



**Delft University of Technology**  
**Friday, 26 May 2023**

**Plenary Lecture**

Speaker: Loek Zonnenberg

Title: Central Exams mathematics and physics 1990-2020

**Abstract:**

Central Exams mathematics and physics 1990-2020

Physicists Loek Zonnenberg and Paul Rutten have researched the performance of pre-university mathematics and physics students (at VWO-level) on the basis of final exams over the past thirty years. We have published our report named Toetsen Getoetst (Exams Examined: Understanding the slowly lowered level of the VWO Central Exam (CE) for Mathematics and Physics) under the banner of McKinsey & Company.

There is a paradox in Dutch education. On the one hand, the average grade for the CE VWO exams in mathematics and physics and the share of pupils with a VWO diploma have risen sharply over the past thirty years. The average grade for the Central Final Examination (CE) rose from 5.8 (1990-1995) to 7.0 (2015-2021) for mathematics B, from 6.3 to 6.9 for mathematics A and from 6.2 to 6.6 for physics. This would be a cause for celebration, one might think. However, the performance of Dutch students on other national and international tests is declining. What is the cause for this discrepancy?

Despite the efforts of many motivated teachers, our new research [1] shows that the aforementioned higher grades hide a significant drop in performance. We analyzed the CEs of the past 30 years, including more than 1,500 exam assignments of 100,000s of pupils. Because the course contents differed over these periods, we have carefully mapped out all differences to ensure comparability. We compared the period of 1990-1995 to 2015-2021 across 6 years of CEs to account for year-to-year variation. Our analysis shows that the performance of VWO exam students has decreased, and that the CEs have become significantly easier. The observed effects are greater in mathematics than in physics.

We therefore conclude that although higher and higher grades are obtained for the exams, the difficulty of the exams and hence overall performance of the final exam students has gradually decreased significantly. In our view, this drop requires action.

The report does not give specific recommendations, but we do see three possible avenues to investigate further: firstly a broad public debate about the reported decrease. Secondly, we hope that this research will be extended to all subjects in VWO and to other types of schools in Dutch K-12 education (HAVO, VMBO). Thirdly, improving education quality should be considered, such as introducing a continuous improvement culture (see, among others, "Een Verstevigd Fundament"), but also slowly tightening the



requirements for mathematics and physics. This will not be possible at short notice, given the need to allow teachers and students to prepare for a stricter exam. Therefore, a robust and broad debate with education stakeholders is vital before taking action.

Loek Zonnenberg is a mathematics teacher and former partner at McKinsey & Company. Paul Rutten is a partner at McKinsey & Company. The authors both studied Applied Physics in Delft. We look forward to being back on campus on May 26 to present and explain our research at FYSICA 2023.