COMMENTARY

Conceptual Change in Science Education: From Cold to Hot Approaches

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"The whole of science is nothing more than a refinement of everyday thinking."
-Albert Einstein

SCIENCE education research finds that children may generate misunderstandings about certain scientific concepts based on their personal experiences prior to formal schooling. These misconceptions may present students with learning difficulties and barriers to deep comprehension of scientific knowledge. In response to this issue, researchers advanced the method of conceptual change instruction to help students shift from scientifically incorrect pre-instructional knowledge structures to scientifically accepted ones (Pacaci et al., 2024). Conceptual change has been deemed an effective approach to boosting students' science literacy by improving teaching and learning in science education (Duit & Treagust, 2003; Treagust & Duit, 2008). Duit contended that conceptual change was not about an exchange of pre-instructional conceptions for the science concepts, but rather conceptual learning pathways from students' pre-instructional conceptions to the science concepts to be learned (Duit, 1999; Duit & Treagust, 2003). Conceptual change studies can be traced back to the 1970s. There have been diverse perceptions of conceptual change in researchers, leading to the development of a variety of conceptual change strategies in science education.

Among common conceptual change strategies are the cognitive conflict strategy, cognitive bridging strategy, and ontological category shift strategy. According to the cognitive conflict strategy, the learner needs to recognize the conflict between their prior knowledge and scientific knowledge and raise queries about the former, to realize conceptual change (Posner et al., 1982). As per the constructivist theory, the student's prior knowledge can serve as a valuable resource in their study of new knowledge; therefore, eliciting their dissatisfaction with prior knowledge alone is far from enough. Some studies suggest that providing bridges between prior and new knowledge can help students correct misconceptions in science learning. Pacaci et al. (2024) named this type of conceptual change strategy the "cognitive bridging strategy." Other researchers borrowed terminologies from ontology to describe the process of conceptual change. As ontology holds that knowledge of each domain has its own structure with every concept belonging to a certain category, the ontological category shift strategy treats conceptual change as a process in which concepts shift from an ontologically wrong category to an ontologically appropriate one (Chi & Roscoe, 2002).

Conceptual change strategies, including the said three types, emphasize the role of cognitive skills (such as logic) with disregard for affective factors like motivation and are, thereby, characterized as "cold conceptual change" (Kural, 2015), as opposed to "hot conceptual change." Pintrich et al. (1993) first advanced the notion of hot conceptual change to stress that conceptual change is not only a cognitive process but also entails motivational, affective, and contextual components (Sinatra, 2005). Inspired by the work of Pintrich et al., later studies developed a variety of hot conceptual change models. For example, the Teaching Model for Hot Conceptual Change (TMHCC), created by Kural and Kocakulah (2016), uses motivational and metacognitive strategies to support conceptual change in student physics learning. Despite the recognition of the critical role of affective factors in conceptual change among teachers and education researchers, there is a dearth of in-depth research into the practical outcomes of hot conceptual change models or strategies.

The Effect of Hot Concept Change on Students' Views of the Nature of Science in this issue focuses on the development of a fresh instructional model that combines inquiry-based learning (IBL) and hot conceptual change strategy, which is compared with a purely IBL-based model. The purpose of the study is to investigate the effects of the integrative model on the conception of nature of science (NOS) in seventh graders (Savas & Kocakulah, 2025). Although the article addresses the use of hot conceptual change strategy in the NOS course, it can provide valuable implications for the across-the-board implementation of conceptual change instruction in science education.

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