Challenges faced integrating an interdisciplinary learning line in a new master in material science

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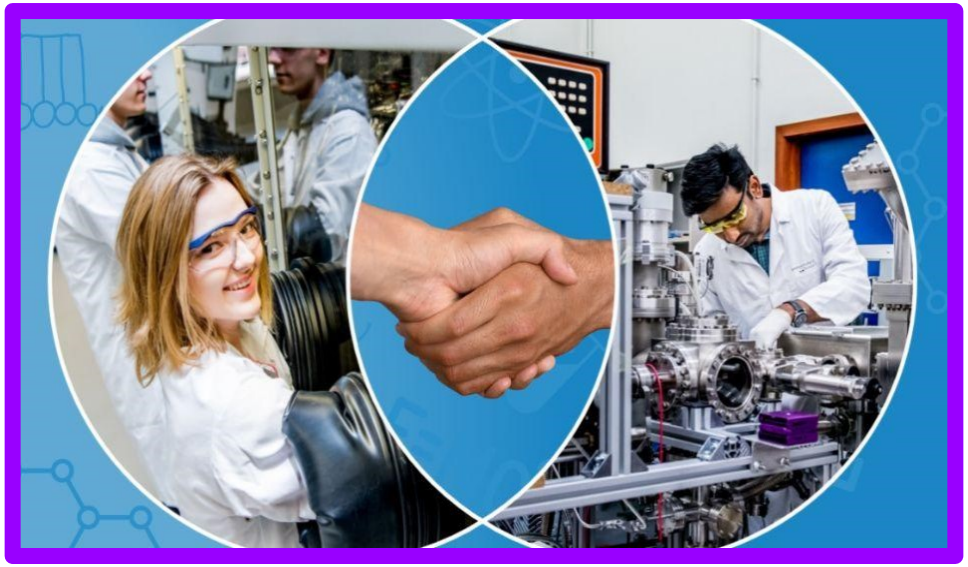
Outline paper presentation

1. Context
2. Interdisciplinary learning line
3. Mentoring program
4. Experiences of the educational teams
5. Conclusion and outlook



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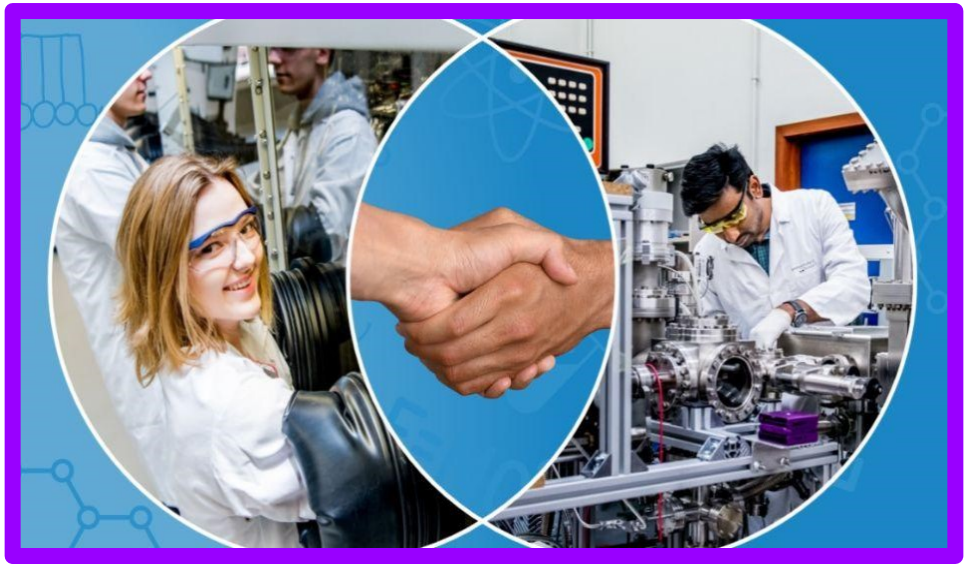

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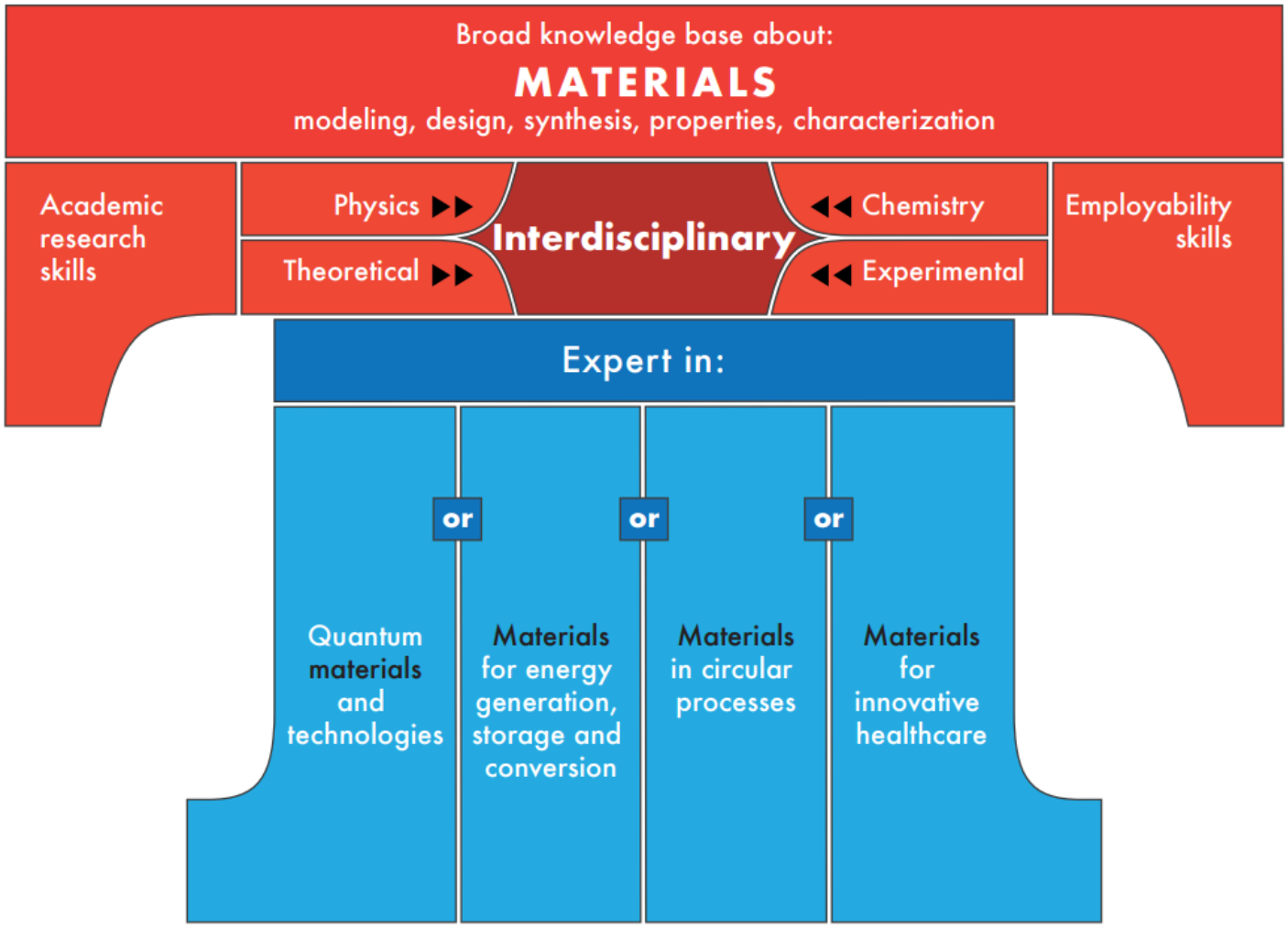
Master of materiomics?

- ★ Unique combination of **chemistry and physics of materials**
- ★ Focus on sustainable and innovative functional materials
- ★ Basis of computational AND experimental approaches
  ⇒ Interdisciplinarity to solve societal grand challenges
- ★ 4 possible areas of specialization: materials for
  - **Energy**
  - **Circularity**
  - **Quantum**
  - **Health**
- ★ Strongly embedded with research expertise of UHasselt's **Institute for Materials Research (imo-imomec)**

Profile of the Master of Materiomics: Interdisciplinary T-shaped professional



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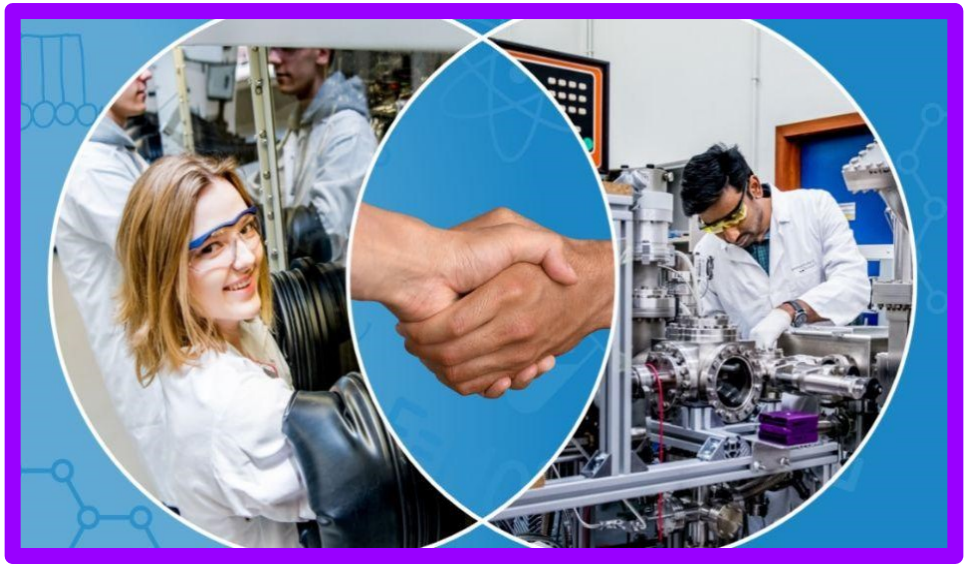

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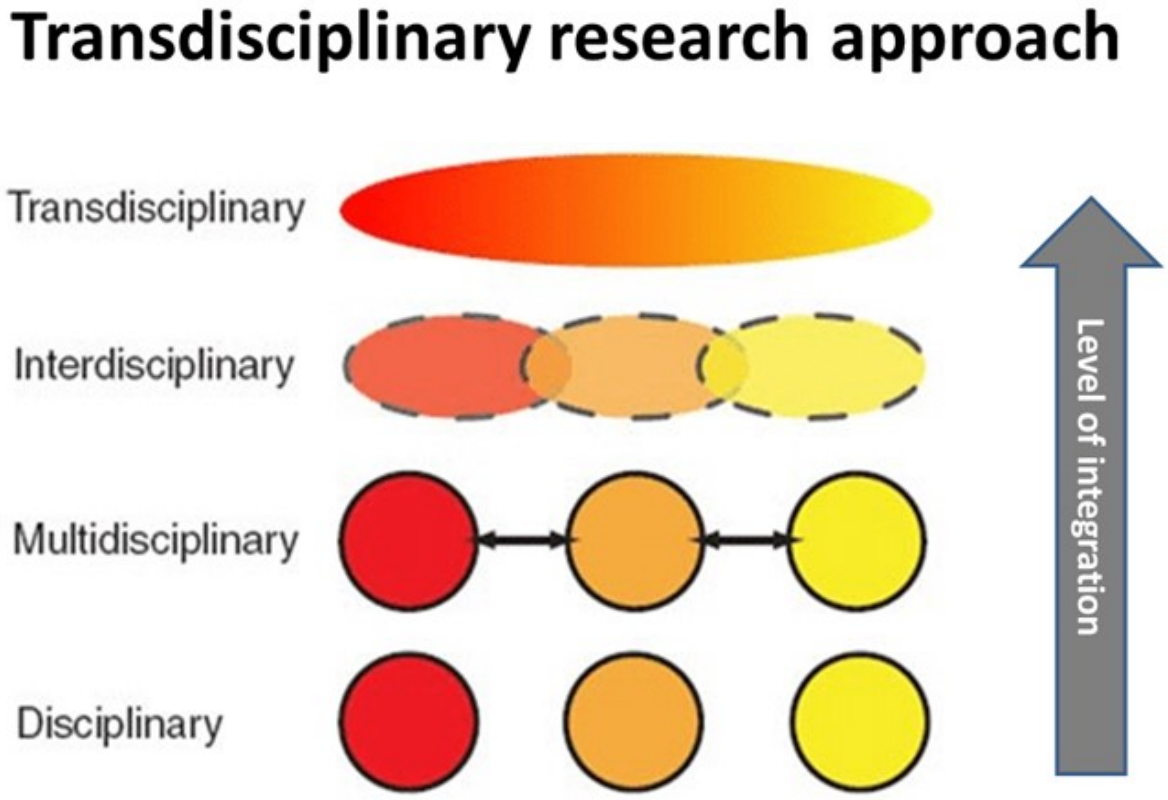
Interdisciplinary educational approach



Source: https://www.slideshare.net/PaulJCroft/education-in-a-transdisciplinary-world

Interdisciplinary learning mechanisms

(Kluijtmans, 2019, based on Akkerman & Bakker, 2011)

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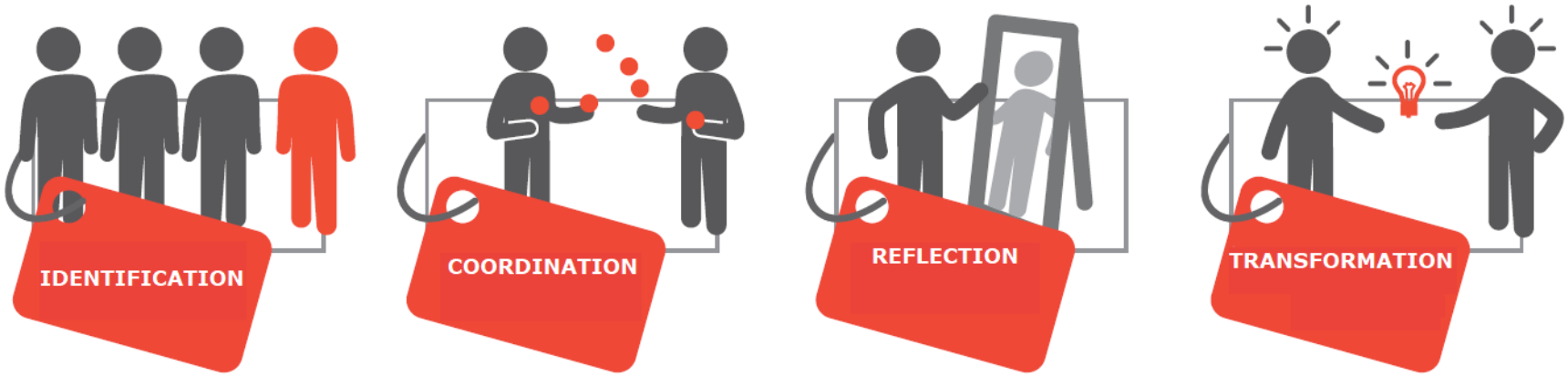
Learning goals



Much used verbs

- verify
- identify
- explain
- describe
- apply

- collaborate
- initiate
- contribute
- organize
- influence
- question
- listen

- evaluate
- consider
- take an informed position
- combine insights from
- reflect
- revise
- contrast
- weigh
- judge
- criticize
- review

- integrate
- develop
- synthesize
- operationalize
- create

From: L. De Greef, Univ. Amsterdam, November 2021

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Example Sustainable materials and energy

Learning outcomes

- EC EC 2. The master of Materiomics can combine chemical and physical principles enabling the discovery of new material concepts based on an interdisciplinary approach.
  - DC DC2.5 The student has knowledge of physical concepts and methods. [learning pathway interdisciplinarity - identification: the students knows which phenomena are studied in the various disciplines and which methods and theories are used]
  - DC DC2.6 The student is able to relate chemical and physical concepts and methods to each other to understand materials. [learning pathway interdisciplinarity - coordination: the student is able to make connections between different perspectives]
  - DC DC2.3 The student is able to devise and examine a new materials concept, taking into account sustainability aspects.
- EC EC 4. The master of Materiomics is able to autonomously consult, summarize and critically interpret international scientific literature, reference it correctly and use it to explore and identify new domains relevant to the field.
  - DC DC4.3 The student is able to critically interpret, evaluate, compare, and/or summarize relevant scientific literature related to materials-related problems or research questions.
- EC EC 6. The master of Materiomics is able to communicate in both written and spoken form and to take a well-argued position in a scientific discussion, going from a general to a specialist level, adapted to the target audience.
  - DC DC6.2 The student is able to adapt to the purpose and target audience of the communication, i.e., can empathize with the target audience and make appropriate choices regarding language use and format.
- EC EC 8. The master of Materiomics is able to act with integrity and independently judge ethical and societal implications of scientific developments in one's domain with particular attention to sustainability.
  - DC DC8.1 The student is able to explain the basic principles of sustainability.

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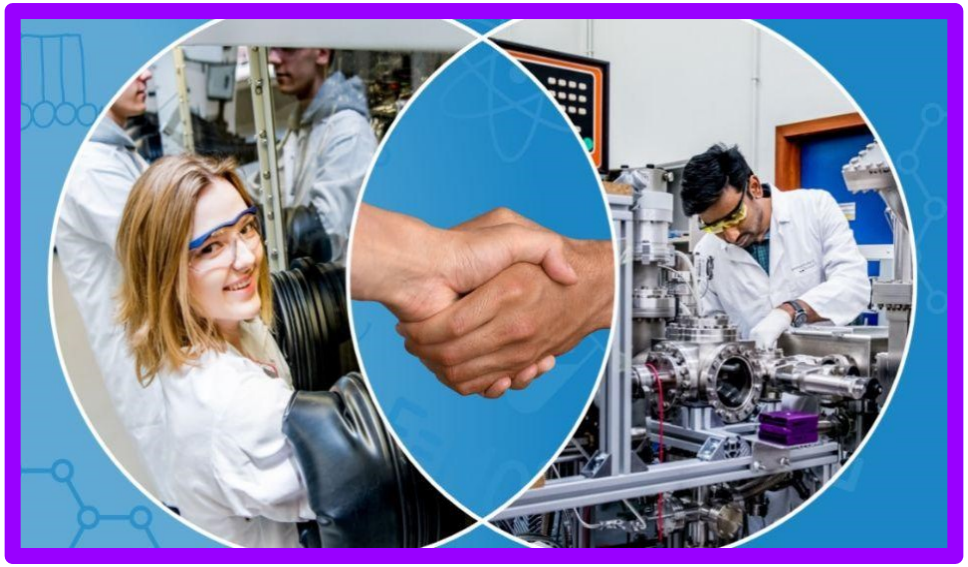

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Supporting development interdisciplinary competences: Mentor trajectory with portfolio

- Mentor = professor of the master (received guidelines)
- 3 times/year in dialogue
- Self-reflection (digital growth portfolio)
- Feedback & feed forward

- academic skills
- employability skills
- interdisciplinary competences

Rubric	Started	Developing	According to expectation	Competent
The student is able to relate chemical and physical concepts and methods to each other to understand materials	descriptor	descriptor	descriptor	descriptor
Interdisciplinary learning outcome 2	descriptor	descriptor	descriptor	descriptor

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Experiences students and mentors

- Students
  - not easy to prepare
  - meeting with mentor experienced as positive
  - sincere interest of the mentor
- Mentors
  - Depending on the student (more introvert/extravert)
  - In general positive experience
  - Open conversation
  - Also other topics (well-being, study load, internship,...) were discussed

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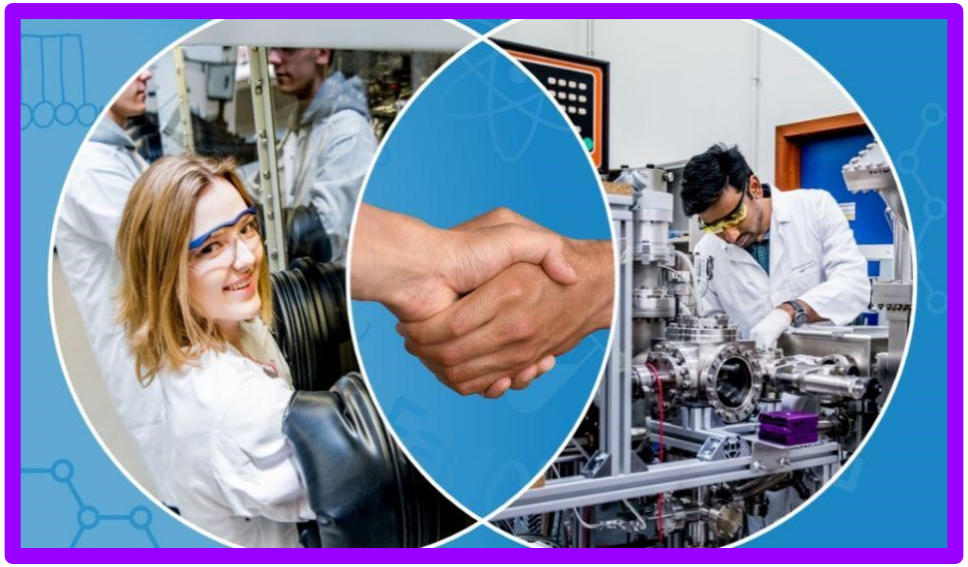

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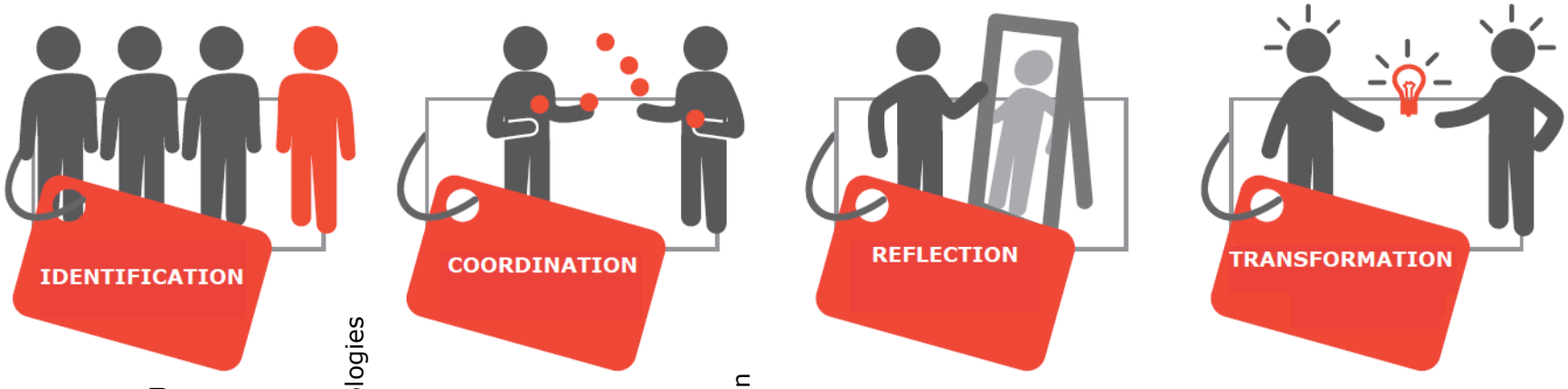
Interdisciplinary learning line



Fundamenten voor materiaalchemie
Fundamenten voor materiaalfysica
Fundamenten voor materiaalmodellering

Advanced materials for emerging technologies
Materials design and synthesis

Eigenschappen van functionele materialen

Sustainable materials and energy
Materiomics hands-on project

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Experiences of the 8 educational teams (focus groups)

Challenges	Tips
★ Differences in preknowledge ★ Balance between depth of content and width (quantity of topics) ★ How to evaluate interdisciplinarity? ★ Course organisation	★ Have course content reviewed by an expert from a different discipline ★ Providing applied examples ★ Teaching method with interaction between 2 experts ★ Support students to study learning material together ★ Assignment spanning the entire course (e.g., paper assignment / debate) ★ Open communication / organisation between coordinator of the course and educational team

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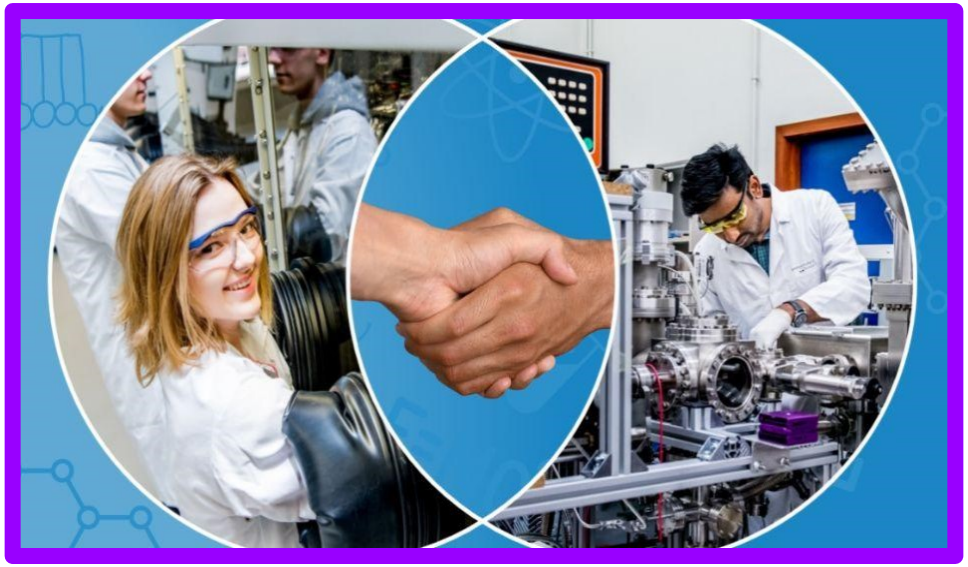

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Conclusion

- So far, so good
- Importance of monitoring the implementation of the interdisciplinary learning line
- Challenges to address → design-based research to improve interdisciplinary boundary crossing further in the curriculum
- In co-creation with students and lecturers
- Based on scientific insights

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Where to next? Materiomics…

- Supporting implementation through **design-based research** and **feedback** from students and teachers
- **Teacher professionalization** and exchange of good practices on the subject (within and outside the program)
- **Facilitating interdisciplinary teacher teams, development of interdisciplinary courses and methodologies** (e.g., applying design thinking (Melles, 2020); workshops that support the four boundary crossing learning mechanisms; Oonk, Gulikers, den Brok, & Mulder, 2022)**, tools related to the evaluation of interdisciplinary competences** (Gulikers & Oonk, 2019),...

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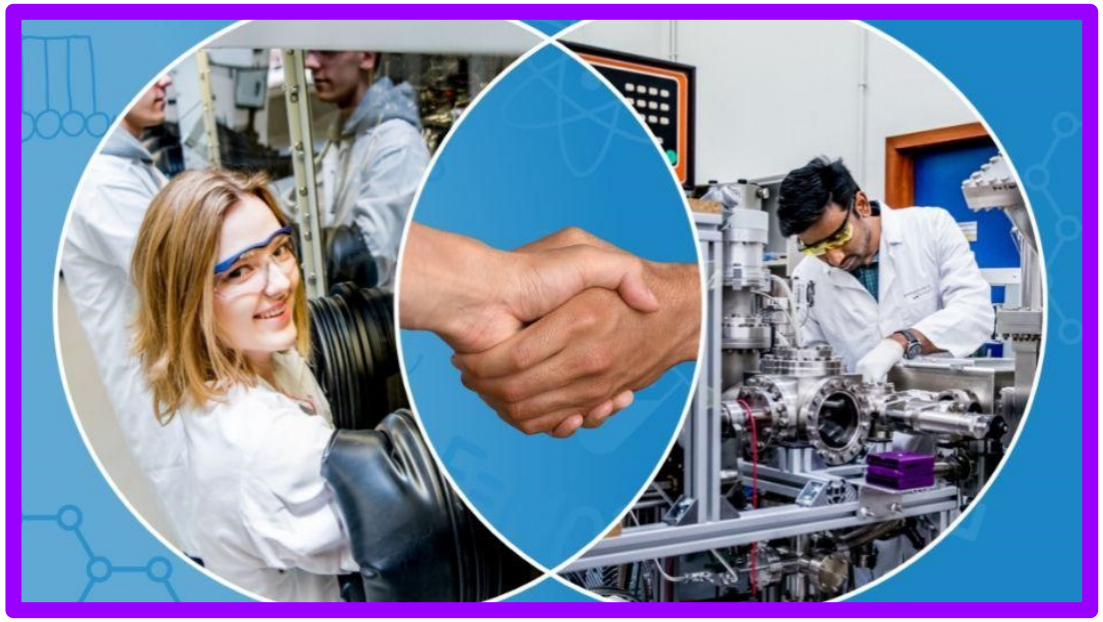
Do you have questions? suggestions? …

Thank you!



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Further reading

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