Investigating heuristics and their differentiation during stoichiometry problem solving by students and teachers

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Research on human reasoning has shown that people make inferences and decisions in their everyday lives by using shortcut reasoning procedures, called heuristics, which reduce the cognitive effort and usually provide reasonable, satisfactory answers. However, they also seem to be responsible for many systematic biases and errors in situations that require more elaborate, analytical processing (Evans, 2006, Maeyer & Talanquer 2010). Shah and Oppenheimer (2008) believe that heuristic behavior necessarily relaxes the difficult requirements of the weighted additive rule, which is an algorithm consisted of five effortful tasks offering safety on making a decision, forming a judgment or coming to a conclusion.

Our investigation was guided by the following research questions:

- What heuristics do solvers of different chemistry educational levels use when solving stoichiometry problems?
- How do these solvers differentiate with reference to the heuristics they use?

For this purpose the retrospective think aloud protocol method was applied (van Someren, Barnard, Sandberg, 1994). Specifically, it was asked from four groups of five solvers, school students, first- year university students, graduate students and teachers, to solve stoichiometry problems.

Protocol analysis showed that solvers followed heuristics of examining fewer cues and integrating less information and heuristics that refer to effort-reduction, associated with retrieving and storing cue values. In this last category, the heuristics of availability, of recognition, of using rules and mathematic formulas, of data fusion and the weighted pros heuristic were found. The two groups of university students, who were solvers with no recent practice in stoichiometry problem solving, used frequently heuristics without differentiation. On the contrary, school students and teachers did not use heuristics so often, although sometimes school students, probably due to their inexperience, followed heuristics that lead to wrong solutions.

References

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