Exploring interdisciplinary education in a new science master's programme: Insights from teachers and students

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MASTER OF MATERIOMICS

Society is confronted with a series of **interdisciplinary grand challenges**, including climate change, the energy transition, global pandemics, the need for secure communication technologies, …. The development of **sustainable and innovative materials** is **critical** in the search for solutions to these societal issues.

In the Master of Materiomics, materials are studied from an interdisciplinary perspective where bridges are built not only between chemistry and physics but also between an experimental and a theoretical or computational approach.

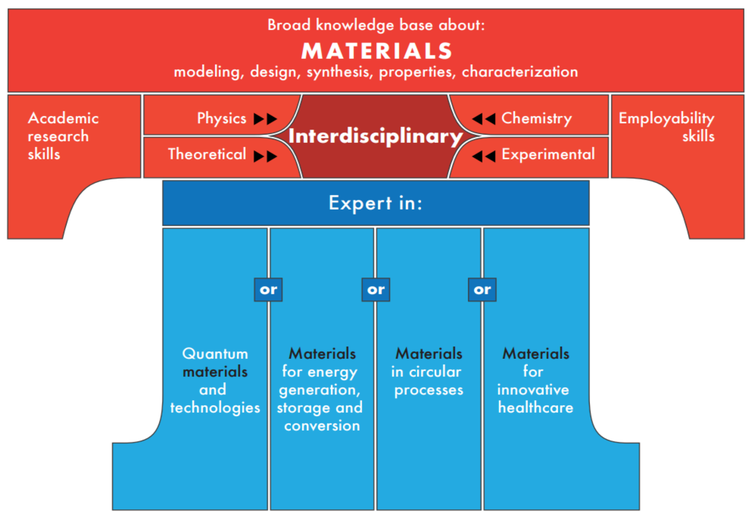


Figure 1. *Profile of the Master of Materiomics: interdisciplinary T-shaped professional. Red: solid foundation (1st master year) and blue: specialization (2nd master year)*

INTERDISCIPLINARY LEARNING LINE

Interdisciplinarity is introduced gradually throughout the curriculum, building on the four learning mechanisms from **boundary crossing theory**[1,2]:

Figure 2. *Interdisciplinary learning line*

- **Identification**: introduction to different perspectives and approaches;
- **Coordination**: making connections between the different perspectives;
- **Reflection**: considering different perspectives and learning from them;
- **Transformation**: developing new (material) solutions by integrating different perspectives.

Practical implementation into the master's programme[3]:

- Interdisciplinary learning outcomes are defined by educational management team and lecturers apply them in their courses
- Mentoring program, in which student's meet regularly with a mentor (professor) and discuss their interdisciplinary competencies development by means of a growth-portfolio.
- A design-based research (DBR) approach to collect feedback of lecturers and students

DESIGN-BASED RESEARCH & METHODOLOGY

Research questions:

? How do the teachers experience (the implementation of) interdisciplinarity in the programme? What can be improved?

How do the courses position themselves regarding the four learning mechanisms of boundary crossing theory? ?

? Which factors and teaching methods can hinder/promote the implementation of the interdisciplinary learning line?

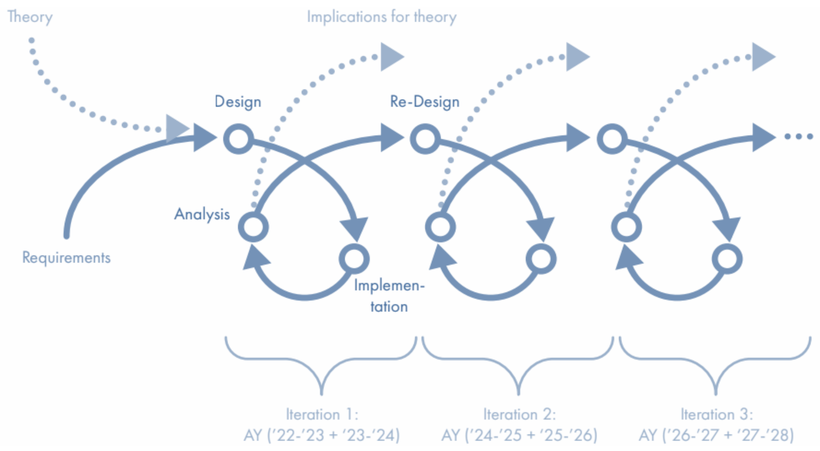


Figure 3. *Design-based research process of the master*

Focus groups:

34 interviews with

- 41 lecturers
- 15 students

Standardized set of questions, recorded interviews were transcribed, pseudonymized and analyzed.

RESULTS

Practical implementation of interdisciplinarity in the programme and factors hindering or promoting the interdisciplinarity:

A. Diverse disciplinary background of teachers and students

Team teaching → high-quality scientific content

Challenges:

- for course coordinator: ensuring interdisciplinarity in the course (instead of multidisciplinarity)
- for students: different teachers teaching in all courses → difficult to keep a good overview

Background: disciplinary distance between teachers and students

Challenges:

- for teacher: take into account the students' divers prior knowledge and rethink content (transfer) to maximise interaction
- for students: getting used to different scientific jargon

B. Selection of course content

Challenge: Balance between breadth in general knowledge and depth regarding specialist content

*"The challenge is to have **sufficient depth** but still that the content is **appealing for all students**."*

C. Teaching methods that foster interdisciplinarity

Expert lecture (seminar / guest lecture); application focused examples; **teaming model of team teaching** (complementary teaching); integrated assignments; interdisciplinary debate (role play); **assignments/projects in interdisciplinary student teams**; peer assessment; …

To think about:

→ Most of these teaching methods are perceived as very high workload by the students

→ Evaluation framework should include 'interdisciplinarity' as a criterion in the evaluation

D. Great minds think alike? Or not? Students' interdisciplinary mindset

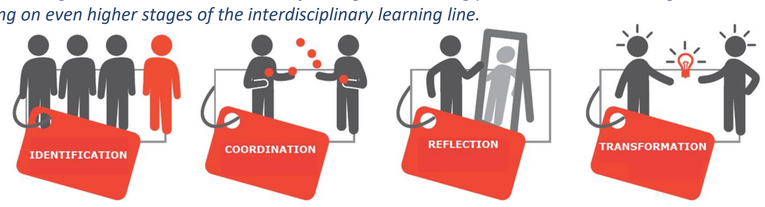
Success depends on students' willingness to submerge themselves in the interdisciplinary way of thinking

"If they start this course with a certain biased attitude from their own discipline, it cannot work here, … or be much less qualitative anyway."

Positioning of the different courses of the master's programme on the interdisciplinary learning line:

- As conceptualized
- Year 1: main focus on identification and coordination
- Year 2: gradually more reflection and transformation → master thesis!
- Regular evaluation is needed to adjust the curriculum

Table 1. *Positioning of the courses on the interdisciplinary learning line by the teachers and students. The crosses indicate how many courses work mainly on the four different stages. The check marks indicate if during that teaching period activities were organized working on even higher stages of the interdisciplinary learning line.*



Teachers' view								
First master – quartile 1		x x x x			✓			
First master – quartile 2		x	x x	x	✓			
First master – semester 2		x		x				✓
Second master – semester 1	x x	x x x x	x	x	x x x			✓
Second master – semester 2	x	x x		x x	x x x	x	x	x
Students' view								
First master – quartile 1		x x x		x				
First master – quartile 2				x x x	x			
First master – semester 2			x		x			
Second master – semester 1	x x x	x		x x x x		x		x x
Second master – semester 2	x x x	x		x		x x x	x	x x

DISCUSSION

Share your experience or ideas:

- What are suitable teaching formats to foster interdisciplinary competence development?
- How to approach iteration 2 of the DBR process?
- How to guide students towards transformation?

SCAN ME

CONCLUSION

So far, so good! These results report the effective implementation of the interdisciplinary learning line in a new materials science master's programme. Exchange of good practices between teachers and continuous monitoring the quality of the master's programme through DBR and feedback from students and teachers is needed to support the implementation.

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