



Critical thinking: Some lessons learned

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Critical thinking (CT) is one of education's most valued outcomes, but it is also very difficult to achieve. A recent DETYA-commissioned survey found that "independent and critical thinking is of great importance to employers. [They] *value* this skill and *can* find it, but it is *rare*." At the University of Melbourne and at Austhink we have been developing new ways to teach CT. The lessons emerging from this multi-year project are both sobering and encouraging.

IMPROVING CT IS DIFFICULT. Mastering CT is comparable to learning a second language. Everyone knows that second-languages need years of regular, motivated practice. CT requires similar dedication. An important difference is that CT expertise is much less obvious than language fluency. We find it harder to gauge skill levels, rates of improvement, and the amount of effort and time required. As a result we tend to underestimate the challenge and be overly optimistic about improving CT through education.

STANDARD TEACHING APPROACHES ARE NOT VERY EFFECTIVE. We try to teach CT in two ways. The indirect method is to hope that students will improve their general skills just by study in a particular domain, such as politics or accounting. This works, but slowly. The direct method aims to accelerate the improvement by teaching CT explicitly, using the standard repertoire of textbooks, 'sage on stage' instruction, exercises and so on. Typically, this doesn't work much better. In the scores of studies of deliberate attempts to improve CT, the results range from 'no difference' through 'no statistically significant difference' to 'mild gain'. In particular, standard one-semester undergraduate courses in CT or introductory logic make surprisingly little difference, if any, to CT abilities.

PRACTICE MAKES PERFECT. CT is a complex, higher-order cognitive skill. We know from cognitive science that cognitive skills, like skills of any sort, improve with practice. We also know that practice should be motivated,

graduated, guided, scaffolded, and there should be lots of feedback. Further, for CT the practice should be practice-for-transfer. What does this mean? The greatest challenge facing teachers of general thinking skills is the problem of transfer: skills acquired in one domain or context often do not carry over to other situations. Improving general CT skills takes more than practice via a particular narrow problem set, and more than practice via a wide range of problems and domains. It involves practising transfer itself – that is, carrying concepts and skills over to new problems in diverse domains and contexts. This is 'quality practice'.

CT CAN BE TAUGHT. Critical thinking skills only improve with quality practice. Key evidence comes from studies of students engaging in intensive quality practice. We rigorously pre- and post-tested students who used software designed to facilitate quality practice. Their mean gain in critical thinking over one semester was almost twice the expected gain over three years of undergraduate study. Properly designed instruction can therefore make a real difference.

DIAGRAMS HELP. Reasoning is almost always presented in prose, either spoken or written. Yet in many ways prose presents the thinker, especially the novice, with irrelevant cognitive burdens. Reasoning can be presented in 'argument maps' that make logical structure explicit and focus mental resources on the reasoning itself. Using argument maps tends to improve thinking and accelerate mastery of the concepts and procedures of CT; these benefits then transfer back to prose-based CT challenges. The software practice environment described above is diagram-based. Over the coming decades, diagrammatic techniques will increasingly displace pure prose as a medium for articulating and communicating reasoning. This transformation in our cognitive practices will improve both the quality of thinking activities and the effectiveness of CT instruction.