

## Transforming knowledge structures: A procedure for developing students' understanding of threshold concepts

Prof Peter Davies, Education Policy Research, University of Birmingham, UK

The portrayal of change in conceptual structure in the fields of conceptual change and phenomenography/variation theory commonly identifies two forms of integration. One form of integration occurs when students move from a conception of a phenomenon as possessing distinct features to a conception of phenomenon in terms of relationships between those features. For example, the literature on students' conceptions of price (e.g. Pang and Marton 2003, 2005) describes improvements in students' conceptions in terms of 'price caused by demand' or 'price caused by supply' to 'price caused by interaction of supply and demand'. Hallden and Lundholm (2009) refer to research on children's understanding of the shape of the earth in which an improvement in conception is observed when children change from thinking of the earth as 'a round object in space' and 'a flat surface on which people live' to 'a globe with a surface on which people live'. This kind of integration echoes the distinction between conceptions composed of 'separate features' and conceptions 'which integrate features' in Biggs and Collis' (1982, 1991) SOLO Taxonomy.

A second form of integration occurs when students reconfigure their understanding of a phenomenon when they come to understand it in a new context. Marton and Booth (1997) refer to this as 'the external horizon' using the example of a deer set in the context of the habitat where it lives. Carravita and Halldén (1994) present a model to represent the way in which understanding of a particular phenomenon is framed by whatever commonsense or theoretical framework is perceived by the individual to be most appropriate. It is helpful to distinguish between these two ways of thinking about integration through a change in conception of context. Coming to understand a deer as usually found in a particular kind of habitat does not alter conceptions of the features of the deer itself (four legs, antlers etc.) or the way in which these features are combined in a deer. However, it is possible to imagine circumstances in which a change in perceived context may change the internal integration within the conception. For example, a change in conception of space may in turn change conception of the earth as a globe in space and the nature of earth as a place where people live. This is the kind of integration, likely to involve change in epistemological beliefs, which is referred to in the literature on threshold concepts (e.g. Davies and Mangan 2008): integration which arises from a change in theorisation of the context in which phenomena are understood within a particular scholarly community.

The evidence referred to in this study is generated from lessons taught with 16-19 year old students of economics. The intervention was designed to uncover (a) any relationships between students' understanding of price in particular contexts and the structure of their economic thinking; and (b) any effects upon their understanding of price resulting from an activity designed to encourage reflection on the structure of their understanding. Evidence on students' understanding of price was gathered through their written responses to two questions about change in price for fuel and air transport. Evidence of the way in which students organised their thinking was gathered by asking them to classify a set of problems any of which might be broadly classified as a price problem but not presented as such. This design followed a procedure suggested by Birney et al. (2005).

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