Reflections

Alternative Approaches to Concept Mapping and Implications for Medical Education: Commentary on Reliability, Validity and Future Research Directions

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This issue includes an article by McGaghie using a specific methodology – concept mapping – to explore the knowledge structures of medical experts in relation to less experienced students. This is one of the several studies using concept mapping methods to identify knowledge structures of medical experts (e.g. West et al., 2002). Taken together these studies are provocative and provide a context for promising continued research programs that could effectively illuminate our understanding of concept maps, their meaning and potential for application in medical education. The differences among the studies and unexpected findings in individual studies provide impetus for further evaluation and refinement of the concept mapping construct as a measure of knowledge structures. The commentary that follows discusses these issues, and provides direction for future research.

The primary strength of the approach exemplified by these papers, in my view, lies in the fact that the research is well grounded in respected theory and prior research from cognitive psychology showing that the structure of knowledge in memory underlies the ability to retain, recall and problem solve. It has been clearly shown that knowledge organization influences the efficiency and effectiveness of recall and problem solving within a domain, and that domain experts have more coherent, well-structured knowledge than novices (Elstein et al., 1978; Ericsson et al., 1980; Chi et al., 1988; Bordage and Lemieux, 1991; Bordage, 1994).

Another major strength is the use of well-established methods for concept mapping to expose knowledge structures. The specific method may differ. For example, West et al. (2002) use a direct, qualitative method (Ruiz-Primo and Shavelson, 1996) while McGaghie et al. use an indirect, quantitative method (Schiffman et al., 1981). Regardless, the findings suggest that the
form of concept mapping employed may be a reliable and valid method for exposing knowledge structures (with some caveats), and the methods may have implications and applications for teaching and assessment methods in medicine. It stands to reason that medical education could benefit from assessment methods designed to reveal the knowledge structures of experts and learners, and no such assessment tool currently exists.

Demonstrating the reliability and validity of any assessment measure is, of course, critical and a reliable measure of knowledge structures could have great added value and potential. Indeed, if we had a feasible and reliable method(s) to expose and evaluate the underlying, core organizational knowledge frameworks that mediate experts’ and learners’ reasoning, we could (as the authors suggest) use these to guide instructional design, to assess the evolving knowledge structures of students, and to differentiate between the knowledge structures of more and less proficient learners at the same stage of education.

A consistent finding is that concept maps (independently of how assessed – direct or indirect methods) of less experienced learners are less coherent, consistent and reliable than the maps of more experienced trainees and/or experts, and that training does result in qualitative changes in the maps that make them similar to the experts’ maps. These findings, taken together with many other studies of concept mapping in other educational contexts and domains, provide convincing evidence that concept maps generated in different ways can be reliable measures in the medical field.

One could further argue that the demonstration of significant effects in a series of studies such as this with disparate medical subject matters, and using different methods for concept mapping, is also evidence of the validity and generalizability of the two concept mapping methods for revealing knowledge structures. In fact, a future program of research outlined by McGaghie et al. focuses on how the use of experts’ concept maps might enhance instruction if used as an advanced organizer. I would concur with the authors that both methods of concept mapping can provide a reliable measure of something – but just what that something is remains in question; (i.e. the construct validity of the maps is unresolved).

In order to demonstrate validity of the maps, one needs more than demonstrations of statistical differences across cohorts with different levels of expertise, or with different amounts of instruction. There is no convincing evidence in any of the studies that the differences in the concept maps are actually related to differences in the ability to retrieve knowledge or problem solve as would be expected based on the theoretical foundations. Although in some studies the authors attempted to address this question (McGaghie et al., 2000; West et al., 2000), they failed to show the predicted correlations between performance on multiple choice exams (MCQ) and the efficacy of the concept maps. This is dismissed as a pitfall of the traditional assessment