# From helicopter to lighthouse: the experiences of a lecturer in equipping first year university physics students to move away from 'answer making' towards 'sense making'

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**Abstract.** This paper outlines the author's teaching philosophy in terms of an analogy to the contrasting parenting styles of a 'helicopter parent' as opposed to a 'lighthouse parent'. This teaching philosophy grew out of the recognition that the majority of students enter higher education in the author's context in South Africa as 'answer makers'. The author uses the theoretical frameworks of Vygotsky and Bruner to inform her attempts to enable the students to make the desired transition to 'sense makers'. This paper illustrates the analogy and then gives concrete examples of some ways in which the author puts her teaching philosophy into practice in a first-year physics lecture environment.

## 1. Introduction

As the South African universities become more inclusive and the number of students entering increases, the range of backgrounds of these students is also broadening. The physics departments have noticed that students are not well prepared for university studies [1]. The physics departments realised that while there are many people engaged in trying to improve the school system, things will not change anytime soon and that we must commit to teaching the students we have and not the ones we wish we had. This paper explores the experiences of an undergraduate physics lecturer as she tries to equip students who enter university as answer makers to move towards leaving as sense makers. While the lecturer concerned is speaking about her experiences with reference to lecturing first year university physics, the pedagogical approach employed and the underlying teaching philosophy transfer easily to high school physics.

This approach is built on Vygotsky's concept of the zone of proximal development complemented with Bruner's concept of scaffolding. In addition, we acknowledge the importance of the theories of epistomological access [2] to increasing the success of students at university in general and at physics in particular. We try to do this by enabling students to think about their learning in a metacognitive way by being explicit not only about the content of the curriculum but also about the learning actions that we expect from them and the cross-curricular skills that we are trying to help them to develop [3].

The challenge faced by the lecturer in these case studies is to engineer the learning environment so that sense making is encouraged over answer making. We desire students to

realise early on that many of the learning methods which they are used to employing need to be changed. As lecturers we realise that we cannot just expect students to realise this on their own but that we need to scaffold the process so that students do not become discouraged by repeated failure [4]. If we are serious about 'equal access for all' then we as educators need to seriously consider our pedagogy so that there is also an equal chance of success for all without compromising our exit standards.

In addition to the challenges faced by the students and the necessity for them to change their learning habits and behaviour, I recognise that I, as a lecturer, often naturally lean towards behaviour that tends to constrain students to remain as answer makers rather than encourage them to develop as sense makers. Recognising and acknowledging this tendency of my own is the first step towards changing my own behaviour and teaching methods in order to enable students to grow and mature as learners.

In this paper I put forward my personal teaching philosophy and explain how I try to use it to inform all my teaching decisions. I will give concrete examples of a few of the ways in which I try to put my teaching philosophy into practice. In so doing, I will try to paint a picture for you and tell you a bit of a story, about the biggest challenge that I face both as a lecturer and a mother...

## 2. My students

At the beginning of the year the new batch of first years arrive and they are the top students from school, they deserve to be here in my lecture theatre. They come with high expectations, both from themselves and others. But often it is not plain sailing for them and they often find it unexpectedly hard at university in general and they find Physics in particular much harder than it was at school. (A few find it unexpectedly easy and that often comes back to bite them later in the second semester or second year.)

### *2.1. Possible (academic) reasons for struggles*

There are many reasons why students may struggle at university: social and emotional as well as academic. Here I am concentrating largely on academic aspects. Amy Bray is also from Rhodes University and we have a paper titled "Why is Physics Hard?" ***CITE***, in the same proceedings, which considers some of these other aspects.

In my opinion, many of the academic struggles of students are due to the fact that we expect them to learn physics differently to how they have been taught at school. Students come from school having learnt the laws by rote whereas at university they need to understand the concepts behind those laws. Instead of being able to genuinely solve a problem, they come to us following a procedure which usually involves picking a formula that (hopefully) contains the correct variables and then grinding through to reach the answer. In many ways the physics of this procedure is less than correct in that they are actively taught to plug the numbers in (without units) at the first step without reaching an algebraic solution first. At school, physics is taught as a series of compartmentalised, disjoint topics so that students have no idea of any overarching ideas or any sense of a big picture of physics. Ideally, I would like students to have intrinsic motivation for what they study, instead of the extrinsic motivation of marks. I do realise, however, that this is an ideal which is seldom realised. These contrasts between students entering university and the expectations of lecturers are summarised in table 1.

But just because the first years come in as answer makers and I tell them they must now be sense makers doesn't make this transition happen automatically or quickly. This is where my struggle is — to help students move from answer making to sense making when my natural inclination is to be a "helicopter parent".

**Table 1.** Students come from school as answer makers, whereas we desire them to be sense makers.

| **Come from school:** | **We want:** |
|---|---|
| – rote learning of laws | – understanding of concepts |
| – follow given procedures | – problem solving |
| – compartmentalised, disjoint topics | – big picture, interconnections |
| – external motivation | – intrinsic motivation? |
| **answer making** | **sense making** |

**3. I want to rescue**

A helicopter parent hovers over her children, ready to rescue them out of situations, instead of guiding them through situations. I can translate this to a similar tendency with my students. Because of my nature, I want to never let my children or my students fail or struggle or get hurt. Some of the ways I behave and the things I say as a helicopter are given in table 2.

**Table 2.** Helicopter behaviour and sayings

| **With my students, my tendency is to:** | **To my children, I catch myself saying:** |
|---|---|
| – always try to make things easy (and I like to think I'm good at explaining!) | – "Let me do that for you!" |
| – never ask questions students can't answer easily | – "Don't touch that!" |
| | – "Be careful!" |
| – tell the answer too soon, without giving students time to struggle through a problem | – "Come down, you might fall!" |

But, vitally, I recognise that if I behave like that, I am keeping both my children and my students away from growth — they need to learn to face problems and situations (and life) *without me*.

**4. What I do about it**

In this section I will give a little taste of some of the things I do when I teach — trying *not* to be a helicopter but rather to be a 'lighthouse'. As a lighthouse, a parent guides and enables her children to find their way through problems, rather than rescuing them out of problems [5; 6]. I continuously try to transfer this philosophy to my teaching.

*4.1. Why do you say that?*

With my first example, I will show you what I do to try and stop myself from doing too much telling, either of information or answers.

I use Paul Hewitt's "Next-Time Questions" [7] and "Figuring Physics" column [8] extensively. As Hewitt points out, it works particularly well at the end of the lecture, so that the students

have time to think about the question before the next lecture. They are always conceptual, and even I as the lecturer have to think hard. I did this once at the end of a Friday lecture and one of the students groaned and said "Oh no! Not another NTQ . . . ". I was a bit disappointed in this attitude — I thought they were such good, thought-provoking questions; and then I heard the rest of his comment: ". . . now we won't be able to stop talking about physics *all weekend*!".

A typical Next Time Question is shown in Figure 1. This one, involving two tracks of the same length one of which includes a dip, is a well-known favourite of more people than me.

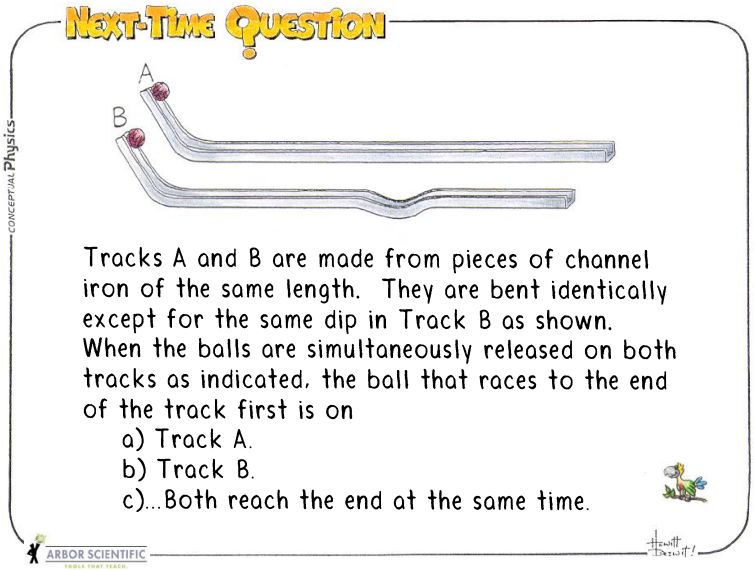


**Figure 1.** A typical Next Time Question

After the students have seen the question I lead the discussion time in a similar way to that described by Mazur [9]. The students discuss the problem with their near neighbours and then they vote for the answer they believe is correct. In the past I have used a 'show of hands' and a rough count for the vote, but more recently I have used a student response system called Plickers [10]. I then encourage students to defend their answers and provide their reasoning. On some occasions that I have used these types of questions, we have started with the vast majority of the class being wrong initially and the remaining minority convincing them. Once it was a minority of two who were correct and all I had to do was decide whose turn it was to speak next.

An advantage of using questions like NTQ or Figuring Physics is that it enables students to develop their skills in developing a logical argument, since I encourage them to (politely!) point out the problems in logic or conceptual reasoning that inevitably come up. The catch is to be aware of the time when the discussion stops being fruitful and then wrapping it up and summarising to make sure that all the students know the reasoning behind the correct answer and thereby emphasising the sense behind the answer rather than the answer itself.

*4.2. How did you try it?*

Another good lighthouse question is "How did *you* approach this problem?". I recently had an extremely humbling experience while looking for a good first year assignment question. I was looking through the book "200 Puzzling Physics Problems" [11] and struggling to know how to start with one of the early (and therefore supposedly easier) problems when my honours (fourth year) class arrived. Comfortingly, they didn't know where to start either, but agreed that it

was an interesting problem and carried on talking about in the Maths department, and to other Physics lecturers, and in the first year practical session to the other demonstrators.... One of the first years heard and got interested. In the next lecture, he came back and said "I've solved that problem!". While he hadn't actually got it totally right, he had attempted it from a completely different angle which enabled me to go ahead and solve it myself — reminding me that there are certainly many approaches to solving a problem, and sometimes my way isn't the best, the quickest or the easiest!

One way to be a lighthouse lecturer is to sometimes take a step back and let students do things their way — we can both learn something in the process.

*4.3. You do this one!*

And finally, I realised I had done something right somewhere along the line when my honours particle physics class arrived one day and I admitted that I hadn't had time to prepare adequately for the class. "Don't worry!", they said, "We'll lecture these sections!". And they did. They split the chapter up between themselves, came back for the next lecture, and lectured it, doing very well in the process.

## 5. Conclusion

I have tried to give a very brief taste of my perpetual struggle not to be a helicopter, always ready to rescue and remove students from any struggle, but rather to be a lighthouse that guides the way *through* the struggle, slowly equipping my students to manage on their own.

This journey starts again with every new intake of first years, and strongly influences all my teaching decisions.

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