

Equipping future chemists for societal challenges: Integrating ethics and interdisciplinarity in materials science

Dorien Baeten¹, Sarah Doumen¹, Geert-Jan Graulus^{1,2}, An Hardy^{1,2}

¹*Faculty of Sciences, Hasselt University, Belgium;* ²*Institute for Materials Research, Hasselt University, Belgium*

The urgent need to address complex challenges, such as climate change, an aging population, and the energy transition, requires chemists who can exceed traditional disciplinary boundaries and act with ethical accountability. To achieve this, our materials science master's program prioritizes interdisciplinary learning via an integrated learning line that builds on the learning mechanisms proposed by the boundary-crossing theory: identification, coordination, reflection, and transformation¹. Each course within the curriculum is required to explicitly state which mechanism(s) are addressed.

This contribution focuses specifically on the two advanced mechanisms of this framework: reflection and transformation. We detail specific teaching and assessment methods (e.g., interdisciplinary projects and other active teaching methods, such as debates) employed to foster these competencies. Additionally, we discuss how teachers and students experience this integration. These results originate from a Design-Based Research study focused on monitoring and refining this interdisciplinary education.

We also further highlight how students strengthen their reflection and transformation competencies through the dedicated course *Capita Selecta*. In this course, students are repeatedly challenged to review their perspective on their education and research based on stakeholder insights. Students reflect, often in interaction with external experts, on their own activities and future ambitions through contributions focusing on applied ethics, innovation management, intellectual property rights, science communication, and science governance. This pushes them toward 'transformation', enabling them to adapt their practice and integrate ethical, societal, and ecological considerations into their problem-solving methodology.

This contribution aims to inspire educators and program directors by demonstrating how interdisciplinary learning and a dedicated course can effectively equip graduating scientists with the necessary competencies to address societal challenges in a responsible and ethical manner.

¹Akkerman, S. F.; Bakker, A. *Rev. Educ. Res.* **2011**, *81*, 132-169.