Lernanto:
An Ambient Display to Support Differentiated Instruction

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Abstract: This paper presents Lernanto, an ambient display designed for secondary school classrooms, aimed at supporting teachers in challenging each student at his or her own level, i.e. differentiated instruction. Lernanto displays real-time information about the progress of each individual student such that teachers can perceive it at a glance during their lessons.

Keywords: peripheral interaction, ambient display, classroom technology, classroom orchestration

Introduction
Today’s classrooms are characterizing by a growing diversity among students. Classes tend to increase in number of students, while at the same time there is an increasing social emphasis on and appreciation for excellence. Teachers are therefore encouraged to challenge each student at his or her own level, i.e. differentiated instruction (Ysseldyke and Tardrew 2007). Addressing this trend, adaptive educational software that adjusts its learning material to the individual student is being introduced in various schools. When using such software, students are thus working on different exercises depending on their level. This raises new challenges for teachers (Ysseldyke and Tardrew 2007): they have to divide their sparse time and attention without having a clear overview of the current progress of each individual student. Particularly in secondary schools, where teachers provide lessons to multiple different classes and thus to up to hundreds of students, it is difficult to be aware of individual levels and needs.

Lernanto aims to support teachers in providing differentiated instruction and structuring teamwork by leveraging data from (adaptive) educational software. This paper presents Lernanto’s design and discusses the evaluation setup of an in-progress field study.

Related work
Most (adaptive) educational software includes a “dashboard” (e.g. www.knowre.com), which displays the real-time performance of each individual student by means of graphs or tables on the teacher’s computer. To access this information, teachers thus need to focus their attention toward the screen during lessons, rather than towards their students, which may reduce the time available for instructions. However, real-time progress information can majorly support the teacher in providing differentiated instruction: it allows them to spend more time on individual instructions and enables them to better meet the individual student’s needs (Ysseldyke and Tardrew 2007). An alternative approach to access such information involves peripheral interaction (Bakker et al., 2013) or ambient displays (Hazlewood et al., 2011); presenting useful information in a subtle manner such that it can be perceived with minimum attention. FireFlies (Bakker et al., 2013), for example, displays information such as division of turns, on primary school children’s desks through light, which teachers can perceive at a glance. Lantern (Alavi et al., 2009) is a light object on students’ desks that presents information about the current exercise they are working on. Lernanto adds to this existing work by using an ambient display to flexibly display real-time information to teachers during lessons in the context of differentiated instruction. Different from the mentioned related designs, Lernanto is located on the classroom wall rather than on the students’ desk. As a result, the presented information is readily available to the teacher, while distractions for students are minimized. However, the information is still visible to students. The effects of this on the student’s experience are not known from related work; we intend to evaluate this when deploying Lernanto in a school.

Lernanto’s design and evaluation setup
Lernanto is a display at the back-wall of a secondary school classroom (see Figure 1a) consisting of several octagon shapes that can emit colored light, each representing one student. The aim of Lernanto is to subtly display information about the real-time progress of each individual student, supporting teachers in gaining quick insight in which student might deserve their attention. This insight is expected to relieve the teacher’s cognitive load, as the need to remember this information is taken away. Indicators chosen to represent the progress of students are the assignment or domain a student is working on (indicated by color) and the pace of work (indicated by the ‘fill’ of the octagon, see Figure 1c). The pace of each student differs depending on his or her level. Pace is therefore presented on a personal scale, relative to the individual expected level, which is
determined by earlier achievements. When a student is performing as can be expected, the octagon is equally filled, while unequal fill indicates performance slower or faster than expected, see Figure 1c.

![Figure 1](image1.png)  
**Figure 1.** (a) Illustration of Lernanto situated in a (hypothetical) classroom (image source: blenderartists.org); (b) the prototype version of Lernanto; and (c) the pace indication for individual students: at expected pace (top), below (middle) and above (bottom) expected pace.

To make sure the teacher can quickly and easily interpret which student is represented by which octagon, Lernanto’s 2 dimensional space is mapped to the physical location of students in the room. To evaluate Lernanto’s usefulness as a support tool for teachers, we have developed a working prototype (see Figure 1b). We are currently running a field study with Lernanto. The prototype uses data from an adaptive educational software system (www.got-it.nl), which is being used during an arithmetic course. At the start of this course the students take a test to determine their level concerning arithmetic skills. During the field-study, the results of this test are used to determine the expected pace for each individual student. The software provides assignments fitting the needs of each individual student in one of four different domains within arithmetic (e.g., numbers, geometry), which are represented by four different colors in the prototype. Lernanto thus provides the teacher with real-time information about both the domain of the current exercise and the current pace of each individual student.

**Conclusions**

This paper presents the design of Lernanto, an ambient display to support differentiated instruction and teamwork. Lernanto presents real-time information about the progress of individual students and the subject they are working on, designed to be perceivable at a glance. This information is intended to help teachers in identifying, at any moment during the lesson, which students might need or deserve their attention. It also intends to help teachers to group students working on the same subject for instruction or teamwork. Thereby, this paper contributes an alternative approach to provide teachers with real-time information during lessons, which is to blend into the environment such that part of the teacher’s cognitive load is relieved.

**References**


