Using an interactive whiteboard combined with an electronic learning environment in mathematics: practice, perceptions and effects on intrinsic motivation and learning achievement
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Introduction

In the Netherlands the use of Interactive Whiteboards (IWB) is spreading slowly. (Pennings, Esmeijer, & Leendertse, 2008). It is expected that at least one IWB will be available in every school in secondary education by 2011 (Kennisnet, 2009). In contrast, the use of an Electronic Learning Environment (ELO in Dutch) is rather common in Dutch secondary education. About 50-75% of the teachers in secondary education uses an ELO on a regular basis. Students and teachers are enthusiastic about the potential of these digital technologies that provide opportunities to make education more flexible and interactive (Kitchen, MacKenzie, Butt & Finch, 2006). Moreover, students' motivation and learning achievements seem to increase when digital technologies are used (Becta, 2006).

This paper focuses at one secondary school in The Netherlands, that uses an IWB combined with an ELO for Mathematics. Math lessons with use of the IWB are filed on the ELO which students can access in their own time. The paper describes both teachers' and students' use and perceptions of this combination of ict-tools, as well as its effects on students' intrinsic motivation and learning results on Math.

Design

A quantitative study was conducted in order to investigate the effects on students' motivation and learning achievements in Mathematics. In a quasi experimental setting, with a control and experimental condition, a series of four measurements was carried out over a period of two years (first year N=286 and second year N=849). Motivation was measured with help of the Scale of Experience on Mathematics (Martinot et al, 1988), that measures students' efforts for Mathematics, perceptions of pleasure and relevance of the course, and anxiousness (in relation to tests etc.). Learning results were measured by school tests on Mathematics. A fifth measurement was carried out with students in the experimental condition only. This group of students (N=183) additionally answered questions about their use of and perceptions on the combination of the IWB and the ELO in the context of Mathematics. Logfiles from the ELO provided information on the frequency and nature of students' use of the ELO.

A limited qualitative study (interviews with teachers and students) was conducted to gain insight in students’ and teachers’ use of and perceptions on the IWB and the ELO.

Results

Students and teachers are enthusiastic about the use of IWB in Mathematics. Teachers report more efficient ways for instruction and they experience more involvement and interaction of students in the classroom. Students like the use of IWB; they find the lessons more captivating. Moreover, the longitudinal analysis of students' motivation shows consistent evidence that students become motivated by the use of IWB.

Students evaluate the ELO as moderately positive. They like the combination of both digital technologies. When IWB-lessons are provided through the ELO, students can look it up anytime, which makes them feel more secure and results in better understanding of the subject-matter. Motivated students evaluate the IWB and the ELO more positive then less motivated students. Perceptions were not related to learning achievement of students. The frequency of ELO-use was not related to students' motivation or learning achievements. However, we did find differences between students in the nature of ELO-use. For example, test-files on the ELO were used more often by less motivated students; information from the IWB was used more often by motivated students, and students in their final exams.

A striking result is that students seem to adjust their method of working deliberately when they are sure that information from the lessons will be available at the ELO. Students who make fewer notes during the lessons, in order to pay more attention to the instructions of the teacher, indeed use the ELO later to look...
up the information from the lessons. Students who suppose to remind the instructions better if they make their own notes, keep making notes and use the ELO less often.

**Discussion**

This study focuses on the combination of an IWB and an electronic learning environment used together in order to make math teaching more interactive and engaging for students, as well as effective in terms of learning results. Students appear to be and stay more motivated; however, no positive effects on learning results could be measured. One explanation is that both teachers and students need to get used to working in such new digital environment for a longer period. Our study also revealed that it is important to use especially the ELO in a consistent way students know and can predict. Then, they are able to use the ELO optimally. One limitation of our study is the fact that the combination of IWB and ELO needs both technical and pedagogical support within schools which may be difficult to organize.

**References**


Keywords: Interactive whiteboard, Electronic learning environment, Perceptions, Effects on motivation