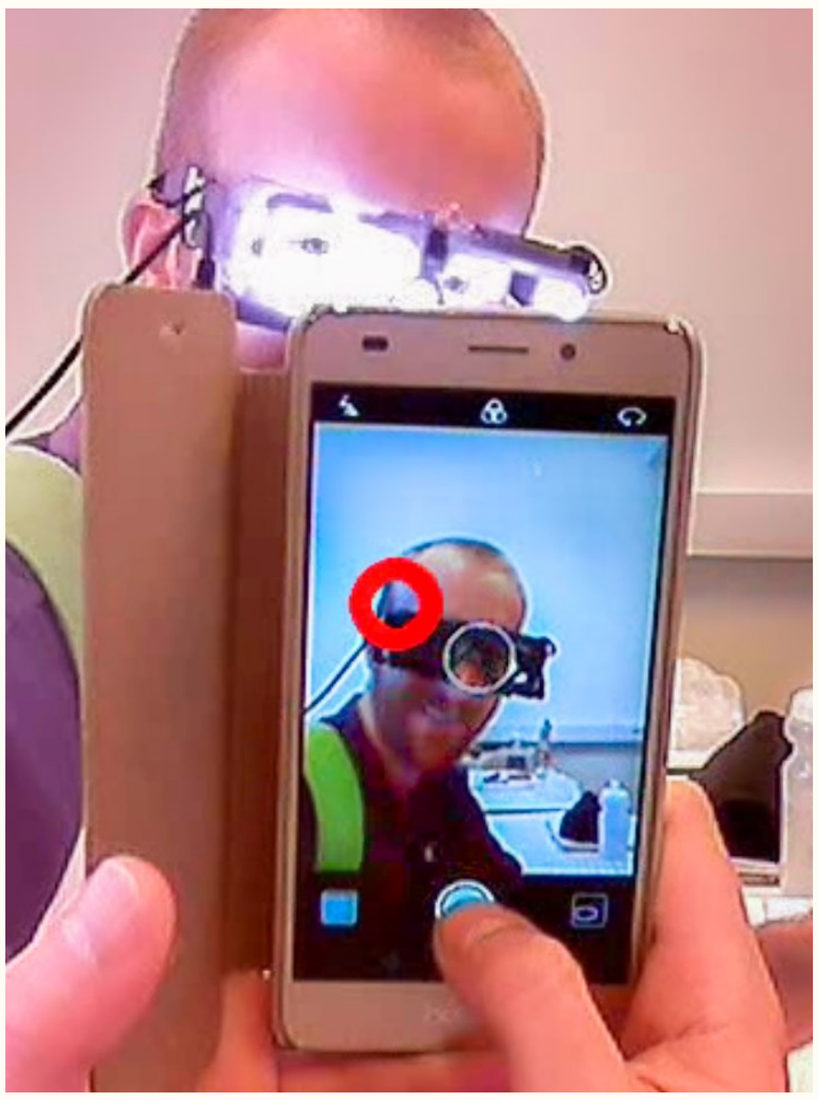
Mobile gaze tracking outdoors

We used the mobile gaze tracking device developed at the Finnish Institute of Occupational Health (Toivanen, Lukander, & Puolamäki, 2017). In addition we used audio, a recall interview and a pre– and post survey.

We did our research in an unstructured outdoor environment and not in a controlled laboratory. The bright sunlight caused some **challenges** to the gaze tracking, such as

- un-typically small pupil size,
- extra reflections on the eye images,
- possible saturation of the eye image,
- squinting of the eyes due to the bright light.

We chose a shady path and the participants wore caps . In the analyse we had to adjust computational parameter for smaller pupil size.

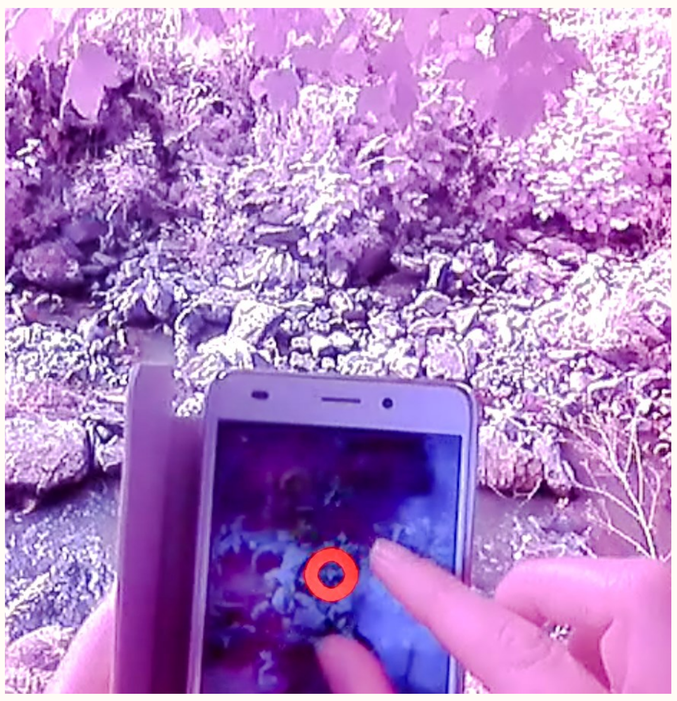


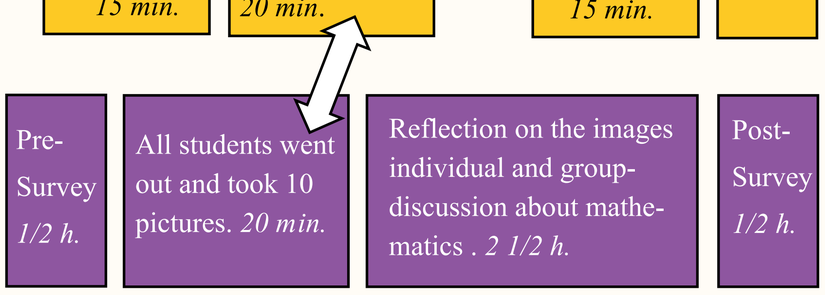
Procedure

The structure of our five hour teaching activity was designed to let the students observe and discuss mathematics out-of-school in depth.

After a pre survey they were given the task to "find mathematics", take ten pictures with their mobile phone and discuss the mathematical content and value for mathematics education.

The gaze-tracking students went out for three walks, one in the beginning (without a task), one during the photography activity and one after the activity.





Results

Analysis of the gaze data for one student showed that during the third gaze walk he had his attention much more frequently and somewhat longer times on objects which were discussed or photographed in comparison to other possible objects.

Discussed/ photographed			Not discussed/ not photographed		
Object	**Number of dwells (f)**	**Average dwell duration (s)**	**Object**	**Number of dwells (f)**	**Average dwell duration (s)**
Car	52	0.48	Fence	11	0.42
House	49	0.85	Stairs	3	0.63
Lamp post	24	0.29	Motor-cycle	5	0.36
Tree	22	0.79	Cycle rack	5	0.30
Win-dow	11	1.43	Leaf	2	0.31
other	39	0.48	other	9	0.46
Total	**197**	**0.63**	**Total**	**33**	**0.41**

The gaze on windows had a long average dwell duration. In the recall interview he told us that they were quite interesting as mathematical objects. The gaze-tracking video alone does not give explanations, so it was important to have the recall interview afterwards.

Additional observation: During the first walk, the students looked at objects only for a short time and in the later interview they did not remember what they had been looking at. The importance of visual information (video record) for the process of remembering was obvious.

Conclusions

- The photograph activity seemed to have an impact on the number and average duration of dwells on targets.
- The activity seems to provide a good learning experience and to help students see with "fresh eyes".
- Without the gaze videos, students do not recall what they have looked at. This highlights the importance for gaze-tracking as a method.

Referanses

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