Education

Where have all the students gone?

Foreign colleagues are usually flabbergasted when they hear that the number of mathematics students in the Netherlands has declined by about 70% between 1975 and 2005, in a world where the paramount importance of mathematics has become increasingly evident. Indeed, currently Holland as a whole sports about as many mathematics students as a single typical large university in a neighbouring country. How can this be? What is being done to turn the tide? The author, Klaas Landsman, is professor of Mathematical Physics at the Radboud University Nijmegen. He was the principal applicant of the GQT-cluster and was a member of the Mathematics Soundboard of the ministry of Education, Culture and Science. He is currently one of the authors of the Masterplan Toekomst Wiskunde, in which the long-term future of Dutch mathematics is being laid out.

Holland is one of the wealthiest countries in the world. Its technological infrastructure is impressive and Dutch civil engineers enjoy a worldwide reputation. At the beginning of the 20th century, Dutch physicists won one Nobel Prize after another. Multinationals like Philips, Shell and AKZO-Nobel rely heavily on research and development. Hence one would expect to find an exemplary educational system, culminating in science students formidable in both quantity and quality.

Diagnosis

Whoops! In actual fact, at the time of writing an official ‘parliamentary enquiry’ has just come to an end. Its goal was to find out how standards of learning could possibly have deteriorated so much over the past 30 years that 40% of our first-year university students are now unable to spell even elementary verbs correctly and more than half of the science and economics students fail elementary algebra tests. The situation at teacher training colleges is equally desperate. Serious Dutch newspapers cover this theme on a daily basis, sometimes even featuring some new negative educational statistics of the above kind as breaking news on their front page. Our population is getting increasingly nervous, politicians following in the wake — at last!

For us, as mathematicians, the main effect of this general demise of learning has been a dramatic decrease in the number of mathematics students: in 1975 about 700 students — already a less than impressive number — entered an undergraduate mathematics degree program at some general or technical university but in 2005 the number had dropped below 200. In addition, even though topics like differentiation and integration of functions of a single real variable have remained part of the mathematics curriculum at school, genuine insight into these and other mathematical operations among schoolchildren is rare. At school, most computations are nowadays performed on an electronic pocket calculator and algebraic formulae are simply copied from a ‘formula card’ without any understanding of their derivation. Only a few prodigies are able to produce a correct deductive argument, let alone a proof of a theorem.

Anamnesis

Part of the decline in mathematics students may be accounted for by the rise of computer science since 1975, which has certainly attracted students who otherwise would have chosen mathematics. Also, the idea that the biosciences have replaced the hard sciences at the frontier of human knowledge has undoubtedly played a role. But these arguments are not peculiar to the Netherlands, whereas the situation sketched above surely is. Thus we have to look for reasons unique to Holland, if only to find out how to reverse the downward trend.

Two major factors appear to have played a role. First, over the past thirty years the teaching profession as a whole has been systematically undermined by a combination of policies. These include:

- Salary cuts;
- Loss of power and influence to school managers;
- Educational reforms.

The salary cuts for teachers, which went beyond those for civil servants, were among the financial measures taken by Prime Minister Lubbers and his various governments from 1982 onwards in response to gross overspending by his predecessors Den Uyl (1973–1977) and Van Agt (1977–1982). The trade unions had their way as well, in that starters had to carry the main burden. The management layer at schools used to consist of the teachers themselves but began to form a separate caste in the wake of government-demanded mergers, which led to schools with thousands of pupils. The reforms — going under the name of ‘new learning’ — aimed at replacing teachers with ‘coaches’ who no longer teach but admire their pupils whilst...
they find out the truth — necessarily subjective — themselves by, for example, surfing the Internet.

Consequently, starting a career in teaching became an unattractive option in many ways. Since especially those with a university degree had other opportunities, the proportion of university-educated teachers has dropped substantially compared with teachers who obtained their qualification from a teacher-training college, or, indeed, have no teaching qualification at all. The latter phenomenon is especially common in mathematics, in which there is such a shortage of qualified teachers that schools are desperately trying to fill their vacancies with whoever is simply willing to teach mathematics, be it an economics teacher or a former driving instructor.

The second factor is slightly controversial, although academic mathematicians appear to be united in bringing it up even as the main culprit. In the mid-80s, the Dutch mathematics curriculum in secondary education was drastically reformed in order to make mathematics ‘realistic’. In fact, what this has come to mean in the Netherlands is that children learn a bag of tricks, which they are supposed to apply to problems typically posed to them in the form of stories. Since genuine applications of mathematics to science or society would require some previous stage of abstraction, these stories are actually rarely realistic at all, typically involving completely artificial if not infantile settings. What little theory and abstraction has remained in textbooks is frequently remote from serious mathematics and is sometimes even plainly erroneous.

The introduction of ‘realistic’ mathematics was partly a response to the ‘New Math’ ideology of the 60s, which in its extreme implementations based highschool mathematics on set theory and even in softer versions made the subject far too abstract and inaccessible for the average adolescent. However, it seems equally wrong to remove practically all abstraction, as in the ‘realistic’ ideology: with the loss of the very essence and power of mathematics, namely the interaction between abstraction and application, the baby has been thrown out with the bath water.

Those responsible for the ‘realistic’ mathematics program would typically say that mathematics has become more palpable this way, so that — as allegedly shown by PISA (Programme for International Student Assessment) tests — the average level of mathematical understanding among the Dutch school population has risen since it was introduced. The interested reader is referred to the critical literature on PISA for a rebuttal of such claims [1]. For me, it suffices that the numerous schoolchildren I have been in close contact with over the past few years during promotional activities of the kind described below themselves complain that they understand neither what mathematics is nor why it is important to science or society. Similarly, in an unprecedented petition called Lieve Maria (Dear Mary), offered to our previous Minister of Education, Culture and Science Mrs Maria van der Hoeven in January 2006, the 10,000 signatories themselves complained that their mathematical training at secondary school had been insufficient.

Treatment

Initially, with a few exceptions, the response from the academic community to the steady drop in enthusiasm for mathematics among teenagers and the concordant decline in students was lukewarm, not to say indifferent. One professor is even on record as saying that he welcomed this decline, as it gave him fewer exams to mark. Fortunately, this introvert attitude — which reminds one of the avoidable assassination of Archimedes — has decisively changed over the last five years. Indeed, academic mathematicians began to feel the impact of low student numbers through dras-
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Klaas Landsman

The unreliability of the PISA tests was one of the conclusions of the parliamentary enquiry mentioned at the beginning of this article. See also www.beteronderwijsnederland.nl/?q=node/1340. Although this web site is in Dutch, it links to a large number of pertinent documents in English. Another relevant website is www.math.nyu.edu/~braams/links.

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Number of first-year mathematics students in the Netherlands (1991–2007)

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