HALF A CENTURY OF RESEARCH ON ALTERNATIVE CONCEPTIONS/MISCONCEPTIONS IN SCIENCE EDUCATION: WHAT HAS CHANGED?

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Studying students understandings of science phenomena is fascinating. A key element is unravelling ways of sense making as everyday experiences, language, overheard conversations are intertwined with what the teacher is saying. The teacher attempts to guide their learners to more scientific congruent ideas, the learner detours and goes through alleys slowly changing and every now and then producing what the teacher delights in hearing. The process is not quick enough for the teacher and convoluted for the learner. Is this a surprise? Once a learner sees ideas through the 'lens of science', some say it is hard to revert back, one has gone the threshold portal. But progressing through 'the scientific lens' is not trivial, after all, much is counterintuitive. What is reassuring for researchers is that there are identifiable, consistent and enduring ideas and pathways which form the cornerstones of alternative conceptions or misconceptions research. The solution is then to find ways through which these can be addressed. Overtime, experiments, technology, simulations and a range of tools have been identified and used. The successful interventions have been reported and some translated into systematic practice underpinning curricula. In this talk I will summarise the field, the contributions of my research team, from multimedia, Veritasium YouTube Channel to concept tools. A key finding which is often not reported is how students develop over their years of physics study, what are their trajectories of changing conceptions. If they don't 'overcome' misconceptions in first year, can they 'overcome' them later on if not explicitly taught? We also offer a few different way of using and thinking about alternative conceptions, threshold concepts from the 'troublesome knowledge' tradition and LCT from linguistics.

Suggested Readings:

Sharma, M. D., Sefton, I. M., Cole, M., Whymark, A., Millar, R. M. and Smith, A. (2005) Effects of re-using a conceptual exam question in physics. *Research in Science Education*, **35**, 447-469.

Georgiou, H., and Sharma, M. D. (2015) Does using active learning in thermodynamics lectures improve students' conceptual understanding and learning experiences? *European Journal of Physics*, **36(1)**, 015020.

Muller, D. A., Sharma, M. D. and Reimann, P. (2008) Raising cognitive load with linear multimedia to promote conceptual change. *Science Education* **92(2)**, 278-296.

Muller, D. A., Sharma, M. D., Eklund, J., Reimann, P. (2007) Conceptual change through vicarious learning in an authentic physics setting, *Instructional Science*, **35(6)**, 519- 533.