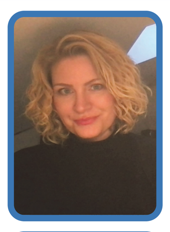
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Digital Cooperative Learning

Introduction

There are several ways higher education may meet Goal 4 (Education) of the 2030 Agenda for Sustainable Development.

In this study we chose to focus on two of these:

- Digital teaching as a means to equal opportunities, accessibility, and competence.
- Development of student generic skills, i.e. skills which operate across various contexts, predict success in life, and help students navigate in and adapt to an unpredictable future (Heckman & Kautz, 2012; Taber, 2016).

…and explored a teaching strategy combining the two:

- Digital cooperative learning (CL). CL differentiates from other types of collaboration by being a highly structured form of group work, hypothesized to develop students' generic skills (Millis & Cottell, 1998). Previous research in undergraduate STEM education supports this hypothesis, at least in physical learning environments (Canelas et al., 2017; Pilcher et al., 2015).

Figure 2. Implemented CL structures: Jigsaw method

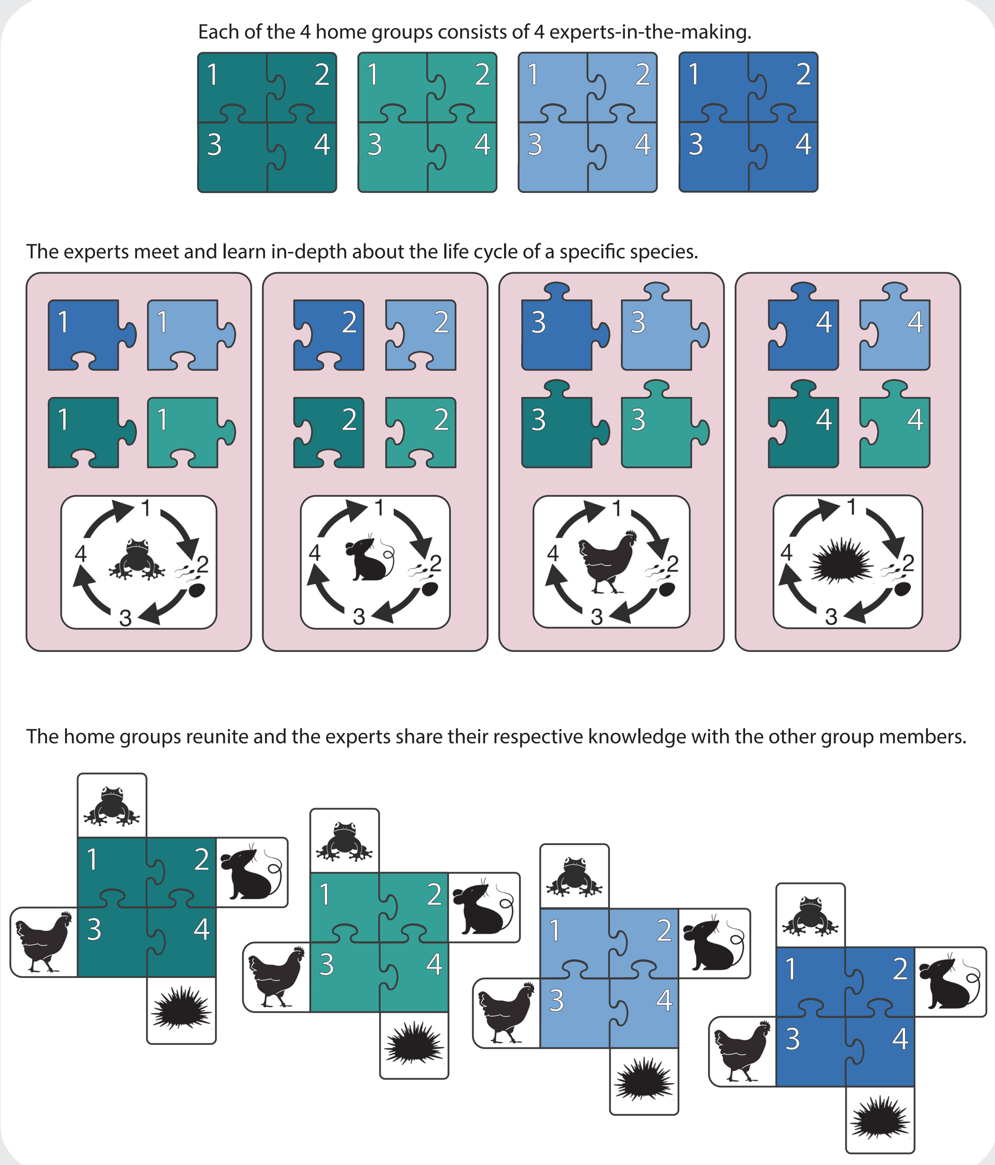
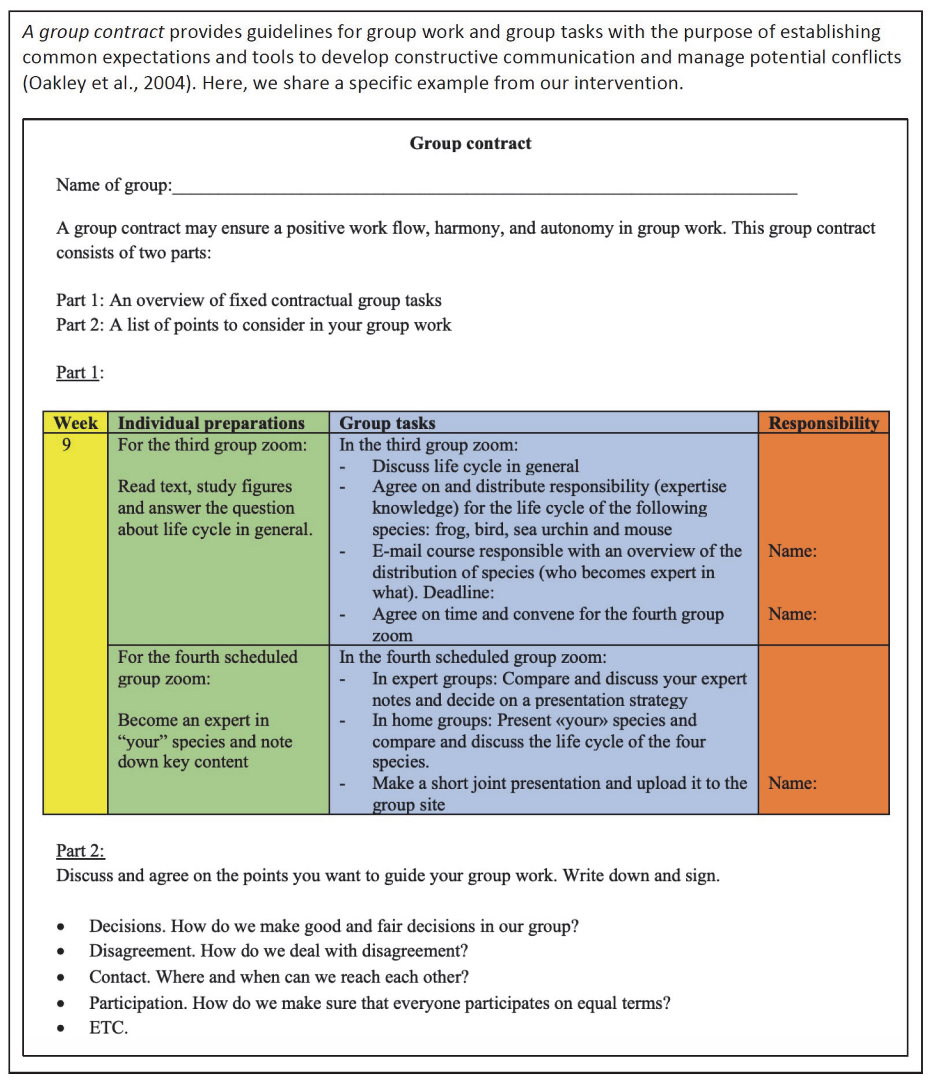


Figure 3. Implemented CL structures: Group contract


A group contract provides guidelines for group work and group tasks with the purpose of establishing common expectations and tools to develop constructive communication and manage potential conflicts (Oakley et al., 2004). Here, we share a specific example from our intervention.

Group contract

Name of group:________________________________

A group contract may ensure a positive work flow, harmony, and autonomy in group work. This group contract consists of two parts:

Part 1: An overview of fixed contractual group tasks
Part 2: A list of points to consider in your group work

Part 1:

Week	Individual preparations	Group tasks	Responsibility
9	For the third group zoom: Read text, study figures and answer the question about life cycle in general.	In the third group zoom: - Discuss life cycle in general - Agree on and distribute responsibility (expertise knowledge) for the life cycle of the following species: frog, bird, sea urchin and mouse - E-mail course responsible with an overview of the distribution of species (who becomes expert in what). Deadline: - Agree on time and convene for the fourth group zoom	Name: Name:
	For the fourth scheduled group zoom: Become an expert in "your" species and note down key content	In the fourth scheduled group zoom: - In expert groups: Compare and discuss your expert notes and decide on a presentation strategy - In home groups: Present «your» species and compare and discuss the life cycle of the four species. - Make a short joint presentation and upload it to the group site	Name:

Part 2:
Discuss and agree on the points you want to guide your group work. Write down and sign.

- Decisions. How do we make good and fair decisions in our group?
- Disagreement. How do we deal with disagreement?
- Contact. Where and when can we reach each other?
- Participation. How do we make sure that everyone participates on equal terms?
- ETC.

Study design

One-group pretest/posttest quasi-experimental design with a double pretest and follow-up (Figure 1).

CL elements

- Cooperation as a learning objective in the course description.
- Heterogenous, long-term groups of four students based on gender, age, and study program.
- Jigsaw structures (Figure 2) and group contracts (Figure 3).

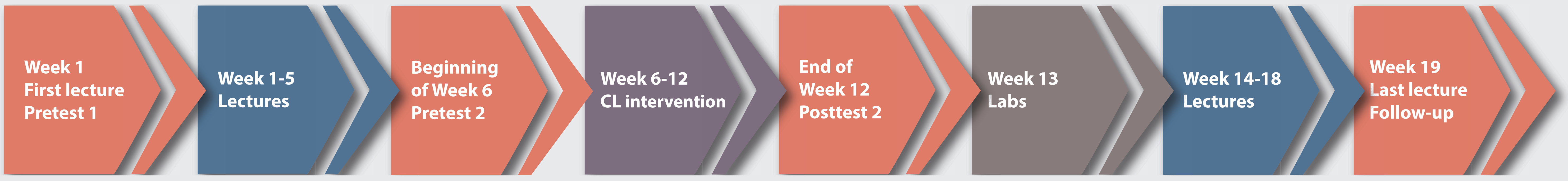
Measures

Subscale "Generic skills" in the Course Experience Questionnaire (CEQ) (Ramsden, 1991).

Participants & setting

71 undergraduate biology students (55% females and 45% males) at the University of Bergen, spring 2021.

Figure 1. Overview of measurement times and digital teaching during the intervention semester



Results

Generic skills changed over time, with a very large effect size* (η_p^2= .44).

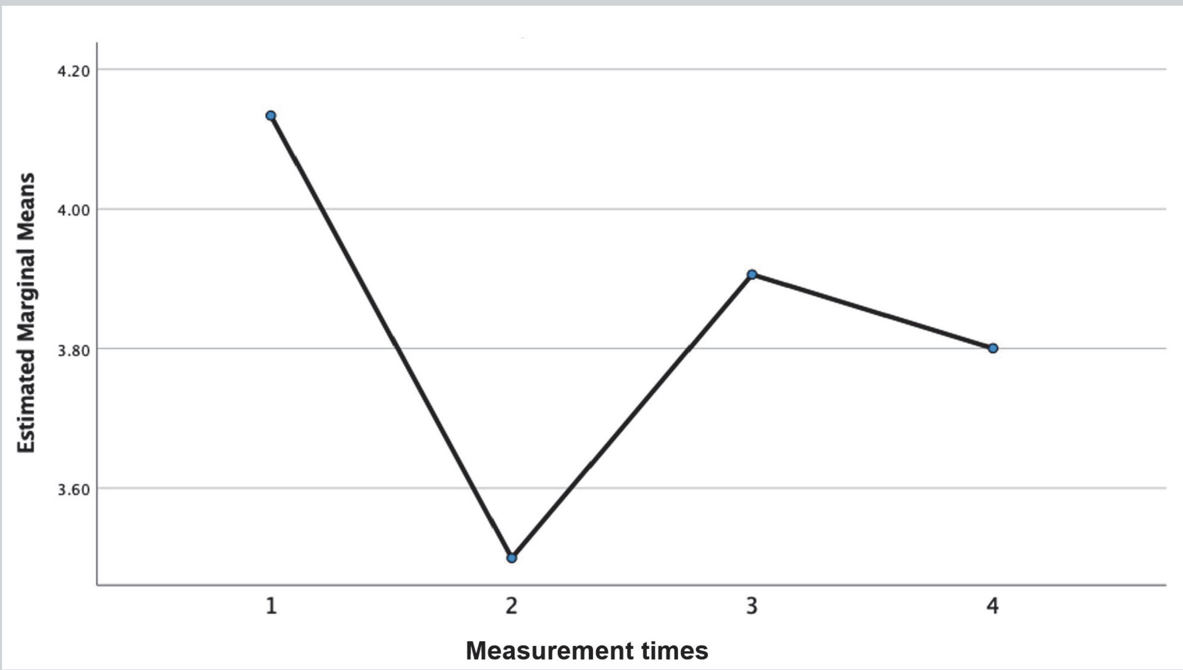
Beginning (measurement 1): the students scored relatively high (4.13 on the Likert scale) on perceived generic skills.

After 5 weeks of digital lectures (measurement 2), student's generic skills (-.63 [95% CI, -.92 to -.35] p<.05) had decreased significantly to 3.50.

After 5 weeks of CL (measurement 3), this trend was significantly reversed, as generic skills (.41 [95% CI, .14 to .67] p<.05) reached 3.91.

After yet another 5 weeks of digital lectures (measurement 4), generic skills dropped to 3.80 (not significant).

Figure 4. Measurement of perceived generic skills



* Partial Eta squared may be considered small (η_p^2 >.01 to .05), moderate (η_p^2 >.06 to .13), or strong (η_p^2 >.14) in magnitude (Cohen, 2013).

Observed outcomes

Extensive group dialog and student well-being.

Quality of the student work and student retention comparable to previous years, despite the pandemic.

Conclusion

Our study supports previous hypotheses (Millis & Cottell, 1998) and research (Canelas et al., 2017; Pilcher et al., 2015) on the effect of CL on generic skills, albeit in a *digital learning environment*.

Our very large effect size may suggest that the effect of CL on generic skills in digital settings is at least as substantial as it is in physical settings.

Taken together with the drastic decrease in generic skills after the first period of digital lectures, we argue that generic skills may be particularly vulnerable to traditional instruction in a digital setting.

Extensive group dialog and student well-being possibly dependent on fixed long-term groups in digital settings.

References

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