



I still miss human contact, but this is more flexible— Paradoxes in virtual learning interaction and multidisciplinary collaboration

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Abstract

Teaching and learning in universities have shifted towards online education, and there is not enough scientific knowledge about suitable pedagogical design principles to guide the construction of hybrid learning spaces for today's university students. In this design-based research, we studied the benefits and challenges in reaching the expected learning outcomes of an e-course, "Collaboration and Professional Interaction Skills." The practical purpose was developing the pedagogical design of this e-course. The scientific objective was to build on the research about design principles that guide teachers in constructing e-courses, enabling in-depth learning in hybrid learning spaces. The pedagogical design was guided by six design principles. Empirical data (21 students' assignments and reflections, teacher's observations, data from the digital learning management system) were collected in two research cycles. Students were from different degree programmes of educational sciences. Thematic analysis of students' individually and collaboratively authored assignments was carried out in both research cycles. The most emphasised benefits and challenges concerned the combination of working and creating knowledge together, virtually, in a multidisciplinary group. Based on the results, practical recommendations were made for university-level pedagogical designs that facilitate effective and active collaboration and interaction, and learning of such competence.

Introduction

Teaching and learning in universities have shifted towards online education. However, there is still not enough scientific knowledge about suitable pedagogical design principles to guide the construction of hybrid learning spaces for today's university students (eg, Bennett, Lockyer, & Agostinho, 2018). When designing spaces for learning, we face a paradoxical challenge: There is a need for more personalised learning opportunities that simultaneously offer flexibility in the

Practitioner Notes

What is already known about this topic:

- In higher education, more emphasis needs to be placed on learning skills such as multidisciplinary teamwork and collaborative knowledge creation.
- There is a need for more personalised learning opportunities that offer flexibility in one's studies and take learners' diverse situations into account.
- Advanced understanding of suitable pedagogical design principles and knowledge from empirical cases is needed.

What this paper adds:

- What to consider when technology is used to mediate the learning processes.
- How to tackle the demands of personalised study opportunities and demanding interaction skills by online collaboration.

Implications for practice and/or policy:

- Pedagogical design exemplifying how students build shared knowledge objects iteratively.
- Students need guidelines and support for multidisciplinary collaboration and interaction online.
- Learning management systems are not fully tailored for iterative multidisciplinary collaboration; thus, the designer of the course must be aware of the limitations and develop ways of overcoming the discrepancies between the learning management system and learning objectives.

studies, take learners' diverse situations into account, and also facilitate the learning of collaboration, which is among key skills in today's working life.

One trend in today's schools in Finland is the focus on collaboration, networking and co-teaching; the national curriculum for compulsory education underlines collaboration (Finnish National Board of Education, 2016; Sirkko, Takala, & Wickman, 2018). Therefore, teacher students should obtain readiness not just to teach but to work together with other professionals. In their future work, they will need skills, eg, in multidisciplinary negotiations about a pupil's individual educational plan (Da Fonte & Barton-Arwood, 2017; Goepel, 2009).

It has been recognised that in higher education more emphasis needs to be placed on learning generic skills, eg, skills in working in groups, communication, multidisciplinary teamwork, collaborative knowledge-building and solving complex problems (Muukkonen & Lakkala, 2009; OECD, 2013; Tynjälä, Slotte, Nieminen, Lonka, & Olkinuora, 2006). Changes in the university curricula have been implemented, eg, in special teacher education, towards more collaborative ways of working and setting goals, which expect the students to work together (see Takala, Nordmark, & Allard, 2019).

An advanced understanding of suitable pedagogical design principles and knowledge from empirical cases is needed. In higher education, current pedagogical approaches highlight learning activities with authentic and open-ended problems (eg, Lakkala, Toom, Ilomäki, & Muukkonen, 2015; Muukkonen, Lakkala, Toom, & Ilomäki, 2017), students' identity as knowledge contributors in a learning community (Wenger, 1998a), and technology-mediated forms of participation and knowledge creation (Hakkarainen, 2009; Säljö, 2010). Teaching and learning methods

used in the present study combined case-based learning (Takala & Wickman, 2019), co-authoring (Damsa & Muukkonen, 2020), multidisciplinary group work, and peer-group e-tutoring (Sansone, Ligorio, & Buglass, 2016).

Additionally, students are a very heterogeneous group in terms of the variety in their everyday lives, which creates new demands for organising studies, eg. as e-courses. The demand for creating e-courses is rapidly growing, including on behalf of universities, to improve the scalability and availability of courses.

It is rare that students choose to engage in high-quality activities or knowledge creation spontaneously in online learning settings (Kobbe *et al.*, 2007). Case-based learning has been used to fill the gap between theory and practice by enabling reflection on cases describing authentic situations (Darling-Hammond, 2006). However, the pedagogical designs of e-courses with case-based and multidisciplinary courses still lack practical and evidence-based knowledge of what to consider when technology is used to mediate the learning processes without endangering the quality of learning. Therefore, there is a need for research that assists university teachers in practice to build courses that tackle these demands of personalised study opportunities and learning demanding interaction skills and online multidisciplinary collaboration. In this design-based research, we study the benefits and challenges in reaching the expected learning outcomes in a university-level e-course called “Collaboration and Professional Interaction Skills.”

Learning professional interaction skills and capacity for multidisciplinary collaboration

Individuals’ ability to be in relationship and collaborate with others is increasingly valued in working life. Thus, the need for learning skilled interaction is no longer restricted to specific professions, such as nurses, early childhood educators or counsellors. Interactional practices are generally seen as a central factor in developing well-being, productivity and innovations in work (eg. Kiema, Mäenpää, Leinonen, & Soini, 2014; Suorsa, Svento, Lindfors, & Huotari, 2019). As a consequence, the course options for learning interaction skills have also increased (eg. Tapio, Alapuranen, Rauhansalo, & Siromaa, 2018). Whereas some training programs—focusing, for instance, on specific “counselling skills”—seem to be effective and well founded in empirical research (eg. Rantanen & Soini, 2018), the field of teaching interactional skills in general is diverse. When developing university-level courses that seek to enhance participants’ interactional skills, it is essential that the development is accompanied by research that articulates the possibilities and problems in learning interactional skills. How do our goals as teachers and developers meet the expectations, experiences and everyday practices of students? How do materials, digital tools and pedagogical designs support or restrict experienced and observed learning?

Learning interactional skills can be approached in several ways. For instance, we can look at changes in participants’ observable behaviour (eg. Rantanen & Soini, 2018) or changes in participants’ goals and reasons for action in interaction (Suorsa, 2019; Suorsa, Rantanen, Mäenpää, & Soini, 2013). In this paper, we focus on students’ reports of their learning outcomes and other experiences during the online course and reflect on them in relation to goals we have set as the developers and teachers of the course. Of particular interest is also the question about what kind of interactional skills can be taught and learned in virtual environments, and what kinds—according to students’ (pre)conceptions—would require face-to-face interaction.

An increasing share of teachers’ work at school is technology mediated. Professionals work with other professionals placed at different locations (schools, services) and parents (Pettersson, 2017). This highlights new demands for virtual collaboration and a better understanding of

how to organise multidisciplinary collaboration combining face-to-face and virtual practices (Kuusimäki, Uusitalo-Malmivaara, & Tirri, 2019).

Designing pedagogy for collaborative knowledge creation

The knowledge-creation metaphor of learning (Paavola & Hakkarainen, 2005) upholds the cognitive (acquisition) and social (participation) forms of learning but emphasises the knowledge-creation (object-centred) approach to learning. Various artefacts, practices, and products—the objects—are seen to mediate knowledge advancement by structuring the efforts of the participants in the direction of working on these objects, negotiating meanings, advancing and versioning them by collaborative efforts. The community of inquiry is a concept also used in other theoretical approaches. In Wenger's framework (1998b), it is highlighted how Communities of Practice develop around things that are important or interesting to people. Because membership is based on participation rather than on official status, these communities can span institutional structures and hierarchies as they are not bound by organisational affiliations. This puts more focus on the participation form of learning compared to the object-centred approach emphasised here. The Community of Inquiry framework was proposed by Garrison, Anderson and Archer (2000, 2010) to examine the potential and effectiveness of computer conferencing. It particularly highlights aspects of presence (social, cognitive and teaching) as well as how the media can support discourse, setting a productive climate and content for learning. All these frameworks share the community as the key contributor and address the interaction and ways of learning within the community, but place main focus on different aspects, ie, participation, communication and object-centred activities. The six design principles (DPs) (Paavola, Lakkala, Muukkonen, Kosonen, & Karlgren, 2011; see also Lakkala *et al.*, 2015; Muukkonen *et al.*, 2019) have been explicated based on this knowledge-creation approach to learning. In educational practice, one or several of them may be emphasised by the pedagogical design. Usually, the first design principle builds a basis for the other principles, but for the rest they do not have any sequencing or order of importance (eg, Lakkala *et al.*, 2012). The design principles were used in this study to examine the characteristics and aims of the pedagogical practices of the course and to reflect on the features of the design of the courses based on student self-reflections and learning outcomes:

- (DP1) Organising activities around shared “objects.” This describes the aim to anchor the collective and individual efforts around a shared object. In the educational context, an object can be, for instance, a report, website, presentation or design.
- (DP2) Supporting the integration of personal and collective agency and work through developing shared objects. The aim is to support students in taking responsibility for their own learning but also for the collective process and learning.
- (DP3) Emphasising development and creativity through transformations and reflection. To support sense-making and structuring the phenomenon, various ways to document and represent the phenomenon could be employed, eg, drawing, filming or modelling, and used to reflect on the transformational aims and processes.
- (DP4) Fostering sustained processes of knowledge advancement. This highlights the in-depth understanding of a phenomenon and creating a plan and materials that have further use after the course.
- (DP5) Promoting the cross-fertilisation of knowledge practices and artefacts across communities and institutions. This would support integrating expert practices into educational settings or various expertise, for instance, by multidisciplinary collaboration.
- (DP6) Providing flexible tools for developing artefacts and practices. To mediate the above-described collaboration practices, digital tools should enable flexible mobility as well as synchronous and asynchronous collaboration.

Aim of the study

The study addresses the aim to provide higher education students with knowledge of and competence for professional interaction, multidisciplinary collaboration and inclusive education. The particularly challenging aspect is that the teaching is carried out as an e-course. Therefore, the design for learning was intended to guide students to engage in activities that would promote the learning of such knowledge and competences. The practical purpose of the study is to develop the pedagogical design of this course. The scientific objective of the paper is to build on the research about the design principles that guide course designers to construct e-courses that enable in-depth learning in hybrid learning spaces.

Research questions:

1. What kind of learning outcomes and experiences were related to the first operationalisation of the course?
2. Which central issues for redesign were identified by comparing the outcomes to the theoretical design principles?
3. What kind of learning outcomes and experiences were related to the second operationalisation of the course?

Methods

Research setting

This design-based research is part of the development project “Supporting Together! Multidisciplinary and Digital Cooperation to Support Learning” funded by the Finnish Ministry of Education and Culture. The “Supporting Together” project aims to develop teacher education by focusing on four issues: co-teaching, positive pedagogy, consultation and digital learning.

A design-based research approach (The Design-Based Research Collective, 2003) was selected to investigate the course in two research cycles. In the design-based research process, research, theory and practice are intertwined (Barab & Squire, 2004). The design was executed in cooperation with a multidisciplinary teacher–researcher group participating in the project. The pedagogical design of the course was guided by theoretical design principles (DPs) (Paavola *et al.*, 2011). The e-course was targeted to students of the educational sciences, and the main themes were professional interaction, multidisciplinary collaboration in its different forms (co-teaching and consultation) and inclusion. The expected learning outcomes concerned good command of the main concepts (professional interaction skills, multidisciplinary cooperation, inclusion, consultation and co-teaching), applying the concepts to examine real-world cases, investigating the cases critically, participating in multidisciplinary groupwork and practicing giving strength-based feedback.

Research cycles

The design-based research consisted of two research cycles. In the first research cycle, the design was operationalised and data (teacher’s observations, students’ assignments, students’ reflections and complementary data from Moodle) collected as the course was carried out for the first time. After the course, the research group analysed the data against the objectives of the course, the pedagogical solutions were adjusted, and the course was advertised for a second operationalisation. In the second research cycle, the course was carried out again and similar data were collected to investigate if the adjustments were good. Lastly, our final aim was to analyse both research cycles and build a finalised version of the course.

Course design

Four design principles were selected as main conceptual tools to design this course aiming to promote collaborative knowledge practices. The idea was that through the course, groups organise their work around group assignments (DP1). In order to do so, they need practices that promote both their individual and collective agency and structure their participation (DP2), help them to iteratively learn and create knowledge (DP3) and use digital tools and platforms to enable this (DP6).

The course design comprised four time periods and five modules (see Table 1). In each module, there were new concepts to learn.

Proceeding in the course was controlled by technical settings: completing one learning task led to gaining access to another one for support of the collaboration, so students would have somewhat same pace and order. However, the deadlines were set to be quite loose, so the course could be completed in a student-centred manner.

When first entering the course area, students only had access to the course instructions. The students were divided into groups of four students from different degree programmes beforehand. In addition to other items, the course instructions addressed the guidelines for group work and co-authoring: Students were not required to meet face-to-face, but they could organise their group work and co-authoring and use the tools according to their own preferences, apart from Moodle, which was the joint LMS for all the teaching material, submissions and peer-group e-tutoring. This was to implement DP6, ie, to offer flexibility concerning the digital tools.

Modules 2–4 had specific cycles, from individual to collective and, again, to individual assignments. The purpose of this cyclicity was to apply DP2 specifying support of both individual and collective agency. Modules began with individual assignments for building basic knowledge about the concepts individually, while group assignments addressed more applied questions and guided the groups to consider cases that presented complex real-world problems situated in the school context in relation to the concepts. DP3 was implemented with the groups investigating the same case in each module but from a different conceptual point of view. The purpose was to create knowledge iteratively, and also to build knowledge and competence that they can use in their future work. At the beginning of the course, each group had chosen a case from the course case bank, all of which were created by school professionals to obtain descriptions that reflected reality.

The group submission settings required all group members to manually accept a submission in the course area. The idea was that this kind of technical setting would work as a tool for agreement on submission within the group, and as a statement of participation to the teacher. After the group submission, groups had to share their assignments with other groups in the course area for peer-group e-tutoring about the content. At the end of the module, students reflected on their learning individually thereby actualising DP3. All tasks had a two-week deadline.

Table 1: Modules in the first research cycle

<i>Time period</i>	<i>Modules</i>
29.10.2018–11.11.2018	1. Module: Orientation
12.11.2018–25.11.2018	2. Module: Professional interaction skills
26.11.2018–9.12.2018	3. Module: Co-teaching
10.12.2018–21.12.2018	4. Module: Pedagogical consultation
	5. Module: Final group assignments

In the final module, students produced final group assignments that worked as the shared objects that all the previous course activities aimed at (DP1). Groups were to utilise all the group assignments and feedback they had received during the course to address their gaining of knowledge and competences.

Participants

In the first research cycle, 11 students participated in and finished the course. The students were from different degree programmes in education: class teacher, special needs teacher, early childhood education and educational psychology.

In the second research cycle, there were 10 students to start with, but one dropped out during the second module. The remaining nine students were from the same degree programmes as the students in the first research cycle, along with a student from the degree programme in educational sciences. Eight students finished the course.

Data collection

The collected data included the students' individual and group assignments, teachers' evaluations of them, students' self-reflections during the course, complementary data about students' access and progress from Moodle and teacher's observations.

The students' completed reflection forms at the end of each module. The reflection forms consisted of the same five questions, asking about experiences related to working in multidisciplinary groups, technology-mediated studying, case-based learning, reaching their personal goals for learning knowledge and competences and other items they wanted to discuss or comment on.

Data analysis

Individual assignments were not evaluated. Group assignments were given written evaluations by one researcher in each module. At the end of the course, groups were evaluated numerically (1–5) based on their final group assignments.

Theory-driven thematic analysis (Braun & Clarke, 2006; also Lakkala *et al.*, 2015) of the student self-reflections was carried out in both research cycles. The unit of analysis was determined as emotional experience (van der Veer, 2001). Coding was carried out using NVivo. The categorisation by Lakkala *et al.* (2015) and the questions on the reflection forms provided a starting point for creating the categories that represented different practices. Also, the category of collaborative knowledge creation was formed based on the need to examine the design, resulting in a total of seven categories. Data that did not describe experiences of the course practices were left out of the analysis. Excerpts presenting both positive and negative experiences were split into two separate units, as eg, this one: "Investigating the case is interesting... Certainly, there is not that much information about the case, after all, to get a clear picture of what has happened." After coding all the excerpts (218 excerpts in the first research cycle, 257 in the second research cycle) into these seven categories, they were coded again as either positive/successful or negative/challenging, which followed data-driven analysis of the sub-categories.

The categories that were created in the analysis were the same in both research cycles, but the sub-categories (in brackets) varied to some extent. In the analyses, the categories were as following:

- General issues (general experience, content and materials and their quality, own commitment and suitability for the course).
- Course structure (arrangement of the orientation, flexibility, timetable, planning and organising the course, proceeding in groups).

- Digital tools (quality of digital materials, usefulness of the LMS, technical issues in the LMS).
- Support (focus of the instructions, amount of support).
- Learning tasks (relevance or adequacy of the tasks, quality of the assignments).
- Multidisciplinary collaboration (multidisciplinary setting of the course, functioning of the group, remote collaboration, division of labour, commitment of group members).
- Collaborative knowledge creation (utilisation of members' expertise, learning from each other).
- Experienced learning outcomes (what students learnt, what students would have wanted to learn more).

Results

Learning outcomes of the first research cycle

In the individual assignments, students repeatedly demonstrated their familiarity with the given literature and learning of the central concepts of the course. Students also reported learning, through case-based studying, the kind of knowledge that they can apply in their future work. However, there were also many reports of not learning enough from the cases on key concepts because of a mismatch between the given literature and the chosen case. From the teacher's point of view, it appeared as though they did not grasp the idea of the cases that was to shed light on the complexity of real-life cases and there being no unequivocal solutions to fix them.

During the course, students reported facing challenges in communicating and building knowledge via the internet, getting group members to commit themselves to collaboration and matching schedules. They reported they "had to be flexible" or act "on insufficient information" without recognising these as issues similar to those they would face when working in multidisciplinary teams in working life.

However, in the final group assignments, groups reported they began to understand how complicated multidisciplinary group work is. The groups were graded 3 and 5 (on a scale of 0–5, with 5 being the best). The grade 3 group's assignment was not written collaboratively nor was it finalised. The grade 5 group reported learning of both knowledge and competence with the help of each other's expertise, and learning from different ways and perspectives of working in a multidisciplinary group, that they could also utilise in the future.

Students' self-reflections in the first research cycle

The most emphasised challenges in the first research cycle concerned (the combination of) creating knowledge (1) together, (2) virtually and (3) in a multidisciplinary group. Therefore, we only focus on the experiences about course structure, multidisciplinary collaboration, collaborative knowledge creation and experienced learning outcomes.

Course structure

The course orientation got only negative feedback because of a too-tight timetable and lack of a "physical" orientation meeting. Many of the students experienced that there was basically no time for proper interaction within or between the groups: "Now there was the same deadline for many assignments which meant that writing itself took a lion's bite of the time in the module. Peer commenting and communication would require a separate timespan." The same pattern repeated with every group and all the modules, as the students' submissions depended on each other's participation. Conversely, some felt that the structure was too flexible and offered too much responsibility for the group. Students also expressed that they wished more in-person interaction could have been organised: "Though I still miss human contact, this is more flexible, which is great."

Multidisciplinary collaboration

There were many negative mentions about multidisciplinary collaboration. The challenges were related to group members' different goals and insufficient participation.

Collaborative knowledge creation

Collaborative knowledge creation was mostly described as successful. Students described complementing each other's expertise in their collaboration. Even more often, students expressed learning from other group members and course takers as the other students, representing other disciplines, challenged and expanded their learning.

Additionally, creating knowledge together did not succeed because of the remote work settings: "Of course, the fact that you don't meet up with your group properly face-to-face definitely decreases the amount of shared pondering and discussions."

Experienced learning outcomes

Students experienced having learnt mostly new content knowledge, such as the concepts of inclusion, co-teaching, pedagogical consultation and professional interaction skills—knowledge that is applicable to practice. Negative comments were related to, eg, the experience that they did not get to learn in practice: "I would have wanted to bring the things learned in practice, but this didn't succeed because the group didn't manage to organise enough meetings. Interaction skills cannot be easily practiced using Whatsapp."

Changes in the course design and use of design principles in the second research cycle

Based on the learning outcomes and experiences, some changes were made to the course design. Comparing the outcomes to the theoretical design principles, it was decided that adding practices to promote DP2 and DP3 were required.

DP2—supporting participation and negotiation

Because of the feedback, the course in the second research cycle started with an orientation meeting. In the meeting, the teacher divided the students into groups and gave them an orientation task to start with. The goal of the task was to put more emphasis on DP2 and to get the groups to better negotiate their forthcoming collaboration. The groups were also ordered to decide on roles to help them share the responsibilities. More time was allocated just for the first module "Orientation" (see Table 2).

The structure of the other modules was also developed: Each of the modules still occupied a 2-week period, but they were now divided in two in terms of deadlines. The first week was for individual and group assignments, and the second week for reflecting on the video lecture and peer-group tutoring.

More emphasis was placed on explaining the purpose of integrating case-based learning, organising group work and co-authoring. For example, the teacher also explained that the cases were not designed to match perfectly with the themes and literature of the course because they were

Table 2: Modules in the second research cycle

<i>Time period</i>	<i>Modules</i>
12.3.2019–22.3.2019	1. Module: Orientation
25.3.2019–5.4.2019	2. Module: Professional interaction skills
8.4.2019–19.4.2019	3. Module: Co-teaching
22.4.2019–3.5.2019	4. Module: Pedagogical consultation
6.5.2019–24.5.2019	5. Module: Final group assignments

real-world cases written by people working in the school context. Also, group submission settings in Moodle were disabled. The group members indicated their participation only by colour codes.

DP3—fostering reflection

DP3 was also applied more extensively: a group-level written reflection was now required at the end of each module to promote and encourage the group members to mention and express their thoughts about “how they were doing” and how they could do better in the future.

The Moodle course area was developed with more instruction texts. Also, a separate “tab” in the course area was added for the above-mentioned group reflection to support the accumulation of learning. The idea was that upon returning to reflect on their collaboration at the end of each module, they would easily see their previous writings and development and base their reflections accordingly.

Learning outcomes of the second research cycle

Similarly to the first research cycle, the individual assignments showed the students’ learning of knowledge concepts. Although there were still some reports of challenges in group work like before, the students now seemed to recognise that when collaborating, they were simulating processes from working life. They reported learning applicable competences about how to collaborate remotely and in a multidisciplinary manner, using different tools for collaboration and learning different work practices.

From the three groups, two were evaluated with a grade of 4 and one with a grade of 5. All the groups evidenced learning of the knowledge and competences of collaboration and professional interaction in their final group assignments. The grade 5 group showed an excellent integration of reflecting on theory and practice, and the text was co-authored and well finalised.

Students’ self-reflections in the second cycle

The overall experience of the course improved in the second research cycle (see Table S1). Again, only the experiences about course structure, multidisciplinary collaboration, collaborative knowledge creation and experienced learning outcomes are described.

Course structure

There were no negative comments about the orientation such as those in the first research cycle. Students’ personal reflections on the course structure changed as they understood the structure in relation to the learning objectives better than in the previous research cycle. Students also submitted assignments and accessed the materials more evenly in terms of time compared to the first research cycle, when there were clear peaks in access every other week (see Figure 1).

The way the course was organised also continued to create contradictory issues in terms of how it affected the interaction between students: “Technology-mediated studies give possibilities for free activity, but I also think that, for its part, it limits real face-to-face interaction.”

Multidisciplinary collaboration

Although three different ways of supporting multidisciplinary collaboration had been added to the course design for the second research cycle, students did not mention them in their self-reflections. However, group-level reflection seemed to promote the kind of reflections that it was intended to promote. Students named things that could be developed further in group work or their own work, but they also manifested some successful issues and praised their group members.

Contrary to the first research cycle, notes were also made about practical training through group work. Additionally, there were much fewer comments about challenges in multidisciplinary collaboration than in the first research cycle, but finding time together remained problematic

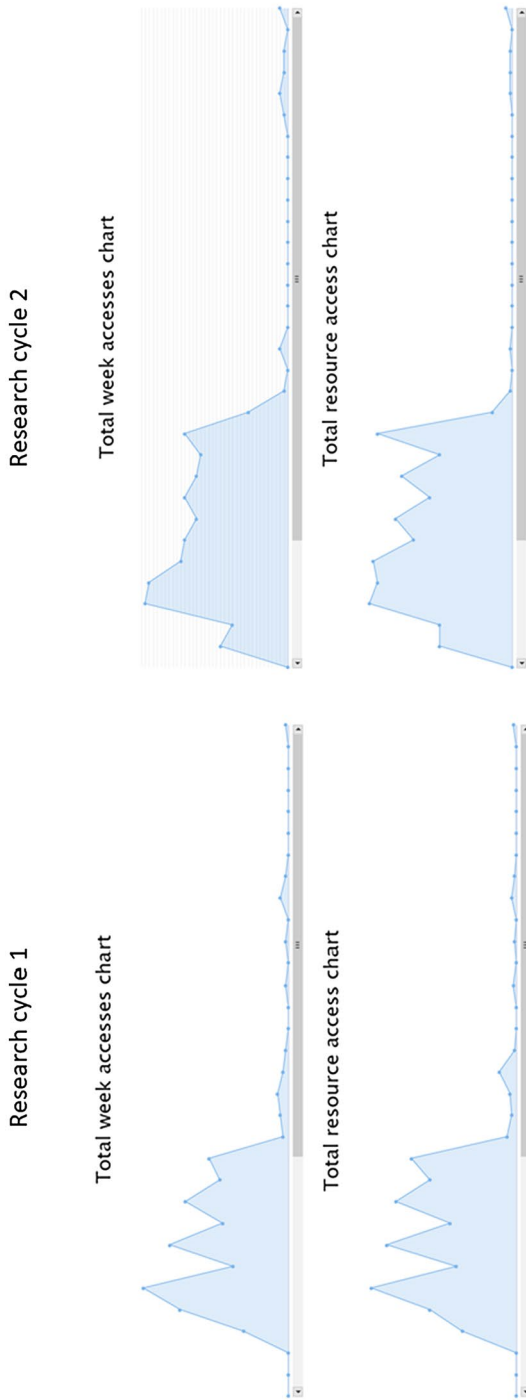


Figure 1: Student access to the learning management system during the research cycles
[Colour figure can be viewed at wileyonlinelibrary.com]

because of a lack of interaction and “physical” presence: “When [a] group exists only online, it’s at times challenging to remember all the tasks along with everything else that is happening in our lives, even though we have discussed things within our group in WhatsApp, for example. A concrete group that meets and is physically present, is different.”

Collaborative knowledge creation

Many notes were made about finding everyone’s expertise useful in writing the collaborative assignments. There were also remarks about the case working as an object that provided a basis for collaborative knowledge creation: “It is easy to start applying theory to a case because the case is sooo practical. Of course, there are no unequivocal answers but that exactly seeds conversation and concrete examples in our group.”

Experienced learning outcomes

In addition to learning new content knowledge and knowledge applicable to practice, new positive mentions concerned working together remotely and working collaboratively. Learning about one’s own expertise was also something positive: “Personal abilities can become valuable and to be seen [as] strengths only after you notice that they are not everyone’s abilities.”

Discussion

This study examined the pedagogical design of a university-level e-course through students’ learning outcomes and experiences in the course “Collaboration and Professional Interaction Skills.” The emphasis of both the content and the learning activities of the course was on learning knowledge and competences for multidisciplinary collaboration and interaction.

The first research question concerned students’ learning outcomes and experiences from the first operationalisation of the course. Students were left “on their own” and given more flexibility, as there were fewer instructions and the deadlines were looser. There was no problem with learning the content knowledge individually. The pedagogical design seemed to support it based on the learning outcomes, students’ self-reflections and teacher observations. In contrast, learning the competences of collaboration and interaction seemed more difficult.

The second research question focused to the central issues for redesign that were identified by comparing the outcomes of the first operationalisation of the course and the theoretical design principles. As it became obvious, it is hard for the students to engage in collaboration without multiple ways of instructional design (also Kobbe *et al.*, 2007). Therefore, more guidelines especially for collaboration and co-authoring were added. Most of the challenges indicated that new practices emphasizing DP2 and DP3, aiming for more negotiation and reflection inside the group, were needed.

The third research question concerned the learning outcomes and experiences in the second operationalisation of the course. Similarly, to the first research cycle, students demonstrated successful learning of the content knowledge. We also observed that students experienced fewer challenges with multidisciplinary group work and evaluated their learning more positively on the competences of collaboration and interaction. This suggested that the pedagogical design succeeded in leveraging the combination of many activating teaching and learning methods aiming to teach collaboration and interaction. However, some challenges remained paradoxical.

Students, especially in the first research cycle, often wished for more “authentic,” “face-to-face” or “physical” encounters—although at the same time they appreciated the digital settings for the flexibility it brings to the studies. As there were mentions of wishes for more training of interaction in practice, it appears that students expected that practicing interaction skills would be something different. It might be that students have the preconception that professional interaction in

their field happens face-to-face, without technology. However, digital interaction and collaboration is also the reality of teacher's work when, eg, working with colleagues in a large municipality or rural areas (see Pettersson, 2017). Also, professionals need to have the readiness to work with other professionals and parents in different locations, meaning that the interaction happens digitally (Kuusimäki *et al.*, 2019). From this point of view, the wish for "authenticity" seemed contradictory.

Previous research has already highlighted the significance of designing the collaboration process around group-level shared knowledge objects (DP1) (Damsa & Muukkonen, 2020; Lakkala *et al.*, 2015; Paavola *et al.*, 2011). In this study, with the first design principle building the basis for the course, the pedagogical design put emphasis on another three design principles. Based on the results, for interaction and collaboration to take place in the technology-mediated settings (DP6), attention was needed most to facilitate negotiation and participation among the students (DP2) as well as the personal and group-level reflection (DP3).

Conclusions

Comparing the results with the design principles, we suggest that the following aspects should be considered when developing courses that emphasise multidisciplinary collaboration and interaction online. In our study, learning activities on shared knowledge object creation were supported by repeated, structured cycles combining both individual tasks and group tasks, each promoting knowledge and competence that aim to advance the final object. For the shared knowledge objects and studied concepts to be useful later, we suggest that groups be offered real-life cases that they reflect from the perspectives of the concepts of the course. It appears to be important that the cases are not designed to fit perfectly to the concepts studied. This is exemplified, for instance, in students' notions that "this is exactly what fosters discussion in the group" while it also sheds light on what it is like to collaborate in a professional context with uncertainties and a lack of essential knowledge. Students might not be used to such open-endedness or submitting work-in-progress, and thus they need encouragement to do so.

Secondly, we suggest that there should be many tasks that concern both the process and the content. In our research, adding the tasks related to the process seemed very valuable as it increased the amount of productive interaction on the course. It was not obvious for the course takers to prioritise discussions about the process over discussions about the content. Students' critical notes about digital interaction reflect their expectations and even idealistic perceptions of what face-to-face interaction is like. Productivity in interaction or creating knowledge collaboratively is not self-evident in face-to-face situations. On the contrary, intense collaboration is possible asynchronously in digital settings, but similarly to face-to-face interaction, presence, encounters and learning cannot be taken for granted. It is essential to create a space that enables them (see Suorsa, 2017). For the assistance of e-course designers, more empirical research is needed on how to create this kind of space in hybrid learning spaces.

Thirdly, a structured timetable is imperative for the collaboration within and between the groups. In our research, shorter interphases seemed to help collaboration, but as the time spans were very short, this resulted in experiences of inflexible structure. Therefore, we suggest there should be clear time spans, but they should be planned as longer periods to add some flexibility.

Fourthly, we suggest that learning activities should be situated within the same system, as the flexibility of tools and platforms may involve limitations. In our study, the learning management system provided by the university did not support collaborative knowledge creation. However, when directing or allowing students to work outside the LMS, we lose important data of students' actions, but most importantly the visibility of their progress. Monitoring would help us to get a

better insight of the organisation of the collaboration. In this research, we had limited access to this kind of analytics data. The line of studies about students' behaviour on collaborative and technology-mediated practices should be developed with the help of analytics of the learning management systems used in the e-courses combined with data about students' subjective experiences of learning on the course.

Some issues remain challenging when balancing between personalised learning and supporting collaboration. Collaboration is always hybrid in terms of learning spaces, because each of the participants brings their own everyday life to the collaboration, a factor which cannot be resolved with pedagogical designs (see Schraube & Osterkamp, 2013). Although students reported that their experiences of interaction, co-authoring and multidisciplinary collaboration involved challenges, they also reported learning knowledge and competence to carry out these activities.

This kind of training is needed in the university not only to develop accessibility of teaching but also because interacting digitally is an important working life skill that needs to be trained. Like on this course, digital technology might sometimes also be the only way in the working life to bring people together to work for a shared goal. Similarly, as higher education is changing towards online education, it is of great importance to emphasise that "teachers are designers" (also Bennett *et al.*, 2018). Hybrid learning spaces can indeed foster in-depth learning and even sustainable development, but leveraging the hybridity requires careful designing.

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Statements on open data, ethics and conflict of interest

The data consist of personal learning outcomes and self-reflections of students. We have not asked for consent to share the data.

Students provided informed consent. The university does not require a statement from an institutional ethics committee for such non-invasive data. The institution's ethical guidelines for data collection, protecting students by using pseudonyms, analysis and storage were followed.

No conflict of interest.

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Supporting Information

Additional supporting information may be found online in the Supporting Information section at the end of the article.