

# Excellent students in Science subjects: How do they differ from other students?

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# Outline of this presentation

1. Scientific literacy in PISA
2. The Dutch educational system
3. Research method
4. Results
5. Conclusions



now you know

# Scientific Literacy: Definition

A scientifically literate person is willing to engage in reasoned discourse about science and technology which requires the competencies to:

## 1. Explain phenomena scientifically

Recognise, offer and evaluate explanations for a range of natural and technological phenomena.

## 2. Evaluate and design scientific enquiry

Describe and appraise scientific investigations and propose ways of addressing questions scientifically.

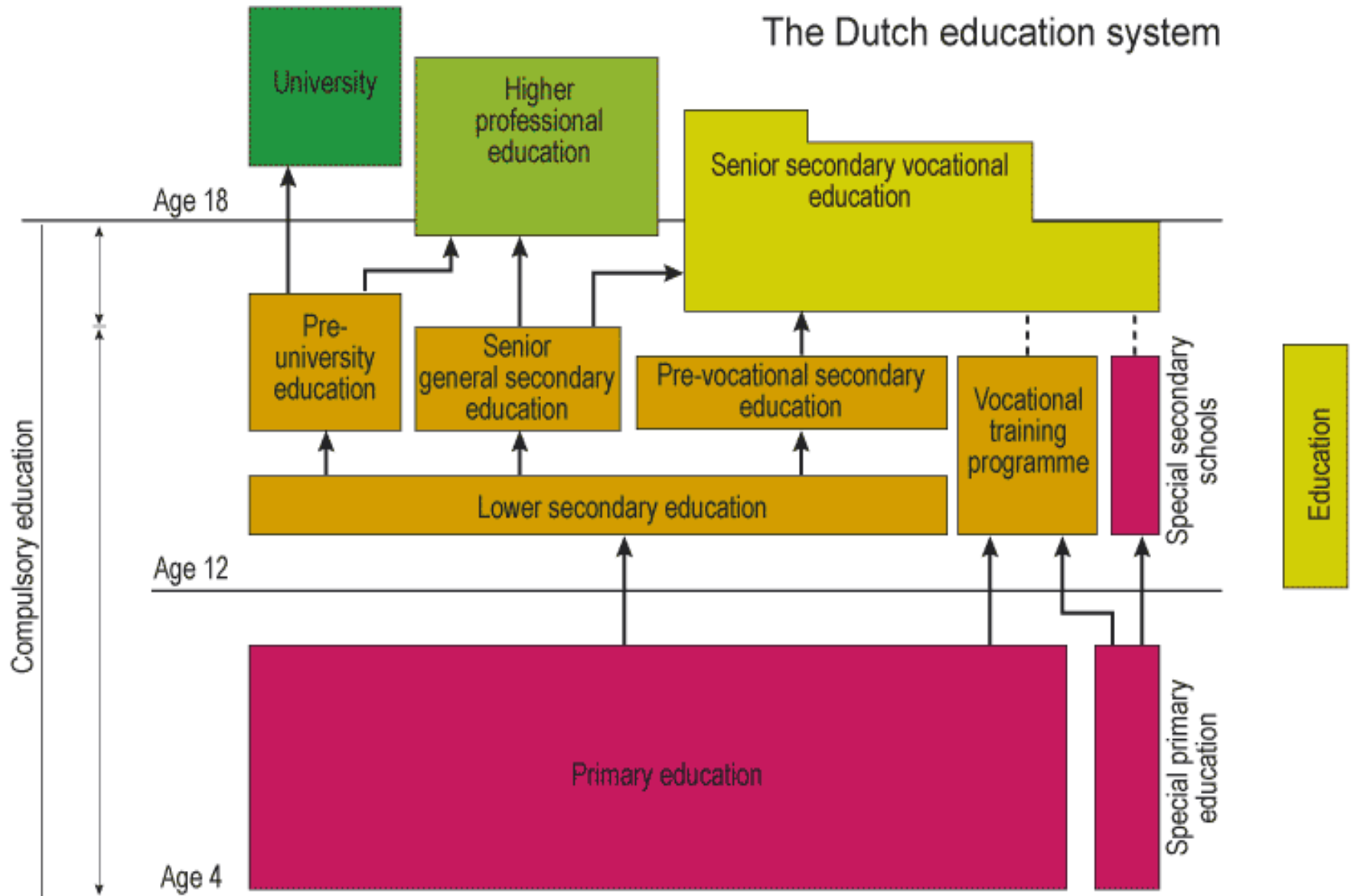
## 3. Interpret data and evidence scientifically

Analyse and evaluate scientific data, claims and arguments in a variety of representations and draw appropriate conclusions.



now you know

# The Dutch educational system



# Definition of excellence

- We've chosen to define 'excellence' as a relative concept with respect to the group of students (school type / study path). This way, every school type has excellent students.
- The definition of excellence is based on PISA-results
- In most results, pre-university education will be discussed.



now you know

# Excellent science-students

In all schooltypes there are more students that excel as well in science as in maths than in science alone. The reason might be that maths and science literacy ask for the same competences.



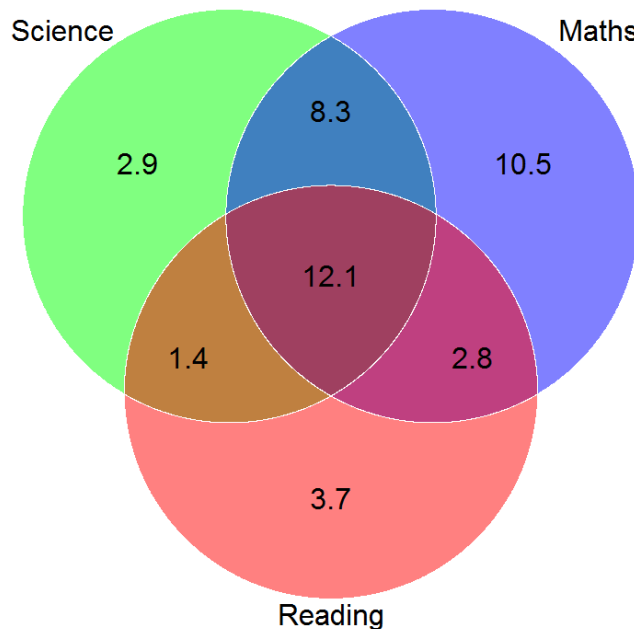
vwo  
(pre-university)  
(N=1132)



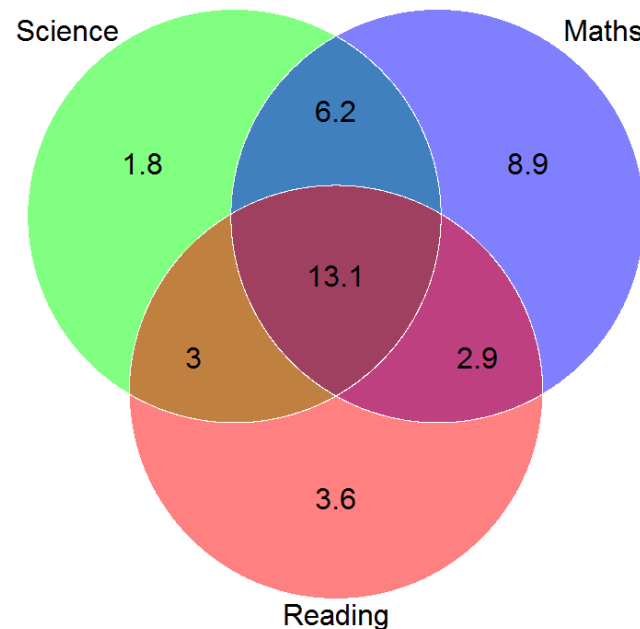
havo  
(senior general s.e.)  
(N=1035)

# Excellent science-students

In all schooltypes there are more students that excel as well in science as in maths than in science alone. The reason might be that maths and science literacy ask for the same competences.



vmbo-t  
(pre-vocational s.e.)  
(N=1260)



vmbo-bb en -kb  
(vocational training)  
(N=1260)

# Sex differences in excellence

Table: Percentage excellent boys and girls in science per school type

		<b>vwo*</b> Pre-university	<b>havo</b> Sen. g. s. e.	<b>vmbo-t*</b> Pre-vocational s. e.	<b>vmbo-bb en -kb*</b> Voc. training pr.
Percentage boys	♂	5,9%	14,7%	31,0%	30,5%
Percentage girls	♀	3,0%	11,3%	17,7%	16,5%

\* Significant verschil



# Differences in origin of students

Table: Percentage excellent native and foreign students in science per school type

	<b>vwo</b>	<b>havo*</b>	<b>vmbo-t*</b>	<b>vmbo-bb en -kb*</b>
	<b>Pre-university</b>	<b>Sen. g. s. e.</b>	<b>Pre-vocational s. e.</b>	<b>Voc. training pr.</b>
<b>Native students</b>	4,8%	13,8%	28,3%	27,3%
<b>Western foreign students</b>	6,9%	17,5%	37,8%	36,1%
<b>Non-Western foreign students</b>	1,9%	4,9%	9,5%	11,0%

\* Significant verschil

# Occupation of the parents and excellence in science

- Within the *pre-university education* students excel more often in science if one of the parents has a science related job (7.6 percent) than if this is not the case (2.2 percent).
- The explanation for this could be that parents that work in science stimulate and help their offspring more with science subjects.

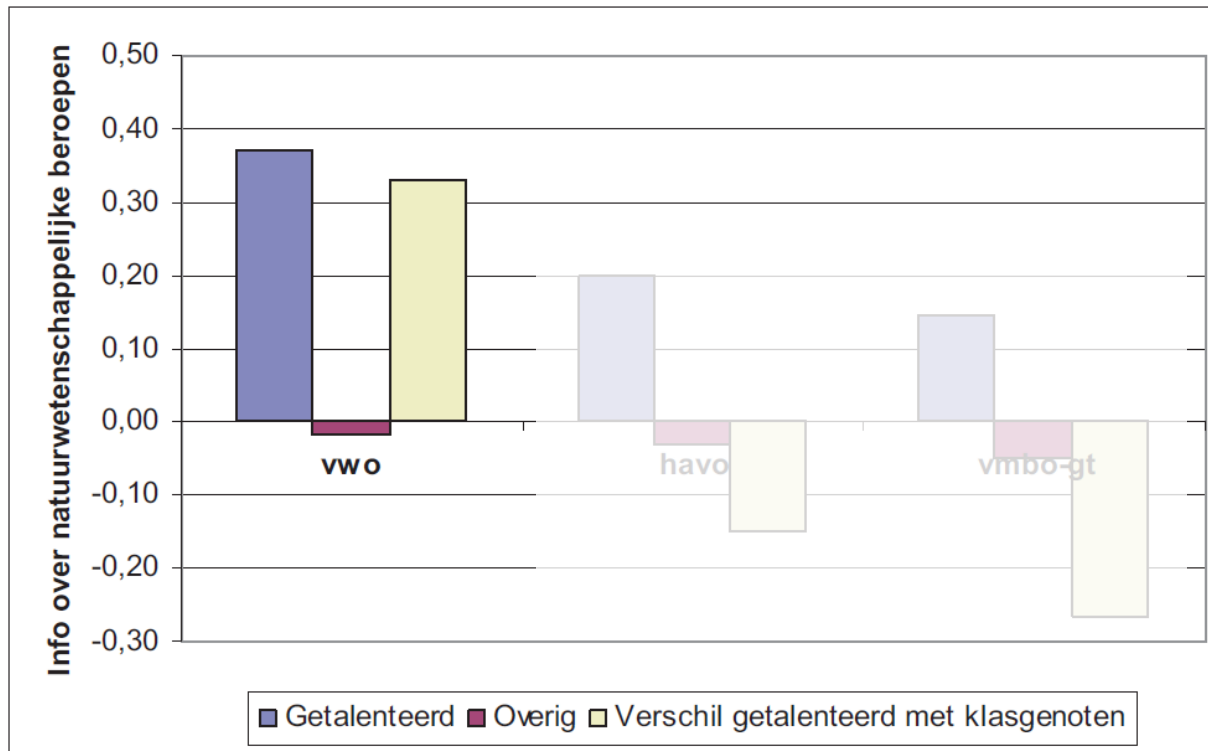
# Research method for attitudes towards school and lessons

- Comparison of excellent students with:
  - all other students
  - their peers within the same school and school type
    - in order to discriminate real differences in the organisation of lessons and differences in the evaluation of classroom activities.
- If excellent students have more positive attitudes than their peers, this means that the school does not provide better classroom activities, but that excellent students value these activities higher.



# Views of excellent students on their science, chemistry and biology classes (1)

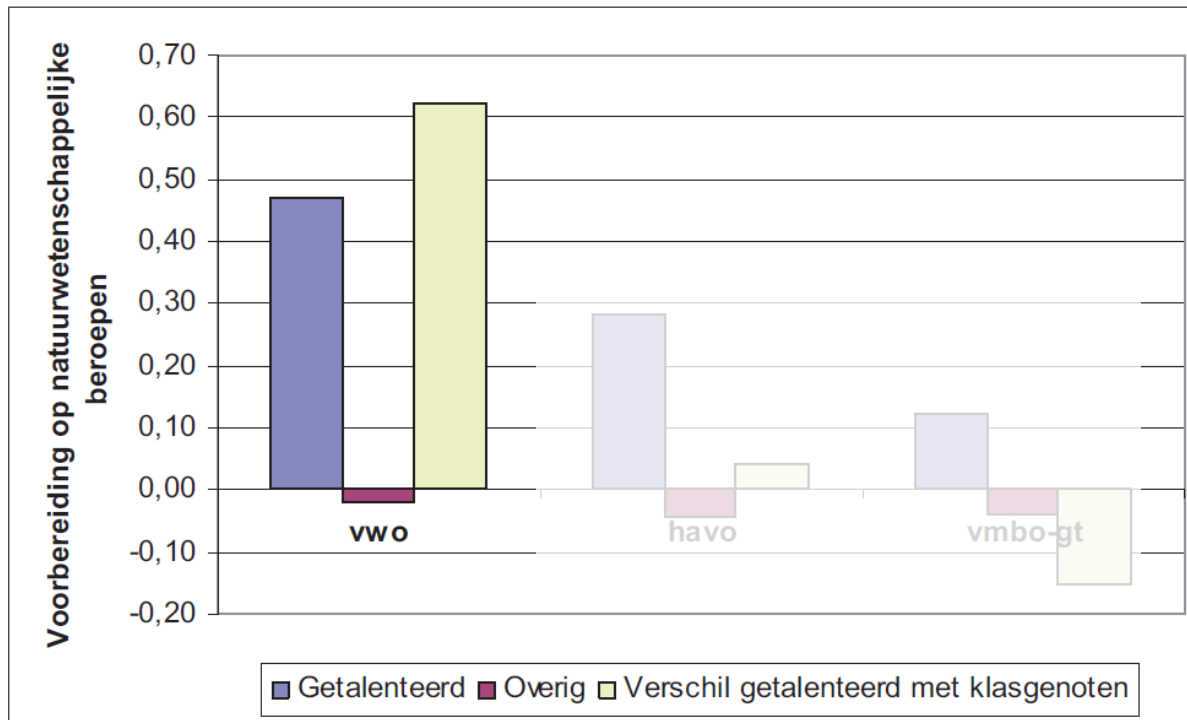
- More positively assessed school / class features



Information about science professions

# Views of excellent students on their science, chemistry and biology classes (2)

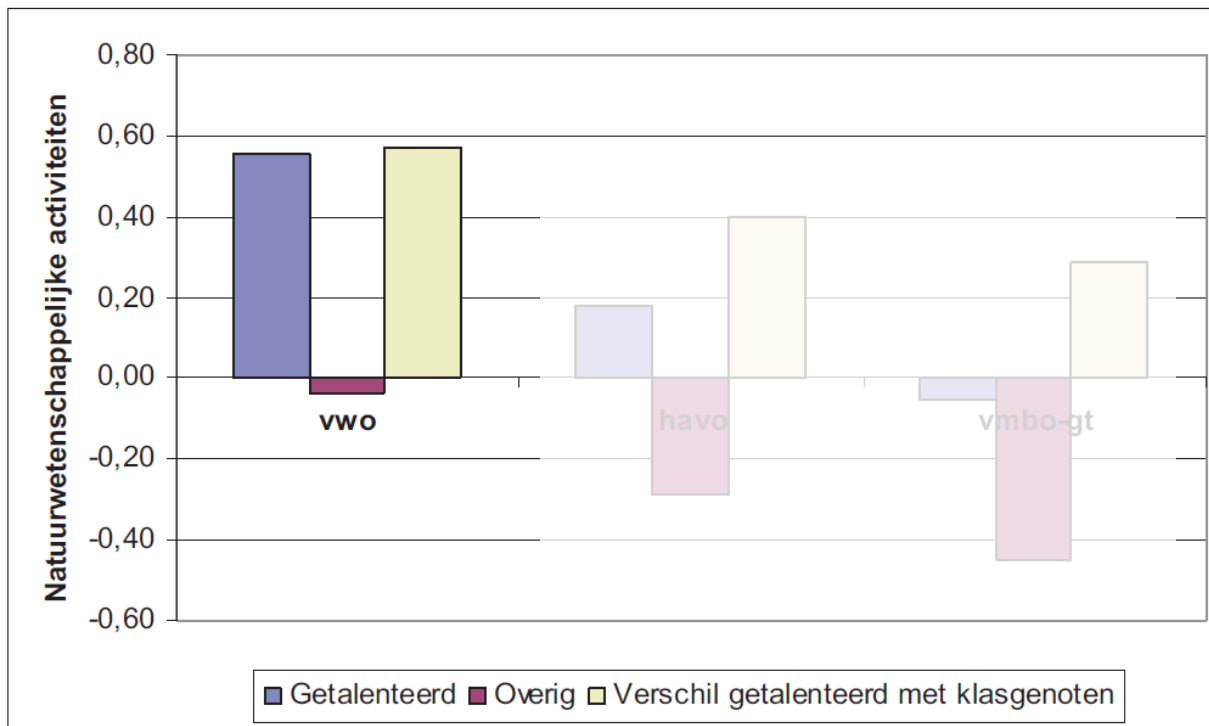
- More positively assessed school / class features



Preparation for scientific professions

# Views of excellent students on their science, chemistry and biology classes (3)

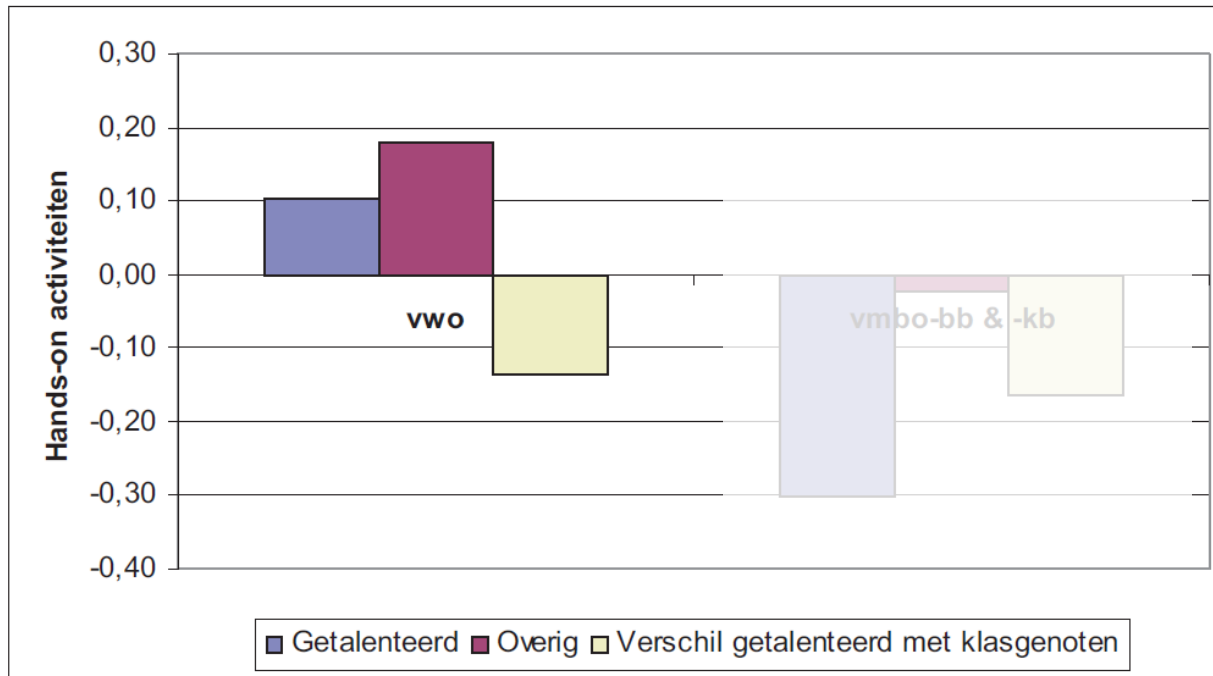
- More positively assessed school / class features



Views on science-related activities

# Views of excellent students on their science, chemistry and biology classes (4)

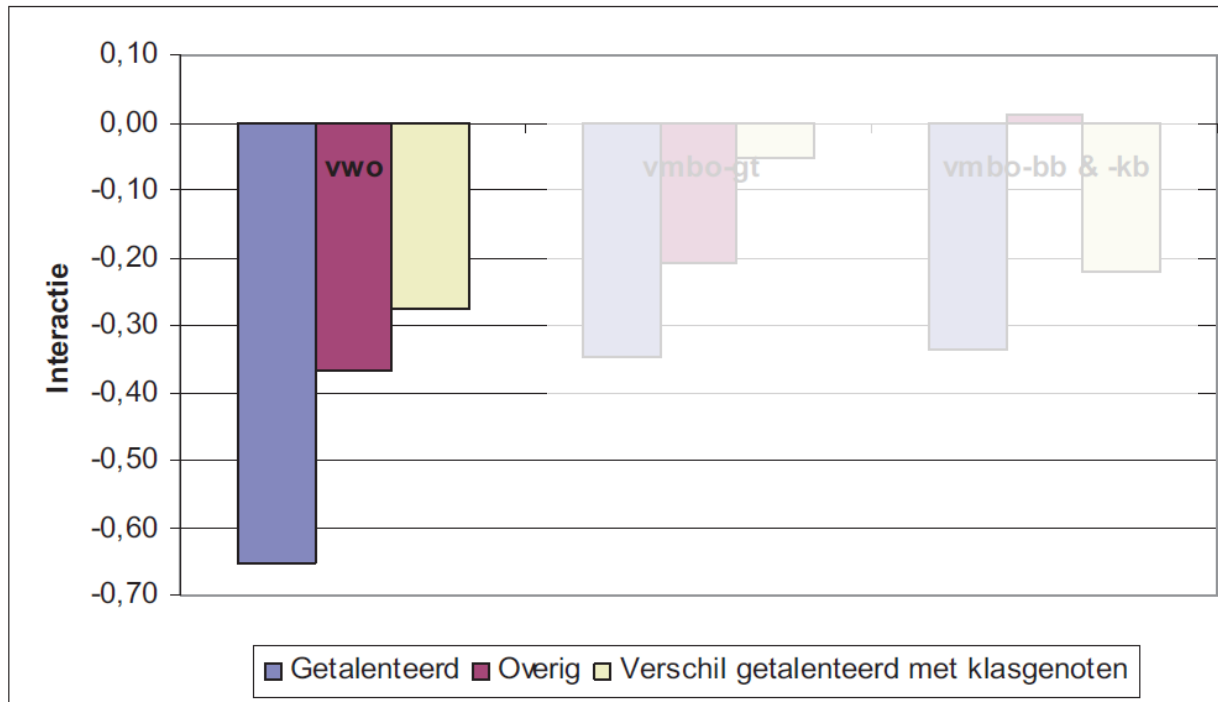
- More negatively assessed school / class features



Views on hands-on activities

# Views of excellent students on their science, chemistry and biology classes (5)

- More negatively assessed school / class features

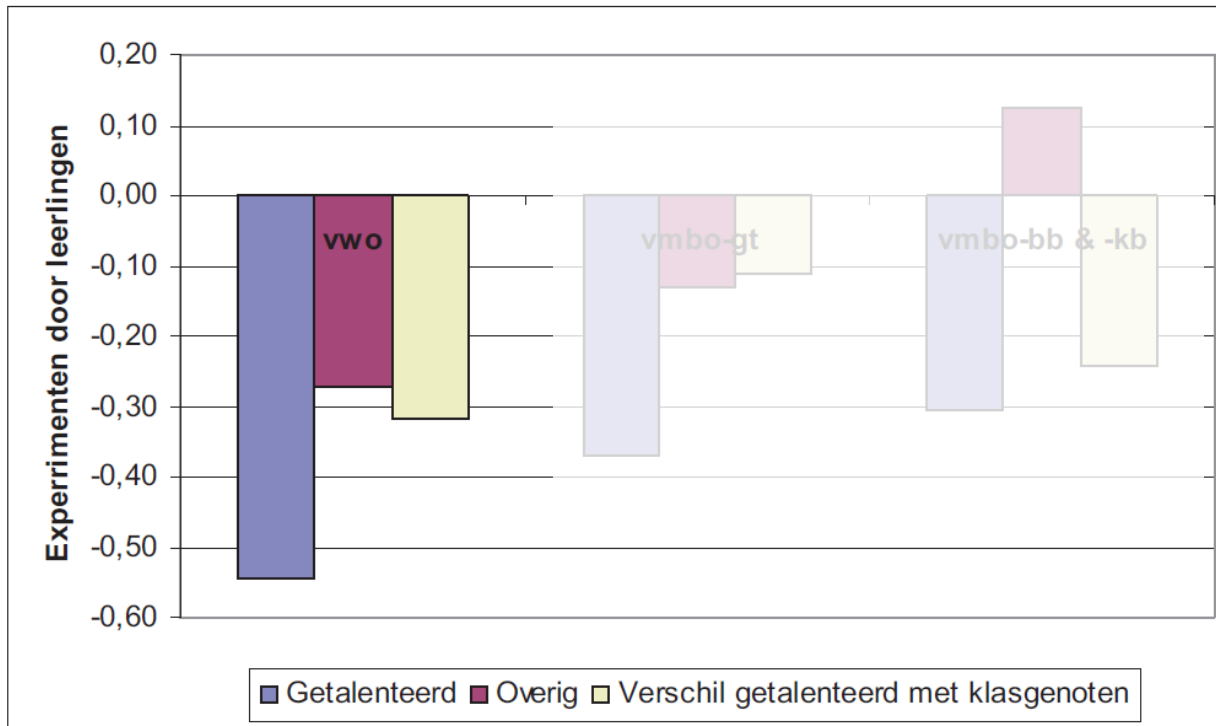


Views on interaction within the science classes



# Views of excellent students on their science, chemistry and biology classes (6)

- More negatively assessed school / class features



Views on experiments (by students) in science classes

# Conclusions (1)

- Students that excel in science tend to excel in mathematics as well.
  - It seems that science and maths literacy partly demand the same abilities.
- Boys do not only on average score higher than girls on the scientific literacy scale, they also excel more often than girls.
  - This difference might be explained by the fact that girls less often choose for a *science profile* or a '*technical sector*' than boys with similar capacities in science.



## Conclusions (2)

- Within the school types *havo* (senior g.s.e.) and *vmbo* (pre-voc.) western foreign students excel more often in science than native students. Non-western foreign students tend to excel less often.
- Within the school type *vwo* (pre-university) students excel more often if one or more parents has a job in science



# Conclusions (3)

- Excellent students in science assess some activities within the school and within their science, chemistry and biology classes more positive than other students.
  - Part of the explanation could be that these students tend to have an over-optimistic view of science-related activities.
- Hands-on activities within vwo (pre-university) are assessed more negatively only in comparison with their peers within the school.
  - This might be an indication that these excellent students would like more hands-on activities than is offered within their school.

