The influence of external representations on chemistry problem solving.

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Because atoms and molecules cannot be directly observed, Chemistry instruction relies on visual representations (diagrams, equations and graphs) to communicate key concepts. This study explores how different representations affect problem-solving performance by chemistry experts and novices. Participants were asked to think aloud as they completed a series of problems on chemical equilibrium. All problems addressed the same core concepts but were presented in different representational contexts (e.g, in one problem equilibrium concentrations were calculated, in another the correct equilibrium concentration was selected among diagrams representing molecules in vessels). Experts were more accurate than novices and were more likely to invoke relevant chemical concepts across representations. However, both novices and experts showed significant variability in performance across problem types, suggesting that problem representation affects the access of relevant prior knowledge. Further, problems that required solvers to integrate information across representations revealed that novices often have simultaneous, conflicting chemistry conceptions.