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Types and qualities of knowledge and their relations to problem solving in physics.

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Summary: Based on empirical findings and theoretical considerations related to the field of expertise research, the importance of “types” and “qualities” of knowledge in relation to problem solving in physics was investigated. The students ($N = 138$) in this study had a level of competence that corresponds to an intensive beginner college course in physics. It was found that conceptual declarative knowledge and problem scheme knowledge are excellent predictors of problem solving performance. However, a detailed analysis shows that the first knowledge type is more typical for low achievers (novices) in physics problem solving whereas the second type is predominately used by high achievers (experts). Regarding types and qualities of knowledge and their relations to problem solving, the results of a multidimensional scaling analysis (MDS) indicate that two dimensions of knowledge can be distinguished. On the extreme limits of the first dimension, which could be named “problem solving relevance vs. structure of discipline”, are the types of knowledge and the qualities of knowledge, respectively. The second dimension of knowledge could be named “single knowledge elements vs. organised knowledge units”. There are types of knowledge as well as qualities of knowledge distributed along this dimension. Consequences of these results for improving physics education are discussed.

Classification: M50 C30

Keywords: domain-specific knowledge; expertise research; physics; problem solving; qualities of knowledge; types of knowledge

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