

Influences on the physics exam grades of (Dutch) high school students

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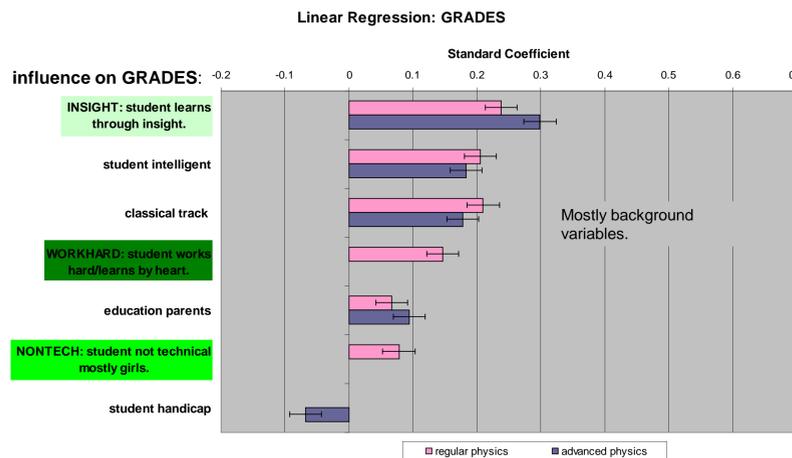
The aim of this research is to study the influence of different didactical aspects of physics teaching in the pre-academic track of high school on the exam grades. This research is inspired and influenced by a similar study of Philip M. Sadler and Robert H. Tai [1].

The survey was conducted on September 2008 among some 9 000 freshmen of science related courses of study in the Netherlands.

Response: 3032 students (34%); 50-50 male/female; 1306 regular physics; 1761 advanced physics.

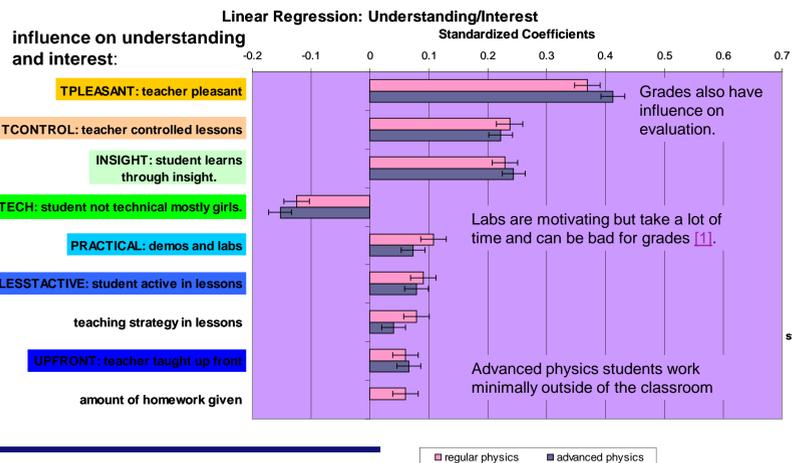
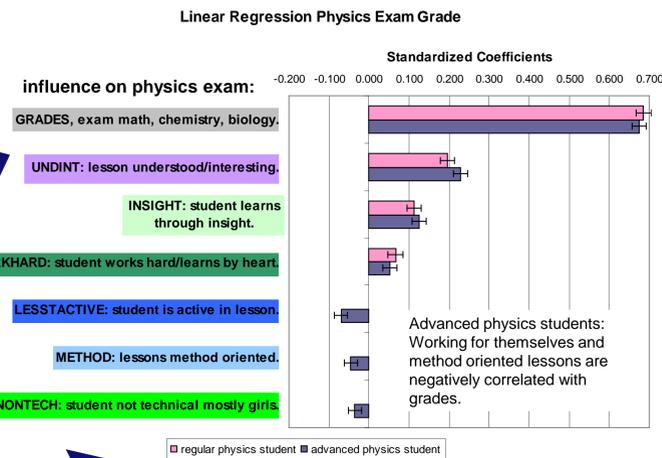
Principal Component Analysis (PCA) is used to reduce the amount of variables in the dataset and to decrease colinearity problems in the rest of the analysis.

Linear Regression is used to find the influential variables first on the physics exam grades and then on the most important of these first exam variables. Only the Standard Coefficients with a significance level of 1% have been retained for this report.



SELECTION Criteria

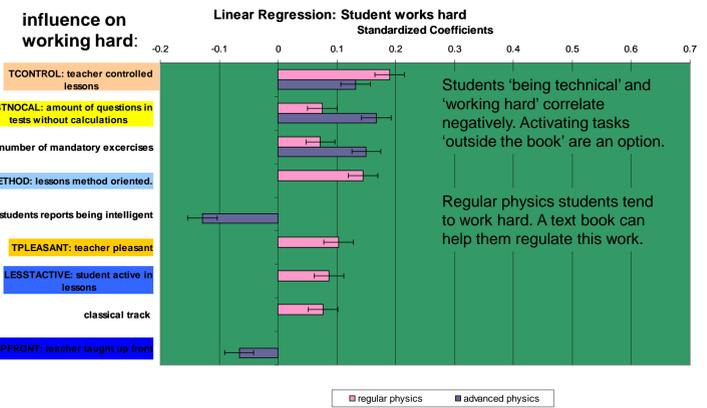
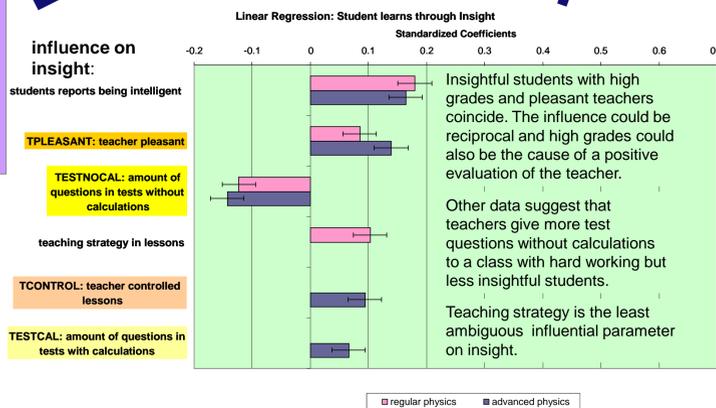
+ middle school science grades (correlations: 0.40 and 0.46)



THE RIGHT TEACHER-PUPIL COMBINATION

TEACHER PUPIL INTERACTION

SMALL INFLUENCE TEACHER
even less for advanced physics



PCA on the 'results' of the physics lessons.	
GRADES	UNDINT
exam results chemistry	student interested in physics lesson
exam results math	student understood physics lesson
exam results biology	

- Other background parameters:
- Dutch influence (parents/pupil living in the Netherlands).
 - Highest education of both parents.
 - Student reporting to be intelligent.
 - Track in high school (classical or regular).
 - Student reporting a handicap.

- Other parameters concerning physics lessons:
- Teaching strategy in lessons.
 - Amount of homework given.
 - Labs outside of the classroom.
 - Availability of answers to the exercises.
 - Number of mandatory exercises.

PCA with variables concerning physics lessons. No significant difference between regular and advanced physics.			
UPFRONT	PRACTICAL	LESSTACTIVE	METHOD
showing exercises up front	labs during lessons	working individually	part exercises from text book
lessons up front	demonstrations	working in groups	use text book

PCA with variables concerning physics teachers. Advanced physics students report to have significantly more pleasant and controlling teachers.		PCA with variables concerning questions in physics tests. The questions involving ...	
TPLEASANT	TCONTROL	TESTNOCAL	TESTCAL
pleasant for pupils	control	explanation	calculations
positive feedback		sketching	
relationship with class		graphs tables diagrams	
variation in explaining		asking for facts	no facts
enthusiasm			
	structured	The first three options don't exclude calculations.	
	attitude consequent		
	competence		

PCA with variables concerning students. Regular physics students work harder and are less technical than advanced physics students.		
WORKHARD	INSIGHT	NONTECH
reports to work hard	learning physics through insight	construction not as hobby
time investment outside class		gender (being a girl)
part mandatory exercises made		
learning physics by heart	not by heart	
reports to work effectively (regular physics)		Mechanical engineering is a course of study full of 'technical boys'.
	reports to work effectively (advanced physics)	

Regular physics students on average work hard, but not always very effectively. Teaching them strategy can stimulate these students to learn more through insight and less by heart.

Advanced physics students, particularly the technical ones, tend to work minimally. To stimulate them to work harder extracurricular and/or practical tasks are advised. Using the lessons to work for themselves on the regular exercises only is counterproductive.

Regular and advanced physics students are not always in separate classes. If differentiation within the classroom is necessary, note that the easiest solution 'leaving the advanced students to work by themselves out of the book while helping the others along' is not the most optimal option.