Exploring physics and physics research from a pedagogical perspective

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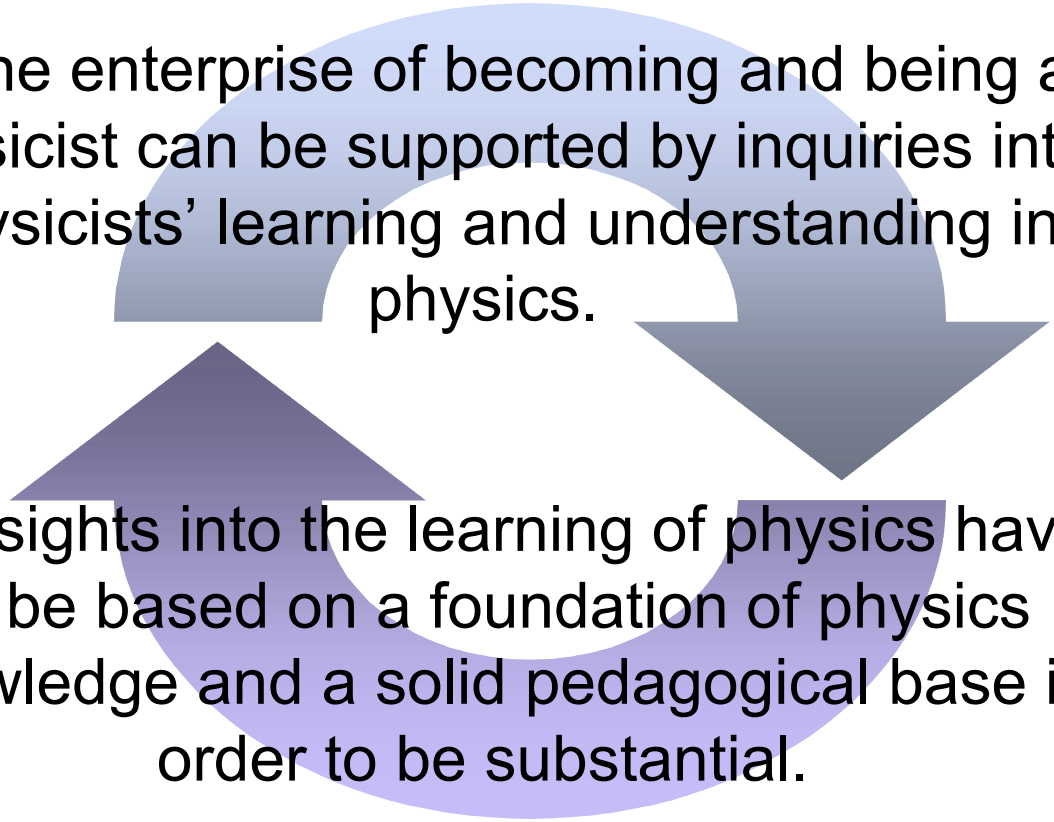
... the enterprise of becoming and being a physicist can be supported by inquiries into physicists' learning and understanding in physics.



... insights into the learning of physics have to be based on a foundation of physics knowledge and a solid pedagogical base in order to be substantial.

What does it mean to become a physicist?

Phenomenography is based on “an interest in describing the phenomena in the world as others see them, and in revealing and describing the variation therein”. This implies the researcher taking a second-order perspective on the research phenomenon, devising appropriate methods of data collection and analysis to enable a description of the ways in which the phenomenon is experienced to emerge as a set of descriptive categories, related both logically to one another and empirically to the research question, but not to the individual participants in the study.

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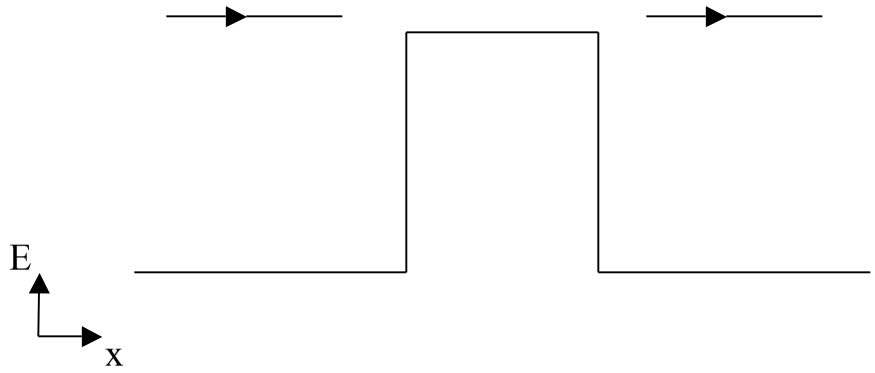
Expounding on physics

senior students and researchers

Interview problem

for students



Interview problem

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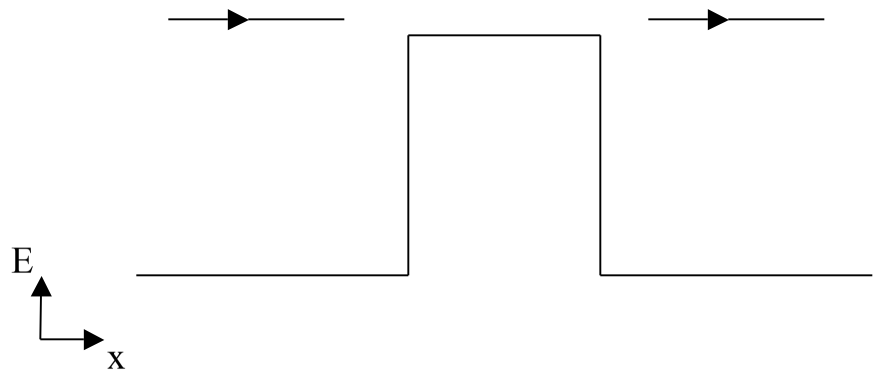


$$T=|\square_{in}|^2/|\square_{out}|^2=1/[1+(k_1^2-k_2^2)^2\sin^2(k_2L)/4k_1^2k_2^2]$$

Categories of description

- Expounding in bits
- Expounding in a single perspective
- Expounding in multiple perspectives
- Expounding through contextualisation

Expounding in a single perspective

I: Can you see that the transmission is less than 1, if you are not, E is smaller than V_0. Is it consistent?

P_{11}:It should be. I have to think. I mean it is ... yes it is. You see, this part here will always be greater than 1 than 0, I mean, it will always be positive, now if this is, if E is less that V_0 this [k_2] would be imaginary but that means that sine [sin k_2L] square will also be imaginary so the imaginary parts take each other out and I have something real, which is also greater than zero, because this is always greater than zero, and this will never be imaginary, times something negative, it will be something positive still,

Expounding in multiple perspectives

P_7: So the transmissivity ...first, the first test we can do is if k_1 is equal to k_2, this would be one, what happens then it just pass and that's the same as V would be 0 so that's OK. ...Depends on the sine here so it could have some kind of oscillating behaviour depending on the width of the hill. I have to think about this...k_2 is real when this and when the energy of the electron is higher than the potential of the hill, so it's just an oscillating behaviour if the energy of the electron is higher than the hill, so then it's supposed to pass and the wave it will be, the rest of the behaviour must depend on the wave behaviour of the electron that depends on the width of the hill.

Considerations

- Interviews as discussions
- What is present to the listener?
- Constituting knowledge objects
- Making talk and making sense

Implications in learning situations

- The senior-junior research discussion, as in supervision of new research students or assistants
- The oral examination of senior undergraduates by their teachers or tutors
- Exposition and discussion in lectures and seminars

Trusting physics research results

How do researchers judge the trustworthiness of their and others' research results?

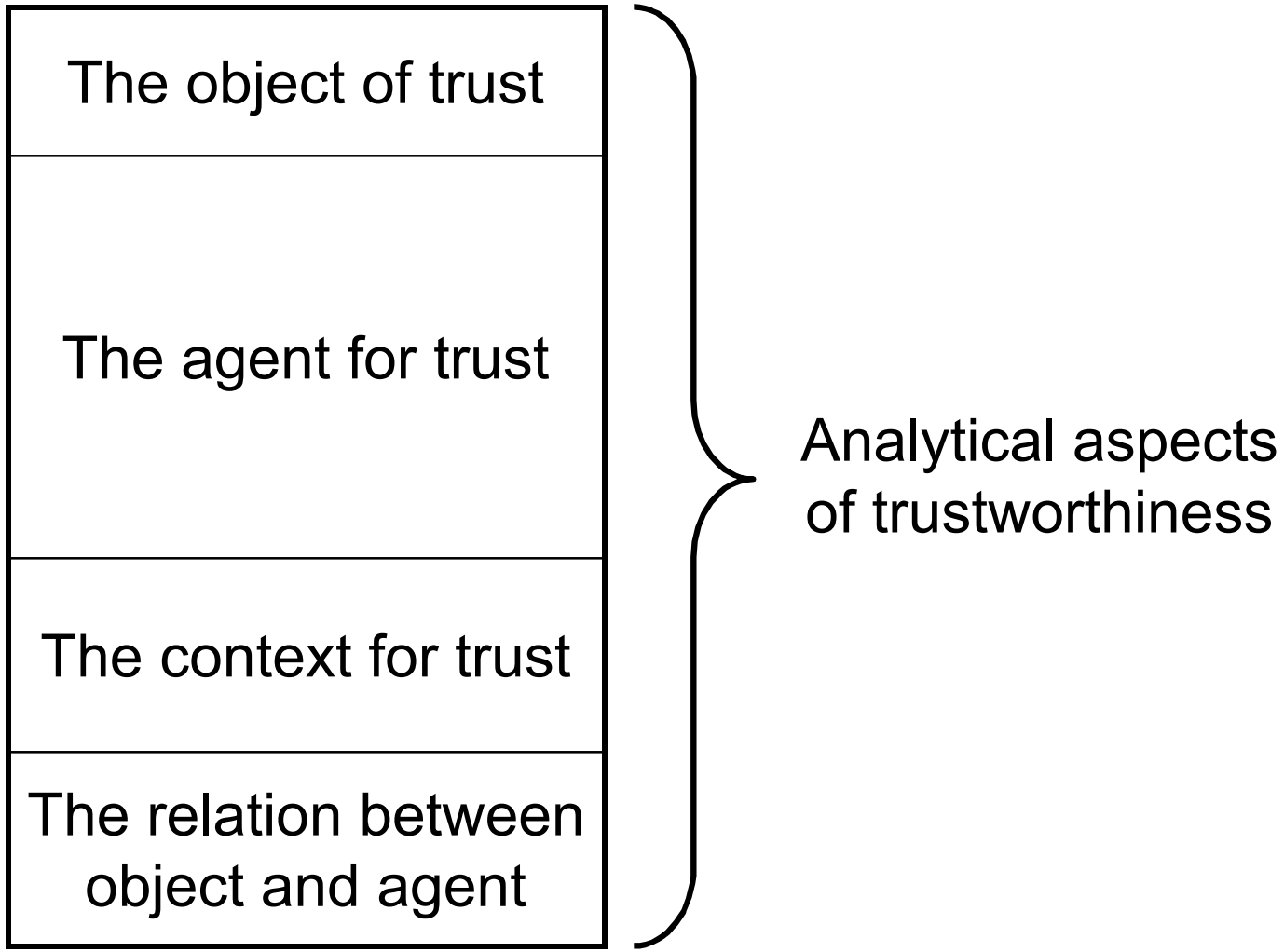
The complexity of trustworthiness

I: Obviously you trust your results, because you have a clear picture of what you are doing. But in the research process: When do you trust your results?

P_{14}: That's a good question. It's a, you really need to verify over and over again in experiment that you get the same result and you also have to look for possible errors or some impossible parasitic effect that you might not think of.

But in the end when you take some data and you, I think really it's important you that have some degree of analysis and theory of your results so that you can, I can see some people are taking measurements and publishing the measurements and not saying very much about the interpretation of the measurements and I try not to do that.

In some cases I have to do that because I have no explanation but then I don't, then it's a conference paper and I sort of publish that to make it known to the rest of the community that this measurement has been done and maybe some theoretician is interested and they might find a solution to it, but I think to make a really good paper I think one should really explain why the measurement data looks the way it does, why it depends the way it does under certain parameters and if you do have a coherent picture of the data, if it's, so I would say for reproducibility is of course the key factor, it should be made at least the same measurement on the same sample several times and of course you would like to have several samples that show the same phenomena.


The object of trust
The agent for trust
The context for trust
The relation between object and agent
Analytical aspects of trustworthiness

The object of trust	• specifics • system
The agent for trust	• personal – (single) person – group or community • impersonal – absolute ideal – relative ideal • formal physics
The context for trust	• me and my work • local network • global network
The relation between object and agent	• single • network

Can physicists through learning about learning in physics enrich physics research?

direct: research in physics

indirect: the making of new physicists