


Forces, to visualise the invisible


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as they can't be seen!**

They are invisible!



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They are invisible!

How to visualise the invisible







Angel's two reflections

1. We push each other away with **different forces** as our mass differ. Both will move although I'm the pusher, but as my weight is lower he will move a shorter distance compared to me if he had pushed me. This is true also **if the force is similar**, the mass is of major importance for whom will move farthest. Both chairs move but one is pushed farther. For every force there is a counter force, **to some extent backwards but more forward in this case.**

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2. (Three weeks later). I relate this to another practical exercise. It was when you should push a person sitting on a wheel chair when you also were sitting on one. Before we made the test we discussed the possible outcome. Both were wrong. When I pushed both moved. But we found it strange that I moved a longer distance compared to him although I was the pusher. We made the test again but he pushed me and we got the same result. Originally we both thought that the pushed person should move a longer distance compared to the pusher but by this experiment we understood that both person are **pushed by the same force** but it is the mass that has influence on how far we moved. **This shows the importance of experiences and not only theoretical thinking.**



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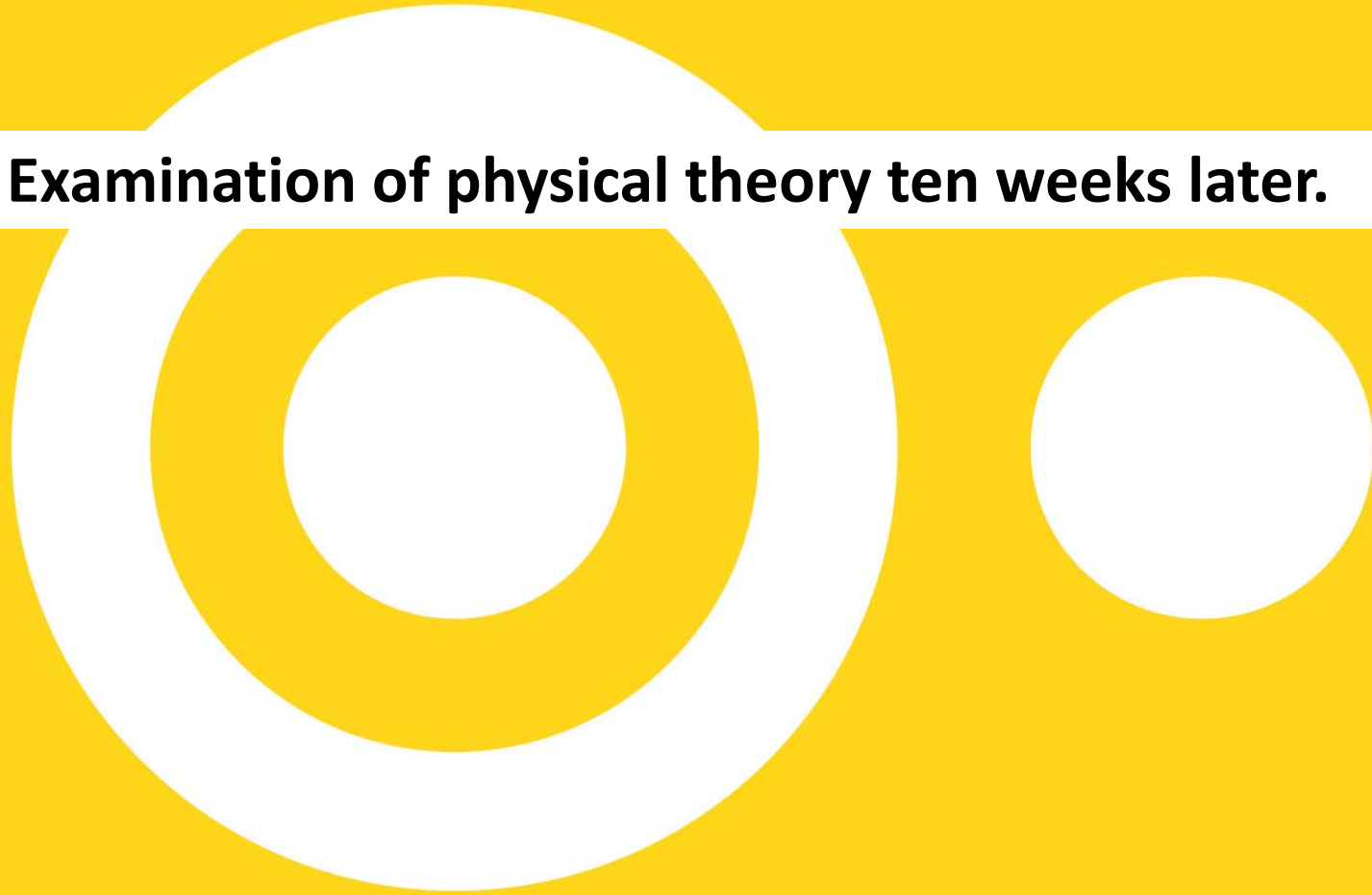
2nd Possible to identify some forces but the experiences and descriptions differ between students.

3rd Realization of differences in the observations due to the previous experiences of the students.



Lack of previous experiences of similar situations make it hard for the students to express their perceptions.

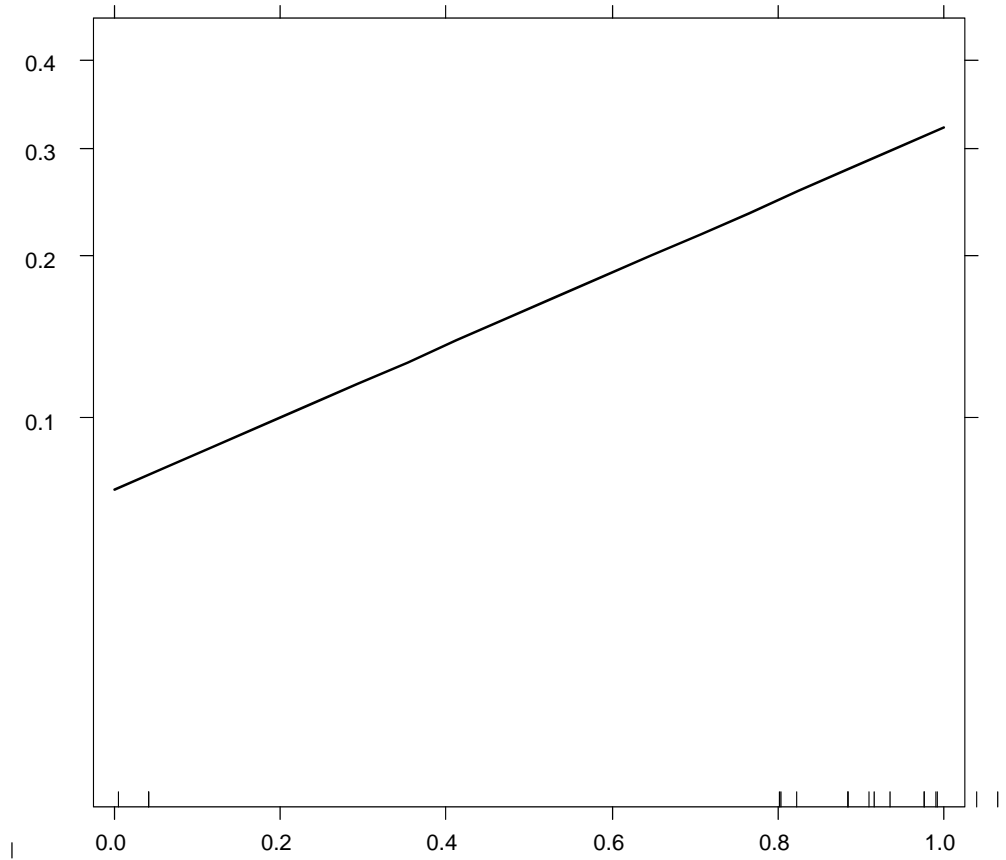
Examination of physical theory ten weeks later.



Student	Mark	Ref to activities	Personal development	Group development	Recursion	Relations	Richness	Rigor
1	F	4	1	0	0	0	0	0
3	F	4	1	0	1	1	0	0
4	F	3	1	1	1	1	1	0
5	G	3	1	0	1	1	0	0
6	V	3	0	0	1	0	0	0
7	G	3	0	0	0	1	0	0
9	V	5	0	0	1	1	0	0
11	F	4	0	0	0	1	0	0
12	G	4	1	0	1	1	0	0
13	V	2	1	0	1	1	1	1
14	F	5	1	1	1	1	1	1
15	F	3	1	0	1	1	0	0
18	F	4	1	0	1	1	1	0
19	F	1	1	0	1	1	0	0
20	F	2	1	0	1	1	1	1
21	V	3	0	0	1	1	0	0
22	F	2	1	0	0	1	0	0
23	F	4	1	0	1	1	1	0
24	G	3	1	0	1	1	1	1
25	F	2	1	0	1	0	0	0

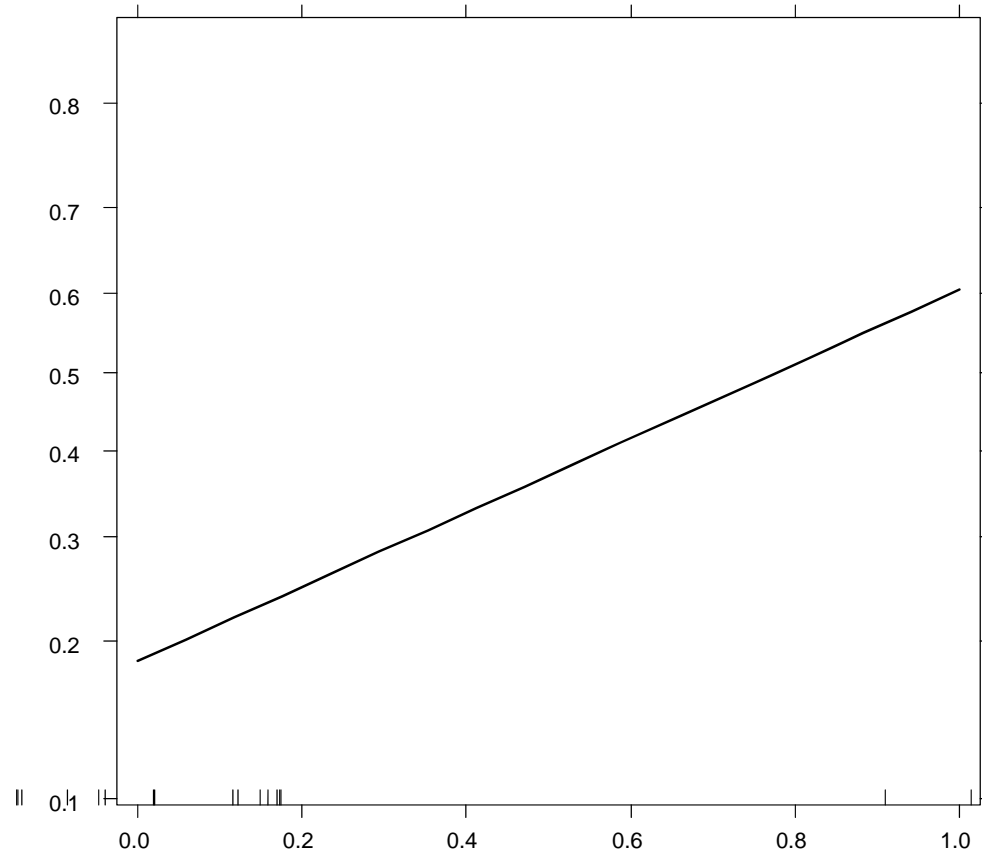
Type of reference	Number of students (N=20)
School curriculum	20
Adaptation to young students	16
Deeper analyses	7
Perception, report	7
Perception, in a cognitive context	5
Personal development	15
Observation of group development	2
Recursion	16
Relations	17
Richness	7
Rigor	4

Result

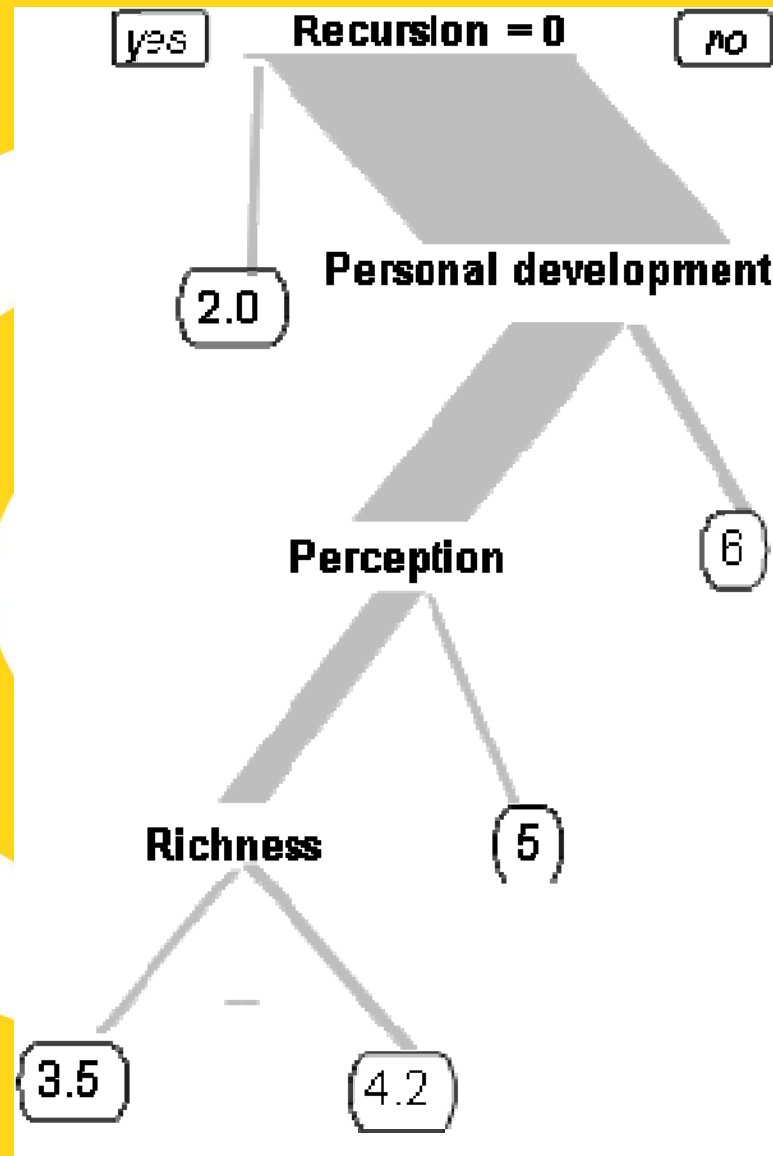


Recursion

Result



Rigor





Thank you!