Individual Assignment, Research Methods

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Introduction

This method paper reflects on the approach of earlier done research on a new application of FireFlies2, which are interactive tangible pixels that can be distributed over the classroom [2]. The objects can be used by the students to set a specific colour based on his/her decision. Within the scope of this research two existing decision moments were defined. One during the explanation phase 'join the explanation or work independently' and during the work phase, 'individual or open for collaboration'. These two decisions are treated as case-studies to analyse how a peripheral visualization of (past) decision making can stimulate the self-regulating behaviour of students. These findings were used to answer the following question: *"How can a peripheral visualization of (past) decision making stimulate self- regulating behaviour of students in the lower-classes of secondary school?".* This paper reflects on earlier found conclusions and discusses possibilities for future research.

Method

The research was situated in the lower-classes of secondary schools in the Netherlands. The user study lasted three weeks and took place in three different classes of one school. Each class had two hours per week of a certain course, during these hours each student received a FireFly to indicate his/her choices for the explanation- and work phase (figure 2).

Figure 1: FireFly 2.0

Figure 2: setup regular classroom

	N	*Mean*
Start	80	3.5819
End	84	3.3970

Table 1: Reflection Scores

	N	*Mean*
Start	80	2.9672
End	84	2.9926

Table 2: Self-monitoring Scores

Data was gathered using a mixed method approach consisting of multiple methods. Semi-structured observations took place both during the intervention period and one hour per class before the intervention.

Next to this each student was asked to complete a survey both before and after the intervention period. Both surveys consisted of nine closed questions, five concerning reflection and four on self-monitoring. Both were based on a validated questionnaire: Self-Regulation of Learning Self-Report Scale (SRL-SRS) [1]. All questions were reformulated in such a way that the answer could be given on a five-point Likert scale ranging from (1) strongly disagree to (5) strongly agree.

Next to these nine closed questions, the before-survey consisted of three open questions. One concerning the current decision moment during the explanation phase, one concerning the current decision moment during the work phase and one question about reflecting on the relation between behaviour and learning. The final-survey had four open questions about the reflective ability of the students on both their actions and the aspect of 'past' decision making.

Finally, a one-on-one interview took place with two teachers to discuss his/her experiences and possibilities for the future. The input from this last part of the interviews was not used to answer the research question but did gave interesting insights on future FireFly2 applications.

Analysis of data

In order to evaluate the self-regulating ability of students in a quantitative way a within subject analysis was conducted. The closed survey questions on reflection were used to calculate a 'reflection score', which is the mean of all given answers per student (table 1). In a similar way a 'self-monitoring score' was calculated based on the last four questions (table 2). To compare both groups an independent sample test has been conducted, a significant difference in reflection score before and after the intervention has been found; $t(162)=2.11$, $p=0.037$. On the other hand no significant difference was found on the self-monitoring score before and after the intervention; $t(162)=-0.208$, $p=0.836$.

Next to these statistical analyses, a thematic analysis has been conducted on the qualitative data gathered by the open questions of the final survey. All answers were treated as quotes and clustered per question. The number of quotes within each cluster was reported together with the cluster names to indicate the relevance of that finding.

The data gathered during the open questions at the start and the semi-structured observations were mainly used as an input for the teacher interviews. Furthermore, they served as a point of reference to make sense of the behaviour and context of the target audience.

Ethics procedures

Before implementation both students and teachers received an explanation on the research purpose and study set-up. However, the exact goal of the intervention was not explained to the students, since this could influence their behaviour and increase the chance on desired answers. The teacher did receive this explanation beforehand since their behaviour was out of scope. After the intervention period a more elaborate explanation was given, and student had the chance to ask questions. The devices did not store any data and did not track anything else than the colours that students could consciously set themselves. Finally, all involved teachers worked with fixed floorplan which allowed for student specific data without hurting the anonymity of the students.

Confidence in Conclusion

Overall the findings showed mainly positive experiences from both students and teachers on an interaction level. The aspect of peripheral visualization is valued mainly by teachers. The design of the FireFly2 created an ambient display that allowed teachers to register the decisions made by their students in one glance. This functionality was especially valued by teachers during the explanation phase. In a similar way the 'alone/ together' indication could function as an ambient display for students during the work phase. However, within the given timespan, there were no evident signs of student recognizing this signal from fellow students.

On an intervention level the findings imply that the visualization of decision-making stimulated awareness of the existence of those decisions. Both the quantitative and qualitative findings showed an effect on the self-regulating behaviour of students in the lower-classes of secondary schools. It is unlikely that the self-monitoring ability of students was affected, but very likely that there was an effect on the reflective ability. The self-reported score for this attribute did decrease, but this can be interpreted as a sign of more critical thinking. Overall the given timespan is too short to recognize any long-term changes. More research is needed on both the aspect of critical thinking and the durability of triggered behaviour changes.

Future Possibilities

Different than expected the self-reported reflection level decreased during the intervention period. A plausible explanation for this decrease is an increased critical attitude. However, the used methods did not directly analyse student's critical attitude. Possibly a different verified survey could be used to verify this assumption. Furthermore, semi-structured interviews could be hosted with small groups of students to get a deeper understanding of their behaviour. The qualitative data that was gathered via the open survey questions did lead to a high quantity of rather flat data. The advantage of interview questions over survey questions is the possibility to ask follow-ups based on the answers of the students. As an interviewer you can trigger the interviewees to come up with examples to explain what they mean or go deeper into the why.

Next to these more incremental improvements it would be interesting to host new case studies in different classes on other schools. Preferably schools where the students have more freedom to make decisions on the way they study. In the current case-study there were only two binary decision moments, which obviously limits the self-regulating behaviour. The timespan for these new studies should be longer than three weeks. Usually each class has only a few hours per week and there are many irregularities (e.g. tests, guest lectures, illness). During this new study it would be interesting to do in moment data-gathering whereby the FireFly2 could serve as a trigger for recording. However, this act of recording their thoughts/ behaviour during the intervention period is a new influence on possible findings. The recording in itself is a new way to trigger reflection and thereby possibly improve self-regulation. Therefore, the findings of the two case-studies could not easily be combined or compared.

References

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