Utrecht University

Best practices for online inter-university teaching

Experiences from teaching the inter-university sustainability course

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Contents

Preamble

This document shows best practices for designing and implementing interdisciplinary and online courses in higher education, designed by teachers from two or more universities[1]. It is the result of a study of a newly developed course, the Inter-University Sustainability Challenge, by three universities: Utrecht University, Wageningen University & Research and Eindhoven University of Technology. This course was delivered within the Strategic Alliance that includes these universities.

Combining forces in the development and implementation of courses has many advantages. Students learn to collaborate with students of other backgrounds and other university cultures; course developers and lecturers can benefit from the knowledge base and didactic experiences of other teachers. At the same time, developing a course across disciplines and universities is challenging, as many boundaries are transgressed, such as: content, organization of the course teams, didactic principles, study schedules, allocation of study credits and even students' privacy aspects.

Very prominent is the aspect of physical distance between the universities. Face-to-face lectures with students on a weekly basis or more frequently, will often be impossible. Therefore, most teaching activities will need to be online – both synchronous and asynchronous.

For designing courses, a body of literature and manuals exist. However, currently there is no such document to support teachers and coordinators interested in inter-university education. In this document, the focus is on interuniversity education in general and on online and inter- and transdisciplinary education specifically.

This document was developed based on the research and experiences of students, teachers and coordinators from two iterations of the bachelor course Inter-University Sustainability Challenge, and core literature. The study team that evaluated the course was funded through the SURF Open Online Onderwijs-scheme (project: Education of the Future: Synchronous Online Interdisciplinary Sustainability Education using the Virtual Classroom). The course team has also received funding from the Strategic Alliance for teacher capacity and funding from the UU Geosciences Deans fund for additional research on online challenge based learning.

The inter-university Sustainability Challenge course was designed as an online course to minimize the need for travel and to maximize course participation while following other courses at the students home institute. The first course iteration took place in February – April 2021, during the Covid-19 pandemic. Under normal circumstances, most other courses of the students that participated in the course would have been face-to-face, with this online course as the exception. As it happened, during the pandemic almost all courses were taught online. Therefore, these students may have experienced motivational challenges.

[1] This document is based on development and implementation of a course designed for bachelor students. However, the principles described below apply to courses for master students as well.

1. Introduction

Interuniversity courses have added value in a student's curriculum, as mentioned by the Strategic Alliance of TU/e, WUR, UU and UMC Utrecht: 'The academics of the future learn to combine the knowledge from their disciplines and their expertise with a broad scale of interdisciplinary and transdisciplinary knowledge and skills. This allows them to cooperate and communicate in a complex, diverse context with colleagues from other disciplines and with partners from outside of the academic world.' Further: 'The institutions jointly create innovative curricula' and 'develop teaching methods such as challenge-based learning' and 'promote the exchange of students and lecturers on behalf of multidisciplinary, interdisciplinary and transdisciplinary education'.[2]

For this document, the terms 'interdisciplinary' and 'transdisciplinary' as defined by Tress et al. (2005) are used:

- interdisciplinary studies: "studies that involve several unrelated academic disciplines in a way that forces them to cross-subject boundaries to create new knowledge and solve a common research goal."(p. 179)
- transdisciplinary studies: "studies that both integrate academic researchers from different disciplines with non-academic participants, such as land managers and the public, to create new knowledge and research a common goal. " (p. 179).

Alternatively, Boix Mansilla & Duraising (2007) drafted another definition of interdisciplinarity, now also widely used: "the skill to integrate knowledge and modes of thinking from two or more disciplines which results in a cognitive advancement, such as the explanation of a phenomenon, solving a problem or producing a product, which would not have been possible if solely the knowledge of one discipline had been used".

This document was designed by evaluating the design and implementation of a new course, the Inter-University Sustainability Challenge (IUSC). This course was delivered twice, in February-April 2021 and 2022. Most of its development took place in the period September 2020-january 2021. After the first iteration, the course team revised the course.

A research team of two persons monitored the design and implementation of the course and carried out the evaluation. These researchers did not teach in the course or assess course products. The research team:

- Attended the design phase of the course team;
- Observed the live online sessions during the course;
- Evaluated (but not graded) the student's products (reports and presentations);
- Evaluated the course among students through questionnaires and a focus group;
- Evaluated the course among lecturers through one-on-one interviews.

The present document was developed based on these evaluations and observations.

[2] https://ewuu.nl/en/education/

2. Organizing interdisciplinary collaboration of staff

2.1. Setting up the course team

Start

Especially for courses where staff from various universities collaborate, the course team needs to be set up timely. Preferably, each university is represented by a principal teacher, who coordinates the course on behalf of their university. They are responsible for carrying out the tasks assigned, and tasks relating to contact with the university's education administration, etc. The principal teachers also act as contact point for other teachers from their institute. Before the start of course design, the principal teachers have already reached common grounds about the main topic, objectives, main concepts and definitions, student populations targeted, and teachers' disciplines required. Based on this brief course outline, additional teachers/staff can be asked to join the course team.

In case not all team members know each other, it is recommended to organize several sessions - in person or online - for getting acquainted, and for reaching agreement about course aims, content, student skills, definitions, and language. If team members join at a later stage during course development, they should be updated explicitly about the design status and be involved in the following decision-making process.

Capacity, roles

Each course team member has their organizations' commitment and has sufficient time/budget for their role during course design, teaching and evaluation. From the start or as soon as possible, the roles and available time for each course team member is clear for each of the phases (design, teaching and evaluation). The course team not only decides who will teach or coach; time-consuming tasks such as building a digital learning environment, giving feedback to students, and grading student's assignments are divided as well. If needed, additional staff or teaching assistants are deployed. If applicable and possible, administrative tasks should be divided among the team. The number of teachers that will teach during the course needs to be limited. If too many teachers are involved, they may get less connected to the course and the students. Moreover, as the students need to get acquainted with the teachers, the number of teachers needs to be limited. While designing a new course, each course team member will enter unknown territory. This may result in feelings of uncertainty about new collaborations, new disciplines, university cultures, new didactic formats. Team members are advised to discuss these feelings of uncertainty and question each other regularly to minimize these uncertainties.

Leadership

One of the principal teachers is the project leader, often (s)he will also be course leader. The project leader is responsible for setting the agenda, leading course team meetings, organizing communication and the decision-making process, course budget and for meeting deadlines. In addition, the project leader sees to it that the various roles during the process of design and teaching of the course are clearly divided. The project leader is also responsible for keeping a good atmosphere during the course team meetings. If the project leader's needs to delegate tasks, the preferred option is to have two roles:

- Inspirator, who is chairperson, communicator, main lecturer.
- Coordinator, who writes minutes and ensures that the deadlines are set and met.

2.2. Organization of course design

Progress meetings

During the phase of course design and delivery, the course team holds regular progress meetings, preferably weekly towards the course implementation. Specific tasks are assigned to task forces that report to the progress meeting. The project leader installs proper meeting procedures, with meeting agenda's, minutes, and action points.

Step-by step documentation

For the design, the various steps need to be made explicitly and should be documented in a working document (or set of documents), accessible online for the course team. This document contains with the building blocks for the course including:

- Planning of design (long term and weekly),
- Main course topic and course objectives,
- Description of the student target population,

- Overall educational approach (e.g. challenge-based or problem-based learning, use of the design or research cycle),
- Learning activities,
- Assignments and course products,
- Course schedule,
- Participating (guest) lecturers, coaches, roles,
- Assessment and grading,
- Online platforms used,
- Course administration,
- Promotion/student enrolment.

Decision-making
As many of these aspects will be amended more than once, some even during course delivery, careful documentation of the decisions made and changes in the course is required. It can be useful to have a flexible course design, e.g., not all contact hours are scheduled in advance. This enables the course team to respond to students' needs during the course. This type of flexibility should be anticipated and scheduled in advance.

Collaboration
Interdisciplinary courses require the collaboration of pairs/teams of teachers (representing complementary disciplines), in the design phase. In this way, the interdisciplinary nature of assignments course elements and their suitability to the various students' cohorts is safeguarded. The teams should constantly address the interdisciplinary aspects of course content and assignments. A major risk is that during the course, student teams will address assignments in a multi- instead of *inter*disciplinary way, in which students need to integrate their know-how and skills.

Over-arching didactics
From the inter-university perspective, the course team needs to pay special attention to overarching didactics, such as challenge-based learning, use of design- or research cycles and the scale of education. Most probably, the experiences that teachers have will differ between universities and disciplines of both teachers and students. Therefore, choices for the main didactic approach need to be made carefully, taking in consideration the consequences for students and teachers. Becoming familiar with didactical approaches that are different, maybe even contradicting the teachers own approach, is a learning process that requires time, openness, and flexibility. A training about the applied didactical approach, the used tools, lesson design, teaching goals and interaction methods can help teachers to understand and reflect their own teaching style.

Communication platforms
For clear communication, at an early stage, the course team needs to select easily accessible data storage facilities in the Cloud (e.g. SURFdrive or MS Teams) for:

- synchronous online communication,
- keeping track of course documents, action points,
- online repository for storing data (such as draft designs, course materials).

In the Inter-University Sustainability Course (IUSC) we used different platforms for different purposes. The course itself and all the course material was provided at Brightspace, a platform used at Wageningen University. Teachers as well as students from Utrecht & Eindhoven needed to get used to this new interface. Additionally, teachers needed to get the rights to access the platform. MS Teams from Wageningen was used for student-coach meetings as well as tutorials provided by coaches. Here we dealt with some difficulties since students and teachers from Utrecht and Eindhoven had to switch from their regular MS Teams account to a newly created Wageningen MS Teams account. The Virtual Classroom at Utrecht University was used for interactive, synchronous online lectures. Students could log-in online while the teacher(s) would teach from the classroom at Utrecht University. An overview of learning platforms used is shown in table 1. These platforms should meet the GDPR-regulations. The repository should include proper folders and be updated continuously. As course design is an intensive phase, staff members may miss important messages. Therefore, sending emails about the course design and organization should be limited. Instead, members should add their texts, remarks, and materials to the online repository.

Table 1. Communication technologies applied in online, interdisciplinary, inter-university course

	Brightspace via Wageningen University	**MS Teams** via University accounts	**Virtual Classroom** via Utrecht University license
Communication between teachers		X	
Communication between students		X	X
Communication between students and teachers	X		X
Synchronous lectures			X
Tutorials		X	
Coaching sessions		X	

Course alignment
In courses developed by a group of teachers, all contributing individually or in teams, there is the risk that the common 'thread' of the course gets out of sight. The common thread, that aligns course objectives, content, didactic approaches, with assignments and learning outcomes. All, in particular the project leader, should continuously keep track of the coherence of the course. Otherwise, the students may be offered a fragmented set of lectures and assignments. Therefore, it is advised to provide a concise course guide, containing learning aims, activities, sessions, and deliverables.

Take away messages
- Before course design, spend time setting up the course team, getting acquainted and dividing project roles and tasks.
- Carefully archive and monitor decisions and tasks.
- Early in the process, pay explicit attention to overall course didactics.
- Make sure that all teachers and students have the rights to access all platforms. One platform that is accessible to all would be most efficient.

3. From idea to course design - timeline

For developing a new course, course leaders/teachers need to go through several phases. We assume that the course leader has identified a topic that fits in the curriculum of a relevant student population, that the teachers have the backgrounds and skills for developing the course and that there are means to develop and implement the course. The coordinator and teachers than must go through phases such as, determining the course topic and student population, course objectives, didactics, assignments, and course activities.

For the course design it is crucial that all participants contribute substantially. This can be at various levels. As an example, in the IUSC course the various universities contributed:

- Experiences from an existing global sustainability bachelor course and experiences in gamification of education, content (UU).
- Pedagogical aspects, including challenge-based learning and the design cycle, content (TU/e).
- Content, case studies for the teams (WUR).

All three universities had experience with inter- and transdisciplinary education.

3.1. Course topic

The topic of an online inter-university course reflects the added value of the participating universities and teachers. For selecting the course topic for more than one university, several criteria apply:

- The topic fits the curriculums of the participating universities.
- In case of a transdisciplinary course – to which also one or more external stakeholders contribute – the topic needs to be co-developed with the stakeholders .
- The topic has added value for substantial student cohorts of the participating universities.
- The teachers involved bring complementary expertise.
- Studying the course topic requires an interdisciplinary approach of both teachers and students.
- Studying the course topic does not require regular face-to-face contact hours (e.g. lab work or designing a physical object).

Taking these criteria on board, the teachers involved need to decide about the topic early in the process. The course topic has major implications for many other decisions, including the students targeted, the course team composition, the pedagogies, course schedule and potential guest lecturers. Therefore, the topic needs to be selected a year or more before the start of the course.

3.2. Course objectives

The course objectives reflect the skills that specifically relate to CBL and interdisciplinary education. These include – in addition to objectives that relate to the topic and content:

- Collaboration skills,
- Interdisciplinary competencies,
- Design / research-related skills.

These choices need to be explicitly agreed upon by the course team early in the process. On a regular basis, the course team reflects on the course design in relation to the course objectives. If needed, objectives should be rephrased or adjusted. Course teams are often inclined to move from course topic to content / assignments. Designing the course objectives is a crucial step, as these define the desired outcomes and course evaluation.

3.3. Didactic approaches

Early in the process, the overall didactic approach(es) need(s) to be agreed upon. The choice of didactic approaches needs to be discussed extensively, resulting in a shared understanding. Which (type of) learning activities will be developed and applied? How will individual students or teams be tutored or supervised? Which types of assessment are suitable? E.g. in case of a project- or challenge-based approach, the design team needs to decide on:

- The assignments for student teams, including the products to be delivered (e.g. research report, design, prototype);
- Formation of student teams (do they choose themselves, or do the teachers also create the teams including a combination of students from different universities and disciplines);
- Modes of team supervision, teacher- and peer-feedback.

Interdisciplinary education
For interdisciplinary education (IE), Angerer et al. (2021) have described how to set up an optimal interdisciplinary team. For true integration of the disciplines, such a team consists of:

1. Several disciplinary experts with interdisciplinary/collaboration skills,
2. A 'bridger', an interdisciplinary teacher or coach who oversees and guides the process.

Interdisciplinary collaboration requires a set of skills that can be learned or practiced. Based on a literature review Lattuca et al. (2012) identified eight dimensions to cluster interdisciplinary competence

(1) Awareness of Disciplinarity
(2) Appreciation of Disciplinary Perspectives
(3) Appreciation of Non-disciplinary Perspectives
(4) Recognition of Disciplinary Limitations
(5) Interdisciplinary Evaluation
(6) Ability to Find Common Ground
(7) Reflexivity
(8) Integrative Skill

These eight dimensions can be used as a capstone for interdisciplinary education. It becomes clear that interdisciplinary thinking consists of a number of subskills students need such as having knowledge about your own disciplines and your peers' discipline including their paradigms (Spelt et al., 2009). Next to knowledge, higher order cognitive skills and communication skills are needed for successful interdisciplinary thinking and collaboration (Spelt et al., 2009).

According to Angerer et al. (2021) disciplinary experts can acquire interdisciplinary/collaboration skills by 'watching documentaries, attending talks or doing some light reading on a subject matter that is outside your discipline'. In addition, 'you could look at the philosophy and research culture of your own discipline.'. Becoming a bridger is for those who 'like to think broadly and have a wide variety of interests, enjoy the bird's eye view of a (complex) topic, feel comfortable in the role o of translator and communicator between disciplines.' More on acquiring interdisciplinary skills or becoming a 'bridger' in interdisciplinary teams, see Angerer et al. (2021) and for rubrics for assessing IE, see Wiegant & al. (2020).

Challenge-Based Learning
To foster Interdisciplinary collaboration between students didactical approaches such as problem-based learning (PBL) and project-based learning (PjBL) can be used. These approaches are based on active student engagement. An upcoming didactical approach is challenge-based learning (CBL) which shares similarities with PBL and PjBL but takes learning and engagement a step further by focusing on urgent, real-life challenges who have no immediate and final end to a solution. According to recent literature it is a suitable approach for courses that require and/or want to facilitate inter- and transdisciplinary learning (Bohm et al., 2020; Chicharro et al., 2019; Ettema et al., 2020; Gallagher & Savage, 2020; Malmqvist et al., 2015; Martin & Bolliger, 2018; van den Beemt et al., 2020; Vreman-de Olde et al., 2021). Additionally, CBL is said to foster a wide range of skills such as self-awareness, decision making, problem solving, teamwork, entrepreneurial mindset, and communication skills (Johnson et al., 2009; Kohn Radberg et al., 2020). A CBL approach can be divided into three interconnected phases students go through when working on a real-life challenge: Engage, Investigate and Act (Nichols & Cator, 2008). A framework has been developed to support teachers in applying CBL in their courses (https://www.challengebasedlearning.org/framework/).

In a CBL course, the focus is less on the content knowledge students should acquire and more on the inter-/transdisciplinary collaboration, systems thinking and creativity. It is more about applying knowledge and skills, reflecting on your own knowledge and skills, and creating new knowledge and skills. Students are placed in a very student centered learning setting which allows them to define their own challenge (to a certain extent), take responsibility and ownership of their collaboration and learning process and apply but more importantly integrate their own background knowledge and skills in a new, real life challenge.

Designing such a course requires teachers and coaches to first become familiar with the idea and goal of CBL. A certain openness from teachers and coaches is required since CBL requires a certain

amount of flexibility and trust in the learning process. Text box 1 shows how the CBL approach was applied in the IUSC course.

Box 1 IUSC course – applying Challenge-Based Learning

We applied a CBL approach in the context of the Inter-University Sustainability Challenge (IUSC) which is an online, interdisciplinary, interuniversity bachelor course. The approach was chosen with the aim to guide students through their interdisciplinary group work. The concept of CBL also fits very well with sustainability challenges or other open, real-life challenges who cannot be simply solved e.g. health care, financial crises and who rely on inter-/transdisciplinary approaches and systems thinking.

During the first course design phase the teacher team spend a lot of time on a metalevel to become familiar with CBL and the framework. Before being able to discuss the content of the course all teachers had to understand and agree with the use of CBL. Only a small part of the teaching team was familiar with this type of teaching and learning. Within a CBL course, teachers have a facilitating role, supporting and evaluating students' investigation and inquiry process. Teachers unexperienced with student-led learning and coaching might need time to adjust and revise their assumptions on what and how students learn.
Teachers created interdisciplinary, inter-university student teams who each were guided by one coach.
Coaches were non-directive yet supportive and engaged students in critical thinking and reflection as well as support inter-transdisciplinary collaboration (Johnson et al., 2009; Pearce et al., 2018). In our course, teachers and coaches had different tasks. The role of the teacher was to provide content knowledge through synchronous online lectures and tutorials as well as providing formative feedback and grading the deliverables. The role of the coaches was to support their student team(s) through the CBL process through regular check-ins and formative feedback.

In the case of the IUSC course, CBL provided a great mix of structure and freedom to support student collaboration, creativity and inquiry. Next to the benefits, we experienced that developing a CBL course especially in an inter-university context requires more time investment prior to the course start, especially for the first two runs. It also requires intensive coaching time during the runtime of the course.

Systems Thinking

Critical analysis and reflection during interdisciplinary collaboration can be supported through systems thinking. A systems thinking approach looks at how the different components of a system interrelate and interact (Meadows, 2008). This included socio-ecological and socio-technological systems, linking more natural science and social science disciplines. The systems thinking approach enables students to understand and manage complex feedback systems and their interworkings (Mathews & Jones, 2008).

3.4. Course content

For interdisciplinary courses, key terms should be explained clearly, already in the design-phase. E.g. in a course on 'sustainability' on a 'local level', where 'stakeholders' are involved, these terms need to be clear for the team members. As students from various disciplines and universities will participate in the course and collaborate in teams, special attention should be paid to students' prior knowledge.

A major challenge in designing interdisciplinary courses is avoiding overload of content: each of the teachers is inclined to include content that (s)he deems relevant. This may well result in imbalance: too much detailed content, and students need to sort out themselves what is relevant for their assignment/assessment. One way to avoid this, is to have a student-driven course. The teachers and stakeholders provide the case, or challenge, and provide the first basic information needed to solve the challenge. Then, students themselves indicate which extra information they need. This student-driven approach or 'co-creation', is a working method in which all participants influence the making and learning process and the results of this process. The co-creation design increases the involvement of the students and thus their own responsibility with regard to the learning process. Following the co-creation model of Healy (2014) all students become active participants in their own learning process and actively pose questions linked to challenge-based learning. However, teachers may find this student-driven approach more difficult, as they do now

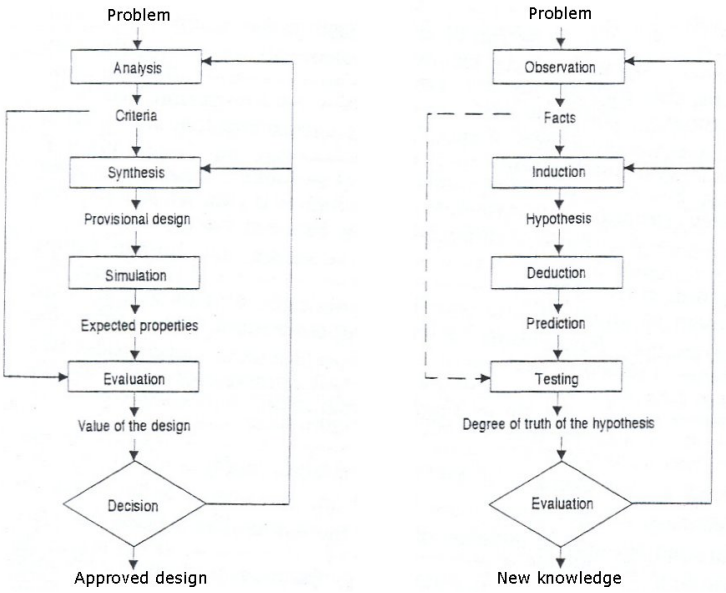
know the exact content of the course beforehand and at times have to find guest lecturers at a short notice to teach about a certain topic.

Following a co-creation approach, the course content offered should be restricted. Only content that is relevant for all students should be offered to all, e.g. in the plenary lectures. Content relevant for only a subset of students should be offered to this subset alone, or the content concerned should be voluntary. The course schedule needs to be fluid and open for adjustment and students' input.

In the IUSC course, an explicit choice was whether to apply the design cycle or empirical cycle. See text box 2.

Box 2 IUSC course - empirical cycle versus design cycle

One of the major decisions made in the process of developing IUSC was the choice between the design cycle and empirical cycle. This choice also reflected the experience the lecturers had with either; UU and WUR-teachers were more familiar with the empirical cycle, the TU/e teachers with the design cycle. The empirical cycle is aimed at developing new knowledge, based on observation, a theoretical framework, research and testing, while the design cycle aims at developing a design as a model for a solution for a problem or challenge. As the team assignment of this course was to develop a design of a visualization, the design cycle was selected. This choice also had implications for the students. TU/e students were more familiar with the design cycle than the other students. In plenary lectures substantial time was devoted to the explanation of the design cycle. That was very useful for UU and WUR students, for TU/e students this explanation was mostly redundant.



Source: Roozenburg & Eekels, 2006.

Whatever approach or cycle is selected, its essence needs to be explained to students. Students from one discipline or university will be more experienced with a didactic approach than others. Potential differences of experience with approaches need to be addressed explicitly, especially during formation of student teams including students with a variety of backgrounds and experiences. In the IUSC course, students from TU/e had substantially more experience with CBL than the other students. This implied that the CBL approach had to explained well. In addition, within the teams, experienced students could help those who were not familiar with CBL. Ideally, team composition should not only reflect complementarity of disciplines, but also complementarity of acquaintance with didactic approaches.

The course team must come to agreement about the grading of the assignments, including the weight applied to teamwork and individual assignments. In case universities apply different course codes and ECTS, the grading needs to be adjusted accordingly. Individual course codes imply differences in OER and examination regulations. In case of differences between ECTS, meaning

that students receive a different amount of ECTS for the course depending on their University, additional assignments can be used to compensate.

Take away messages

- Constantly ensure the aligning of course topic, objectives, and didactics with the inter-university character of the course and its interdisciplinary approach.
- Acknowledge and make use of the variety of experiences that teachers and students have with didactic approaches.
- Avoid overload of course content.

4. Teaching online

4.1. Synchronous and asynchronous education

If possible and feasible, include one or several face-to-face sessions for students, e.g. at the course start and end or for brainstorm sessions. This will allow students and teachers to get to know each other and especially student team members can socialize.

For offering teaching materials, such as literature, clips, descriptions of assignments and exercises, use a digital learning environment (DLE) offered by one of the participating universities. For direct online interaction, use a platform for synchronous education, such as MS Teams or ZOOM. Ensure that the selected platforms include all features required, all students have access to the platform selected and the platform selected complies with the privacy regulations of the university offering it.

For each of these platforms, appoint a team member who oversees that platform. E.g. for the DLE, one teacher is responsible for its set-up, this person can be consulted by the others and provides a manual or guidelines for teachers and students. This person is also responsible for trouble-shooting and is in touch with a support team at their university.

Use the synchronous sessions aimed at all students strictly for aspects that are relevant to all, such as general course information, general lectures, and presentations. Content that is only useful for a subset of students should be provided to this subset alone or in the DLE.

4.2. Synchronous online didactics / online formats that work

In the context of setting up this protocol, synchronous teaching took place via the Virtual Classroom / weConnect platform (plenary lectures) and MS Teams (teamwork and coaching). For the Virtual Classroom, a set-up was created in a studio at Utrecht University (see text box 3).

Figure 1 The Virtual Classroom at Utrecht University, 2021

Box 3 Virtual Classroom at Utrecht University.

The Virtual Classroom (VC) enables teachers to teach remotely, from the studio in Utrecht Science Park. During a session, the teacher stands in front of 6 screens (in the second iteration: 8 screens), each with a maximum of 6 remote, visible students. Below the 6 screens with the students, the VC also contains two screens to display the presentations of the teachers or students, and the results of online questions.

By using the Virtual Classroom we were able to support online collaborative learning with synchronous student-student, student-teacher and student-content interaction. Two well-known frameworks were the base for the online course design and online synchronous interaction in our course:
the 'Community of Inquiry' (CoI) and the 'Transactional Distance Theory'.

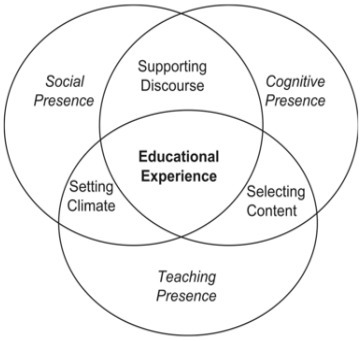


Figure 2: Community of inquiry

According to the Community of Inquiry (CoI) framework by Garrison & Arbaugh (2007) three overlapping presences are fundamental to deep meaningful collaborative learning:
Social presence: students experience the presence of their fellow-students and are able to interact in a meaningful way.
Teaching presence: students' social and cognitive experience through teaching design and facilitation.
Cognitive presence: students can cognitively engage with the content and construct meaning.

At the intersection of these three presences, deep learning occurs. See figure 2.

Box 4 IUSC course – implementing the Community of Inquiry

Aware of the Community of Inquiry theory (CoI), we implemented it in our online synchronous lectures especially in the context of online student-teacher, student-content and student-student interaction.
We focused on all three presences to enable meaningful learning in the online, synchronous sessions.
The set-up and features of the Virtual Classroom enabled us to support all three presences. For instance, 'teaching presence' was supported through the more personal communication and interaction among students and between students and teachers. Visibility and insight into students' individual responses and understanding during online sessions played an important role.
We supported 'Cognitive presence' through prompts, (knowledge) quizzes, chat and live discussions.
Grouping students online on different screens and providing different camera views (teacher front view, PowerPoint slides, whiteboard, classroom view) social presence was supported.

Next to online classroom observations, student as well as teacher interviews were conducted to get more insight into students' perception of social, teaching and cognitive presence (Kasch et al., submitted). To further investigate students' perceptions the 'community of inquiry questionnaire' can be used which contains 34 Likert-scale items from 0 (strongly disagree) to 5 (strongly agree) (Arbaugh et al., 2008). See Appendix A for the survey questions.

Results of these measurements of students' perceptions of presence in the IUSC showed that moderately high presence perceptions could be achieved in an online inter-university course where a heterogenous group of students collaborated in an interdisciplinary way using the virtual classroom. Looking at the total questionnaire scores, students scored 119 points on the presence scale with a possible minimum of 34 points and a possible maximum of 170 points. More details about the research project can be found in Kasch et al. (submitted).

Community of Inquiry
Within a "Community of Inquiry" (CoI) successful collaboration towards a common goal and knowledge construction can take place (Garrison & Cleveland-Innes, 2005). Social, teaching and cognitive presence are required for this (Garrison & Cleveland-Innes, 2005) and should be supported by teachers and through the course design.
The literature confirms that interactive synchronous online sessions can support online presence and a sense of community (Martin & Bolliger, 2018). Enhancing personal contact among students as well between students and teachers for example by addressing individual student responses and offering Q&A sessions enhances online interactiveness and presence (Martin & Bolliger, 2018).

Prompts and guided questions can deepen student learning and are important online teaching strategies (Martin & Bolliger, 2018).

Transactional Distance
A second framework essential for (online) collaborative learning and course design is the Transactional Distance theory by Moore (2013). Transactional distance is an individuals' perception of psychological distance. In an educational setting it is the perceived psychological space or distance between students, teachers, and the course content (Moore, 2013). High perceptions of transactional distance are thus to be avoided.
This framework is especially important in highly heterogenous course settings as is the case with inter-transdisciplinary, inter-university courses. According to Moore (2013), increasing and supporting student engagement can result in lower perceptions of transactional distance. Three related variables influence transactional distance: structure, dialogue and autonomy. All three variables need to be addressed by course designers and teachers to ensure low perceptions of transactional distance between students and teachers (TDST), students and the course content (TDSC) and among students (TDSS). If students perceive constructive interaction with their teachers, the course structure is flexible and if they perceive autonomy of their learning, this can decrease transactional distance.

Ensuring social, teaching and cognitive presence while minimizing the transactional distance applies to face-to-face as well as online education. Especially for online education, where teachers and students are physically separated, minimizing transactional distance needs special attention. The course design as well as the technology/platforms used determine.

Box 5 IUSC course – measuring Transactional Distance

We had students from three different universities, from various study backgrounds, prior knowledge levels and CBL experience. It was important to us and for the interdisciplinary collaboration that students were able to connect to each other and the teachers as well as coaches online. However, disciplinary differences and a physical distance can increase feelings of psychological distance and impede successful online collaboration.

Interested in students' perceptions of transactional distance (TD) in the IUSC course, we used the Revised Scale of Transactional Distance (RSTD) by Paul et al. (2015), see Appendix B.
In our study (Kasch et al., submitted) we found that it is possible to achieve low perceptions of transactional distance in an online, interdisciplinary, inter-university course. The total possible minimum and maximum scores on the transactional distance scale were 12 (indicating high undesirable transactional distance) and 60 (indicating low desirable transactional distance). The overall mean score for the Transactional Distance Scale at the end of the course was 46.85 (SD=4.47).

Based on these frameworks and experiences of teachers and students in the IUSC course, the following requirements for designing synchronous sessions and the technical set-up are relevant:

General
- Duration of online sessions should be limited and include short timespans.

Presence
- Students can see a high number of peers on their screen and interact with each other through chat, verbal communication and break-out rooms.
- Students can see the teacher well, preferably top to toe (most resemblance with face-to-face teaching), and interact with her/him.
- Students can continuously see and engage with the content.
- Limit anonymity as much as possible: cameras are turned on, students can see the individual responses on quizzes and polls

Learning
- Sessions not only aim at the transfer of knowledge but at active learning and deep learning as well.
- Sessions contain regular, well-prepared interventions for interaction and feedback. For example through polls, quizzes or hand raising.
- Students can ask/respond at any time.

- Students are well-prepared for the session: e.g. through clips, reading material, assignments in advance.

For the online situation, this implies:

1. Visibility of teacher, preferably top to toe
While in home situations, the teacher generally sits in front of a camera. Only her/his head and upper part of torso and hands are visible. If possible, use a set-up in which the teacher stands upright, is fully visible and can move around. Students indicate they prefer to watch a teacher in a more natural habitat. Moreover, teachers generally prefer a setting that approaches in person lectures and perform in more energetic way. This, in turn, is appreciated by the students.

2. Continuous visibility of students
For enabling (limited) visibility of facial expressions and gestures, students should be visible as well. Teachers can then also respond to non-verbal signs. It is evident that this only applies to courses with a small of moderate number of students. Depending on the set-up, we estimate that 50-60 students is the maximum.
In many online courses, most if not all students are inclined to turn off their cameras. For ensuring visibility of students, the obligation for students to keep their cameras on needs to be part of the course rules and teachers need to pay attention to the necessity of this. In addition, students need to be able to see each other well.

3. Eye contact between students and teacher
Some teacher set-ups offer 'eye-contact' with students. In the weConnect platform, the set-up is divided in groups of students, e.g. six students per screen. Each group watches the teacher via a dedicated camera. When the teacher approaches and looks at a group displayed on one of the screens, these students feel as if the teacher makes eye contact.

4. Interaction starters
In online teaching, direct interaction with students is more difficult than during on campus teaching. Interaction starters such as online quizzes and polls – either offered by the online platform, available as plugins or offered via internet, increase the options for asking students. There are several ways:
Quiz: ask students to think about and enter a correct answer (to a multiple choice or open question). Subsequently the teacher can ask a student why (s)he has given a particular answer and then discuss the correct answer.
Poll: students are asked to give their opinion about a given topic. Subsequently, the teacher asks a few students to elucidate their answers.
Options such as displaying the answers given on across of each individual student's face facilitate easy interaction.
Preferably, quizzes and polls can be prepared in advance, e.g. by displaying a question or statement in the presentation. They can also be used spontaneously. The teacher can then write these on a digital board or state the question orally.
Ideally, students as well as teachers can see the individual responses from students on the screen. Often student responses on quizzes and polls remain anonymous allowing the teacher only to get a general idea of the entire student group. In the Virtual Classroom student responses to quizzes and polls were visible on the student 'faces' on the screen and thus visible to all students in that online class.

5. Flexible break-out rooms / channels
The set-up offers channels and/or break-out rooms for group work. Online platforms offer options where students can either choose a channel or break-out room or are assigned to a break-out room. In comparison with on campus group sessions, the duration of online group sessions should be limited.
For monitoring progress in the break-out rooms or channels, the preferred platform is one that enables teachers to enter several break-out rooms / channels during the session.

6. Continuous engagement with content
Students have easy and direct access to the content during the online session - in addition to content offered in advance/after the course. They can see the presentation and document used at any time and, preferably download chat content.

7. Well-visible chats and hand-raising

For supporting hand-raising, digitally raised hands can be used. In addition, students can interact via chat functions. Especially for teachers, easy monitoring of the chat is important (e.g. via a separate screen). Inclusion of a voting system for students brings the ability to prioritize question. An extra is the availability of an anonymous chat, enabling students to pose 'stupid' questions.

8. Recording of sessions
Set-ups aimed at interaction do justice to synchronous education. Recording of session – so that students can view a session later – may suppress students' need of being present during live session. Moreover, students who need structure usually benefit from synchronous session where they must attend. Therefore, only (parts of) synchronous online sessions where teachers lecture, should be recorded.

4.3. Access to online platforms

When selecting online platforms for synchronous teaching such as MS Teams and ZOOM:

- Ensure that all teacher and students have timely access to these platforms. If a platform is novel for a group of teachers or students, provide proper instructions.
- Minimize the number of platforms used. Ideally, use only one DLE and one synchronous platform. If feasible, select platforms students are already used to.
- Teachers need to be either experienced user, or if not, should practice in advance with the platform.

Privacy aspects have become very important, also for online platforms. Ensure that the platform selected has proper documentation, including a Data processing assessment (DPA) for the platform and Data protection impact assessment (DPIA) for the courses or activities. These documents should be available in your university.

Take away messages

- Select well-tested and accessible e-learning and synchronous online platforms.
- The platform and set-up of synchronous teaching needs to facilitate interactive learning.

5. Study administration

Course codes need to be available well in advance and decisions will have to be made about planning of the course, number of ECTS, student registration and promotion and grading. This is a complex and time-consuming process. Preferably, part of the course administration is outsourced to specialists from the participating universities.

5.1. Planning of course / course code

The course needs to be planned well in advance. Check with each university for the deadline of publishing the course on the study registration platform (e.g. Osiris). For scheduling the course, the academic calendars of universities may differ, in terms of the starting date and length of teaching periods. In addition, the team must decide whether to use one code generated by one of the participating universities or to use different course codes, one for each individual university. One course code for all students simplifies registration for the course. On the other hand, having a different course code for each university will ensure a feeling of ownership at each institution. The choice for one course code or a course code for each participating university affects student enrolment as well as course registration. And it may also affect registration for various learning management systems and electronic learning environments.

5.2. Study credits (ECTS)

Various universities may require different ECST-distributions. E.g. one university may prefer a course of 5 ECTS, while the other prefers 6 or 7,5. Preferably, all students earn the same number of ECTS. If that is not an option, students who will earn more ECTS should have additional tasks, such as doing an additional module or writing an extra essay.

5.3. Student enrollment requirements

Well in advance, the team discusses the maximum number of students per university as well as the requirements for participation. In case at one university, the maximum number of student registrations has not been reached, it should be clear whether additional students from other universities can be enrolled as well. The latter can lead to an imbalance in student numbers per university.
In addition, the balance of students' backgrounds needs to be considered.

5.4. Course promotional actions

In general, course promotion should start as early as possible – preferably before summer of the academic year in which the course is taught. In addition, at each university, additional promotional efforts need to be planned in actual periods of course registration. It should be noted that universities use different deadlines for course registration.

For new courses, a proper communication plan could include aspects such as:

- Contacting relevant faculties,
- Contacting fellow-teachers and teacher networks,
- Ask teachers to mail their current and recent students,
- Placing news items on faculties' websites,
- Informing educational directors and study advisors,
- Informing relevant students' study groups / associations,
- Displaying the course on students' web pages,
- Promoting the course in university newspapers,

For each university, one team member coordinates student promotion and enrolment.

Take away messages

- Study administration for inter-university courses are complex and time-consuming; start early in the process.

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Appendix – Measuring instruments

Arbaugh et al. (2008) Community of Inquiry Instrument

Items Teaching Presence
1. The teacher clearly communicated important course topics.
2.The teacher clearly communicated important course goals.
3.The teacher provided clear instructions on how to participate in course learning activities.
4.The teacher clearly communicated important due dates/time frames for learning activities.
5. The teacher was helpful in identifying various disciplinary approaches and views on course topics that helped me to learn.
6. The teacher was helpful in guiding the class towards understanding course topics in a way that helped me clarify my thinking.
7. The teacher helped to keep students engaged and participating in productive dialogue.
8. The teacher helped keep the students on task in a way that helped me to learn.
9. The teacher encouraged students to explore new concepts in this course.
10. Teacher actions reinforced the development of a sense of community among students.
11. The teacher helped to focus discussion on relevant issues in a way that helped me to learn.
12. The teacher provided feedback that helped me understand my strengths and weaknesses relative to the course's goals and objectives.
13. The teacher provided feedback in a timely fashion.
Items Cognitive Presence
14. Getting to know other students gave me a sense of belonging in the course.
15. I was able to form impressions of some students.
16. Online communication is an excellent medium for social interaction.
17. I felt comfortable communicating in this online course.
18. I felt comfortable participating in the course discussions.
19. I felt comfortable interacting with other students.
20. I felt comfortable disagreeing with other students while still maintaining a sense of trust.
21. I felt that my point of view was acknowledged by other students.
22. Online discussions help me to develop a sense of collaboration.
Items Social Presence
23. Sustainability challenges posed increased my interest in course issues.
24. Course activities increased my curiosity.
25. I felt motivated to explore content related questions.
26. I utilized a variety of information sources to explore problems posed in this course.
27. Brainstorming and finding relevant information helped me resolve content related questions.
28. Online discussions were valuable in helping me appreciate different perspectives.
29. Combining new information helped me answer questions raised in course activities.
30. Learning activities helped me construct explanations/solutions.
31. Reflection on course content and discussions helped me understand fundamental concepts in this class.
32. I can describe ways to test and apply the knowledge created in this course.
33. I have developed solutions to sustainability challenges that can be applied in practice.
34. I can apply the knowledge created in this course to my education or other non-class related activities.

Transactional Distance Questionnaire

Item Transactional Distance Student Teacher
1. During lectures and workshops the teacher pays no attention to me. [R]
2. I receive prompt feedback from the teacher on my performance.
3. The teacher was helpful to me.
4. The teacher can be turned to when I need help in the course.

Items Transactional Distance Student Content
5. This course emphasized synthesizing and organizing ideas, information, or experiences into new, more complex interpretations and relationships.
6. This course emphasized using and reflecting on existing knowledge for creating new sustainable solutions.
7. This course emphasized applying theories and concepts to practical problems or in new situations.

Items Transactional Distance Student Student
8. I get along well with my team members.
9. I feel valued by my team members in this online course.
10. My team members in this online course value my ideas and opinions very highly.
11. My team members respect me in this online course.
12. My team members are supportive of my ability to make my own decisions.