Taber, K. S. (2008) There's danger in folk pedagogy, *Physics Education*, 43 (4), pp. 346-348.
https://iopscience.iop.org/article/10.1088/0031-9120/43/4/F01/pdf

Reflections on Teaching and Learning Physics

The danger of folk pedagogy

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> "There is the transfer theory [of teaching] which treats knowledge as a commodity to be transferred from one vessel to another …. Whichever theory a teacher uses to help him/her think about the process it will affect the strategies she/he uses and it will colour his/her attitudes to students"
>
> (Fox, 1983: 151)

The idea that children develop their own alternative conceptions of mechanical principles that can interfere with the learning of school physics is well recognised, and not only within the physics education community. 'Intuitive physics' is one of three domains of 'folk' science commonly acknowledged - the others being folk biology and folk psychology. The taxonomic categories used in folk biology are at odds with those of scientists. However, these categories have developed because of their utility value in societies: where classifying and identifying plants on the basis of their use as foods and medicines, or as poisonous, has traditionally been more important than recognising their evolutionary relationships. Even in an industrial advanced society where few of us grow or gather our own food such folk categories as 'tree' or 'sea food' are more useful to most people than the technical classifications used in scientific work.

Intuitive physics has a more immediate origin in individual experience than folk biology, which is largely socially communicated. However, believing that an object will come or a stop unless a force acts, or that working too hard can lead to us running out of energy, are notions that are widely shared and so reinforced by social interactions. It is clear that such alternative notions do not withstand close analytical scrutiny, but as Joan Solomon long ago pointed out, that is not what children's everyday talk about scientific topics is about! According to Solomon, such talk is often concerned with social cohesion more than analytical coherence (Solomon, 1993).

Physicists are allowed to be off-duty

Ideas that are widely shared, and useful in everyday contexts, are not readily replaced by more technically correct concepts that tend to mainly be of value in limited contexts (such as doing your physics homework and passing a test). It is not surprising that most people have trouble learning Newtonian physics, and do not let technical concepts infiltrate their everyday understandings of the world. Nor should we be too critical of the scientist who lapses into lay-science mode when off duty. There is a limit to how many times one wishes to explain to a shop assistant that you are not actually wishing to buying 'batteries', but electrochemical cells with the potential to be used as a battery. It is easier just to buy a 'pack of batteries'.

What would seem less forgivable would be for the physicist to use an impetus conception when designing rockets, or to measure heat in degrees Fahrenheit when investigating engine efficiency, or to put a sign on her laboratory generator warning the cleaner not to touch the device and risk thousands of volts being passed through the body. In a professional context, folk physics is not acceptable. A physicist who adopted folk-science ideas at work would not do her job well, and could indeed be very dangerous.

Developing a theory of mind

The third widely recognised domain of folk-science concerns psychology. An important part of human development is the acquisition of what is known as a 'theory of mind'. Young children learn to recognise other people as being like themselves in having desires, needs, beliefs and so on. Developing such an understanding is essential to live successfully in complex human societies, where people may say something different from what they think, and may believe things we do not

believe. Without such an understanding, we would necessarily believe that Johnny thought that the dog ate his homework - because he reported this event to us. We would also be unable to interpret Julie's comment that planets do not attract the sun, but are only attracted by it, as meaning that she thought that the gravitational force only worked one way, as *we* know this is not the case. Making sense of Ali's comment that particle physics is boring would be quite beyond us!

Folk psychology, like other aspects of folk science, comprises of a set of ideas and beliefs that are not always supported by strong evidence, nor as clearly defined or coherently developed as we might expect for scientific theories. However, these notions do a useful job in allowing everyday talk about people and their minds. People will change their minds, and sometimes lose them, whilst being mindful that such talk is more metaphorical than literal. Having convenient and widely shared metaphors that aid communication can however make us lazy: comfortable metaphors sometimes come to stand in place of more powerful forms of explanation (Taber & Watts, 1996), and when those we converse with readily accept them as such, we soon fail to notice. Labelling someone as mad or simple-minded may convey a message about their behaviour, but is a pretty limited form of explanation for that behaviour.

Folk pedagogy

We hear this type of talk a lot in education. Lay conversations often include references to children being bright, dull, sharp or dim-witted, where these descriptors (based on generalisations of observed behaviour) become used to *explain* performance in school. Teachers, of course, would avoid such shallow tautologies.

There is a very common folk-psychology notion of teaching. In everyday life teaching is often discussed as a process of transferring knowledge into the minds of students. The components of good teaching then become that the teacher always knows the appropriate subject knowledge, and is able to transfer it clearly, and accurately, into the minds of the learners. The teacher has to make sure the knowledge being transferred does not go above the heads of the students, and they have to pay attention so that the knowledge does not go in through one ear and out of the other. Learning can be tested through seeing if the student can faithfully reproduce the knowledge transferred. When this fails (and sadly, this is common in science teaching), the teacher can at least demonstrate that the fault is with the receiver and not the transmitter, by demonstrating that accurate and complete knowledge is recorded in the student's notebook. This shows that the

teacher transmitted the knowledge accurately, and also kept the students on task, working hard to keep a full set of notes. Any fault lies with "poorly motivated, unintelligent, lazy, forgetful students" (Fox, 1983: 95).

Of course professional teachers are well aware that learning is a process of active construction of knowledge, slowly building up meaningful knowledge structures that moves students' thinking closer to the scientific models. Teaching is about facilitating this construction process, which is known to be slow and often difficult. The constructivist metaphor is well supported by research, unlike the transfer metaphor of folk-psychology.

When teachers are talking to lay-people about their work they have to be aware that most people only have available the language of folk-psychology to discuss school learning. Correcting someone at a cocktail party who refers to knowledge being transferred will be seen as socially appropriate as holding up a queue of shoppers to explain the battery concept at the supermarket till.

Like physicists, however, teachers need to operate with the appropriate technical concepts in the professional arena. If teachers were to habitually talk to each other about teaching and learning as though knowledge was something that could be transmitted and absorbed wholesale into young minds, then there becomes a danger that instead of teaching, teachers will spend their lessons trying to transfer their own knowledge into the notes and minds of their learners. That would be very boring for the students, and ultimately very frustrating for the teacher.

References:

Fox, D. (1983). Personal theories of teaching. *Studies in Higher Education, 8*(2), 1983.

Solomon, J. (1993). The social construction of children's scientific knowledge. In P. Black & A. M. Lucas (Eds.), *Children's Informal Ideas in Science* (pp. 85-101). London: Routledge.

Taber, K. S., & Watts, M. (1996). The secret life of the chemical bond: students' anthropomorphic and animistic references to bonding. *International Journal of Science Education, 18*(5), 557-568.