STUDENTS' LEARNING GAINS IN CHALLENGE-BASED LEARNING

What do students learn and what learning experiences contribute to their learning gains?

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CHALLENGE-BASED LEARNING (CBL)

- Prepare students to contribute to Grand Societal Challenges (Tassone et al. 2017)
- CBL = interdisciplinary experience where learning takes place through identification, analysis and collaborative design of sustainable and responsive solutions to real-life problems (Malmqvist, Kohn-Rådberg, & Lundqvist, 2015).
- Working with societal partners, stakeholders and citizens
- To challenge future generations: making an impact while acquiring skills

EWUU CHALLENGES (2023)

BITT CHALLENGE
BIO-TECH-MED NUTRITION INTERDISCIPLINARY TEAM TRAINING

Besides tackling their disease, patients and experts experience other disease-related challenges. They face challenges that can be technical, medical, nutritional, or a combination of all. In order to tackle these challenges, we place the patient in the middle.

DUTCH DAIRY CHALLENGE

The rapid growth and development of the Dutch dairy industry has brought a lot of challenges. These are related to the influence on our landscape, the pressure on biodiversity, the reduction of emissions and the improvement of animal welfare. The transition to a sustainable dairy industry that respects animals and the environment is a complex endeavor that will require all involved parties to cooperate and work together on solutions.

INTERUNIVERSITY SUSTAINABILITY CHALLENGE

THE CITY OF 1,5 DEGREE
What will a city look like at 1.5 degree Celsius temperature increase, or what should a city look like? Global warming requires us to change and adapt. Where will we live, how do we travel, what will our grocery store look like, and many more questions and issues come up. We need solutions for these matters, and we need them fast.

PLANETARY HEALTH AND CLIMATE RESILIENT HEALTH SYSTEMS CHALLENGE

Our daily activities, consumption and exploitation of natural resources are putting enormous stress on our planet and are unsustainable. The health and survival of humankind and the planet are inseparable. Planetary health aims to identify new pathways that will support the renewed relationship between humans and Earth's natural systems – in a way that society can continue to responding to their needs without overburdening their environment and the Earth's natural systems.

Introduction | Previous Study | Current Study | Theoretical Framework | Methodology | Preliminary Results | Conclusion
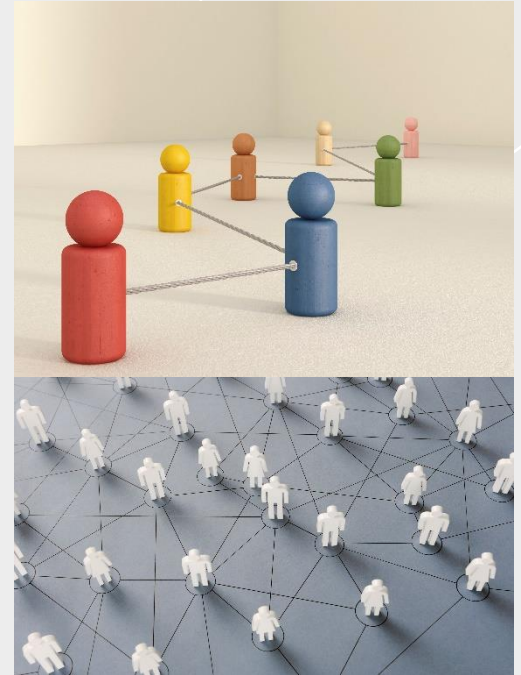
PREVIOUS STUDY (2022)

*Research conducted by the team: Gemma O'Sullivan, Cassandra Tho, Yvette Baggen, Despoina Georgiou, Heleen Pennings, & Antoine van den Beemt

Investigate students' network in CBL

- **WHO** are students contacting?

- **WHAT** are students contacting them for?

- **HOW VALUABLE** are these actors to the students?

Key results

- Students reach out most to teammates and experts, but also family and friends

CURRENT STUDY (2023-2024)

Exploration of students' learning in CBL

What are students' **perceived learning gains** while participating in CBL and which **learning experiences** impact those learning gains?

LEARNING GAINS FRAMEWORK (VERMUNT, ILIE AND VIGNOLES, 2019)

Cognitive	Metacognitive	Affective	Socio-communicative
• Critical thinking • Analytical thinking • Problem-solving	• Self-regulation • Life-long learning attitude • Learning to learn	• Attitudes towards own discipline and towards learning • Motivation to learn	• Social embeddedness • Communication skills

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RESEARCH METHODOLOGY

RESEARCH DESIGN
Explorative,
qualitative

DATA COLLECTION
Semi-structured
interviews

PARTICIPANTS
N=19 students
*from TU/e, WUR, UU,
UMCU*

DATA ANALYSIS
Abductive thematic
analysis (Thompson, 2022)

RESULTS: LEARNING GAINS

Socio-communicative 39%

Engagement with others, perspective-taking

Affective 17%

Motivation & inspiration, Emotional struggles

Cognitive 30%

Content & procedural knowledge, reasoning abilities

Self-regulation

Meta-cognitive 14%
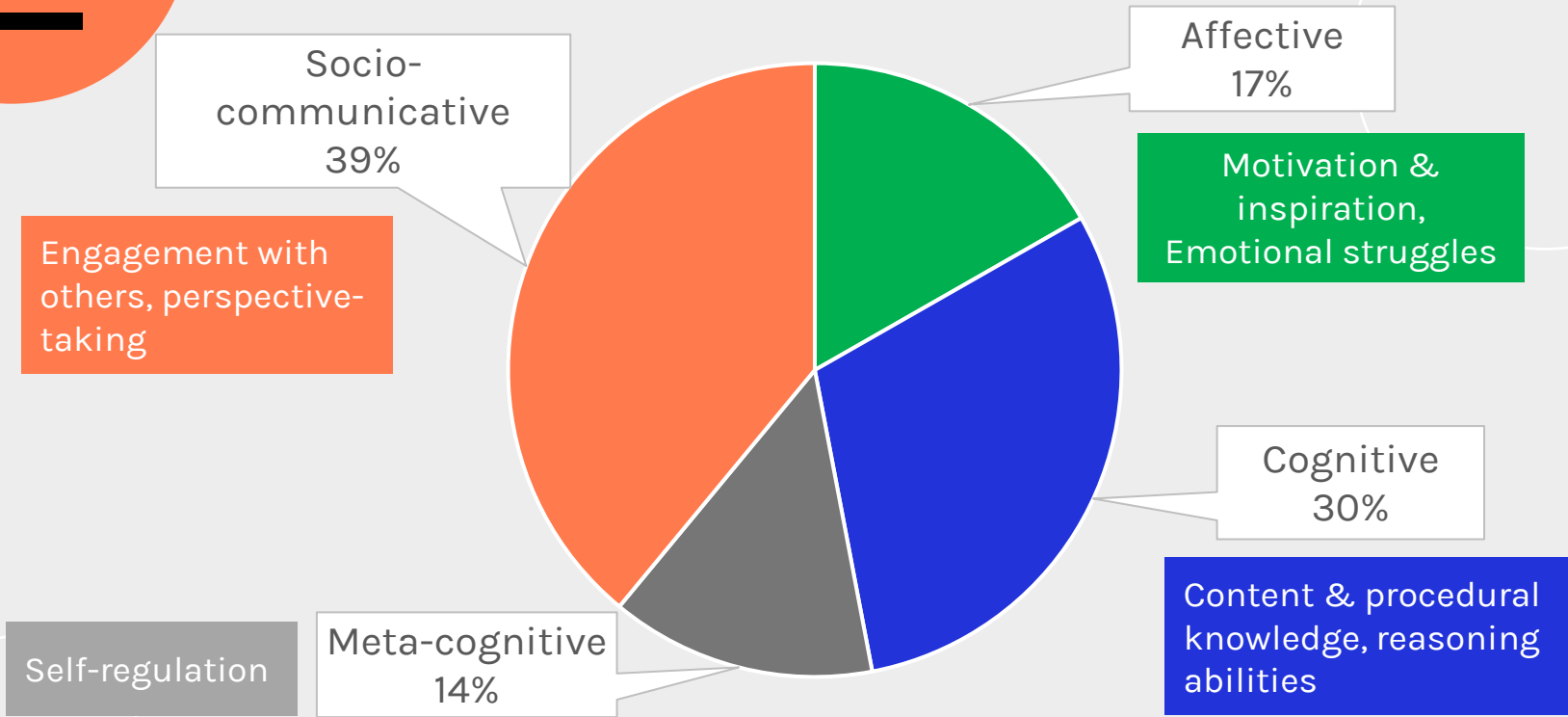
RESULTS: LEARNING EXPERIENCES

Most of the learning gains were linked to:

- **Working in teams**
- **Interaction with stakeholders**
- **Working on challenge outputs**

◆ ○ LE_challenge organised moment { 32 - 0 }
◆ ○ LE_interaction with coach { 14 - 0 }
◆ ○ LE_interaction with course academics { 3 - 0 }
◆ ○ LE_interaction with stakeholders { 63 - 0 }
◆ ○ LE_observation of others { 6 - 0 }
◆ ○ LE_overall reflection of experience? { 1 - 0 }
◆ ○ LE_searching for information on topic { 14 - 0 }
◆ ○ LE_set-up of challenge { 11 - 0 }
◆ ○ LE_while overcoming challenges { 12 - 0 }
◆ ○ LE_working in teams { 116 - 0 }
◆ ○ LE_working on challenge outputs { 62 - 0 }
◆ ○ LE_working on own learning goals { 3 - 0 }

SOCIO-COMMUNICATIVE: PERSPECTIVE-TAKING

C6: Maybe also seeing like the different types of people and also like seeing the value of it because, for example the engineering student she was really like, concerned, or not concerned, but like really into the details [...]

*For example, we had to do the poster. And then she was really in the details of the posters that I was like "whoa, this is such an added value." It's like the first time I really experienced that **because people are different, they can bring different things to the group**... and it's really beneficial...*

Working in teams

Working on challenge outputs

SOCIO-COMMUNICATIVE: INTERDISCIPLINARY LEARNING

*C3: I think we just have very different backgrounds and therefore **we have different ideas of what is the good way of treating a patient or a good way of finding an intervention**. [...]*

I think also in my future, there's a high chance that I will work together with doctors, nurses or people with that background again. So I think the Challenge contributed to me knowing how they think... and that they prioritize treating before preventing.

Working in teams

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META-COGNITIVE: SELF-REGULATION

*A2: I also learned to work independently. Because this was not the teacher telling you what to do... you just had deadlines and you had to figure out like, yeah, when to do your stuff. So it also helped me to learn **how to work independently, plan myself and get the job done** [...]*

Set-up of challenge

CONCLUSION AND TAKEAWAYS

- CBL provides plenty of learning opportunities
- Good way to learn about perspective-taking and interdisciplinary learning
- Student suggestions: networking session, prototype making
- Take note of the meta-cognitive and affective side of learning too, e.g. by organizing reflection moments

FURTHER RESEARCH

- **What do students specifically learn between institutions and how can that learning be best supported**

- **Learning processes that take place in CBL**

- **Better understanding of interdisciplinary and transdisciplinary learning in relation to adaptive expertise**

LET'S CONTINUE TO CHALLENGE FUTURE GENERATIONS

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REFERENCES

Malmqvist, J., Rådberg, K. K., & Lundqvist, U. (2015). *Comparative analysis of challenge-based learning experiences.* Proceedings of the 11th International CDIO Conference, Chengdu University of Information Technology, Chengdu, Sichuan, PR China. Retrieved from http://rick.sellens.ca/CDIO2015/final/14/14_Paper.pdf

Tassone, V., O'Mahony, C., McKenna, E., Eppink, H., & Wals, A. (2017). (Re)designing higher education curricula in times of systemic disfunction: a responsible research and innovation perspective. *Higher Education*, published online. https://doi.org/10.1007/s10734-017-0211-4

Thompson, J. (2022). A Guide to Abductive Thematic Analysis. *The Qualitative Report.* https://doi.org/10.46743/2160-3715/2022.5340