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Editorial: Interconnections between cognition and emotions and the process of science learning

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Editorial on the Research Topic
Interconnections between cognition and emotions and the process of science learning

The process of science learning involves far more than the acquisition of conceptual and procedural knowledge. The consideration of affective variables in the process of science learning is particularly important given the complex and, generally, abstract nature of STEM subjects. For some time now, research has shown that cognition and emotion are deeply intertwined (Koballa and Glynn, 2013; Graesser, 2020; Krapp and Prenzel, 2011; Mao et al., 2021). Affective dimensions influence core cognitive processes such as memory, attention, problem-solving, self-regulation, study strategies, and academic achievement (Graesser, 2020). Thus, they play a crucial role in conceptual change processes (Duit et al., 2013; Özdemir and Clark, 2007) and, hence, in shaping students' learning experiences and outcomes, particularly in STEM education. Furthermore, recent research in neuroscience and educational psychology has shown that emotions are not separate from cognitive functions but rather constitute an integral component of cognition—functionally and neurally embedded alongside memory, attention, and reasoning (Todd et al., 2020; Eldar et al., 2016). Taking proper account of the affective domain may have an important impact on the quality of teaching. Its recognition may also help educators to better tailor their pedagogical approaches.

Since understanding the interplay between affect and cognition is essential for fostering conceptual change, enhancing scientific reasoning, supporting meaningful long-term learning and, so, providing equitable and quality opportunities to learn science for all, the focus of this Research Topic is to further explore the role of the affective domain in the process of learning science. Thus, this collection addresses how cognitive and emotional processes interact in science learning environments, and how these interconnections can be better understood and assessed using different research methodologies. The contributions tackle these issues from a variety of perspectives, levels, topics and procedural methods, including the design, validation, and application of self-report instruments to explore affective constructs.

Thus, for example, Lampert and Porro investigate qualitatively the social representations, emotions, and interests of secondary school students regarding the

environmental issue of arsenic contamination in water. Using surveys and image-evoked interviews, the authors reveal students' emotional responses—such as sadness, fear, and helplessness—and their recognition of personal agency in addressing environmental problems.

López-Banet et al. examine the impact of an educational intervention on pre-service teachers' emotional and cognitive engagement with scientific practices related to greenhouse gases. The findings suggest that targeted interventions can enhance both emotional involvement and cognitive understanding in teacher education contexts, an issue of special interest in environmental education for promoting environmental awareness and action.

Moreover, Hernández-Barco et al. explore, through a longitudinal approach, the interplay between affective factors—such as motivation, interest, and emotions—and cognitive development. Findings indicate that affective components significantly influence cognitive processes and underscore the importance of integrating emotional awareness into pre-service teacher education programs to enhance scientific literacy and promote sustainable educational practices.

The work of Praderio Gaias et al. focuses on early childhood education and the recognition that emotions play a crucial role in shaping teaching practices. Data was collected through surveys, in-depth interviews, and classroom observations. The study highlights the importance of emotional awareness in teaching practices and suggests that addressing negative emotions through teacher training and professional development can enhance teacher confidence and satisfaction.

Marcos-Merino and Muñoz-Losa explore the impact of an interactive physics class on affective factors of pre-service teachers, specifically in their future roles as educators using STEM-based pedagogical methods. Findings indicated an increase in both positive emotions and self-efficacy following the interactive class and a gender difference (male students reporting higher levels of positive emotions and self-efficacy).

Finally, Manassero-Mas and Vázquez-Alonso have investigated the relationship between secondary school students' perceptions of science classes and their intentions to pursue STEM careers, utilizing data from the Relevance of Science Education Second questionnaire. Approximately one-third of students expressed intentions to pursue STEM careers, with significantly higher interest among boys. Six key perceptions of science classes were identified as significant predictors of these intentions.

Together, the articles featured in this Research Topic reflect the current state of the art in the field and provide valuable insights into how affective dimension influence science learning. The findings could have important implications for both research and practice: helping educators, curriculum designers, and policymakers aiming to foster more holistic and effective STEM education practices. The editors express our gratitude to all the authors for their original and thought-provoking contributions, as well as to the reviewers for their critical insights that helped shape the final manuscripts. Their collective efforts have made an invaluable impact on this thematic compilation. We hope that the insights presented here will inspire further research and innovation at the intersection of cognition, emotion, and science education.

Author contributions

PR: Conceptualization, Visualization, Resources, Project administration, Writing – review & editing, Writing – original draft. RE: Writing – review & editing, Supervision, Validation, Conceptualization. JM-M: Conceptualization, Supervision, Writing – review & editing, Validation. AV-A: Conceptualization, Writing – review & editing, Supervision, Validation.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Generative AI statement

The author(s) declare that no Gen AI was used in the creation of this manuscript.

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