STUDENTS' ORCHESTRATION OF GROUP WORK AND THE ROLE OF TECHNOLOGY

by

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CV

I received my Master in IT, Learning and Organisational Change at Aalborg University, Denmark, in 2016 and started as a PhD student in the Department of Communication and Psychology, Aalborg University, in 2017. During the PhD, I have been affiliated with E-learning Lab – Center for User-Driven Information. My primary research interest is the relationship between technology, education, and learning. My research has centred on student self-organised use of technology to support group work.

In my PhD dissertation, I have studied students' orchestration of collaboration in a problem- and project-based learning environment based on a multi-sited ethnographical study.

Mia Thyrre Sørensen

ENGLISH SUMMARY

Technology plays a vital role in students' collaborative practice. This practice holds a complexity that we may not yet fully understand.

Within educational technology, research has previously centred on how educators design technology-supported teaching and, to a lesser extent, on students' self-organised digital practices. Students increasingly use technology to organise learning and bring informal digital practices into a formal educational arena. At the same time, research into students' digital practices has focused on mapping *which* technologies students use. In contrast, we still have only limited insight into *how* and *why* they use the specific technologies and how these affect their learning.

Technology has become an integral part of education. While it may have previously made sense to consider online and onsite as two separate domains, students are increasingly working in hybrid learning environments. Here, online and onsite are interwoven so that they cannot be understood in isolation. Research on student digital practice has focused primarily on individual practice rather than digital collaborative practice. Furthermore, research into collaborative learning groups tends to focus on either online collaboration or face-to-face collaboration, while a smaller proportion deals with collaboration in a hybrid learning environment.

This dissertation explores student self-organized hybrid collaborative practices in a problem-oriented and project-based learning environment. It reports a multi-sited ethnographic study of student orchestration of collaboration and the role of technology in collaboration. At Aalborg University (AAU), Denmark, students work under the AAU model, a problem-oriented and project-based pedagogical model; the students collaborate in small groups on an authentic problem of their choice, often for a semester (three to four months). The model implies a high degree of student autonomy; the students manage how they collaborate on the project, including meeting place, meeting frequency, planning, division of labour, work constellations (individually, in pairs, together in the group), choice of technology, and how they use technology to support their project collaboration. The students collaborating on a problem-based project are examples of students applying the technology to active learning. Research indicates that students, on the one hand, need support to develop their digital practices and, on the other hand, develop small creative practices that we as researchers and educators can learn from. Throughout a semester, from group formation to project exams, I have followed project groups across onsite meetings and digital platforms. The participating groups are selected across the five faculties at AAU.

The studies show a high degree of diversity in the students' collaborative practice in and among the participating project groups. In the dissertation, you will encounter:

- Project groups that work closely together and project groups that primarily cooperatively divide the tasks among the individual members
- Project groups that meet daily and project groups that meet weekly
- Project groups that meet in group rooms, at home with group members, meeting rooms, the library, and virtually
- Project groups that work with a fixed work division and fixed work constellations and project groups in which work division and constellations are dynamically changing
- Project groups with a collaborative practice characterised by routines and project groups with a practice characterised by navigation in the present and an ad-hoc structure emerging due to the given situation

In this dissertation, I focus on the *actual* practice of the students. In technology and education, there is a tendency to focus on what technology does in education and learning and how technology improves or degrades education (most often the first). In practice, however, technology appears more like an expected and unremarkable element of education. I have taken an exploratory and adaptive approach to the study, focusing on describing the students' collaborative practice in addition to normative and deterministic considerations about technology, education, or students' ability to use technology for learning, with the primary purpose of developing new concepts and models helping to explain student practices.

The dissertation offers empirical examples and descriptions from the field of student collaborative practice, which, through analysis and in the dialogue between data and ideas, has turned into categories, concepts, and models. Among other things, I propose an understanding of the student collaboration as balancing the six dimensions: social – academic, PBL collaboration – PBL cooperation, individual – shared, planning – improvisation, routine – ad-hoc, and together – apart. The dimensions substantiate that the project work can take several forms and show that no ideal balance exists for the project groups to strive for. The six dimensions of group work have both analytical and more practical potential by forming basic analytical questions for students' collaborative practice and questions that require students to reflect on their collaborative practice.

Furthermore, the dissertation shows that a linear causality thinking between technology and practice can be problematic, and it is impossible to give an unambiguous answer to the question of what technology *does* or *brings* to the students' collaboration. It supports the notion that technology plays a vital role in student collaboration and provides various examples. The technology can help structure the collaboration while simultaneously offering flexibility and demanding fluidity. Digital and analogue technologies constitute, individually and in interplay, essential

tools in project work. In addition, technology can act as a place and plays an essential role in students' construction of the workplace. It emphasises that the use of technology to support project collaboration cannot be reduced to choosing the right tools and using them in the right way. It is also about constructing a workplace and creating a space for learning and collaboration. This workplace construction implies negotiating the boundaries between onsite and online and between contexts and roles within and outside the university.

DANSK RESUME

Teknologi spiller en vital rolle for studerendes samarbejdspraksis. Denne praksis rummer en kompleksitet, som vi måske endnu ikke helt forstår.

Indenfor uddannelsesteknologi har forskning tidligere centreret sig om hvordan undervisere designer teknologi-understøttet undervisning og i mindre grad om de studerendes selvorganiserede digitale praksisser. Studerende anvender i stigende grad teknologi til at organisere læring og bringer uformelle digitale praksisser ind i en formel uddannelseskontekst. Samtidigt har forskning i studerendes digitale praksis primært fokuseret på at kortlægge *hvilke* teknologier studerende anvender, mens vi stadig kun har en begrænset indsigt i *hvordan* og *hvorfor* de anvender de specifikke teknologier samt hvordan disse påvirker deres læring.

Teknologi er blevet en integreret del af uddannelse, og hvor det måske tidligere har været meningsfuldt at betragte online og onsite som to separate domæner, arbejder de studerende i stigende grad i hybride læringsmiljøer. Her er online og onsite filtret sammen i sådan en grad, at de ikke kan forstås isoleret. Forskning omhandlende studerendes digitale praksis har primært fokuseret på individuel praksis fremfor digital samarbejdspraksis. Ydermere har forskningen i kollaborative læringsgrupper tendens til omhandle enten online samarbejde eller samarbejde ansigt-til-ansigt, mens en mindre del omhandler samarbejde i et hybrid læringsmiljø.

Denne afhandling undersøger studerende selvorganiserede hybride samarbejdspraksis i et problemorienteret og projektbaseret læringsmiljø. Den rapporterer et multi-sited etnografisk studie af studerendes orkestrering af samarbejde og teknologiens rolle i samarbejdet. Ved Aalborg Universitet (AAU), Danmark, arbejder studerende under AAU-modellen, en problemorienteret og projektbaseret pædagogisk model. De studerende samarbejder i små grupper om et autentisk selvvalgt problem, ofte af et semesters varighed (3-4 måneder). Modellen rummer en høj grad af autonomi til de studerende; de studerende styrer selv hvordan de samarbejder omkring projektet, herunder mødested, mødefrekvens, planlægning, arbejdsdeling, arbejds-konstellationer (individuelt, parvist, sammen i gruppen), valg af teknologi og hvordan de anvender teknologien til at understøtte deres projektsamarbejde. De studerende, der samarbejder om et problembaseret projekt, er et eksempel på studerende, der anvender teknologien til en aktiv læring. Forskning indikerer, at de studerende på den ene side har behov for support til at udvikle deres digitale praksis, og på den anden side, udvikler små kreative praksisser, som vi som forskere og undervisere kan lære af. Gennem et semester, fra gruppedannelse til projekteksamen, har jeg fulgt projektgrupper på tværs af onsite møder og digitale platforme. De deltagende grupper er udvalgt på tværs af de fem fakulteter ved AAU.

Studierne viser en høj grad af diversitet i de studerendes samarbejdspraksis i og blandt de deltagende projektgrupper. I afhandlingen møder du blandt andet:

- Studerende der samarbejder tæt sammen hele gruppen, studerende der arbejder i par, og studerende, der primært kooperativt fordeler opgaverne mellem sig, og studerende, der mødes hjemme
- Projektgrupper, der mødes dagligt, og projektgrupper, der mødes ugentligt
- Projektgrupper, der mødes i grupperum, hjemme hos gruppemedlemmer, mødelokaler, biblioteket og virtuelt
- Projektgrupper, der arbejder med en fast arbejdsdeling og faste arbejdskonstellationer, og projektgrupper, hvor disse er mere skiftende og dynamiske
- Projektgrupper med en samarbejdspraksis der er præget af rutiner og projektgrupper med en praksis, der er præget af navigation i nuet og ad-hoc strukturer, som opstår i den givne situation

I denne afhandling fokuserer jeg på de studerendes *faktiske* praksis. Inden for teknologi og uddannelse, er der en tendens til at fokusere på hvad teknologien *gør* ved uddannelse og læring, hvordan teknologien forbedrer eller forringer uddannelse (oftest det første). I praksis, fremstår teknologien dog nærmere som et forventet og ikke-bemærkelsesværdigt element ved uddannelse. Jeg har gået til studierne med en eksplorativ og adaptiv tilgang, med fokus på at beskrive de studerendes samarbejdspraksis ud over normative og determinitiske betragtninger om hvad omkring teknologi, uddannelse eller studerendes evne til at anvende teknologi til læring, og med det primære formål at udvikle nye koncepter og modeller, der kan hjælpe til at forklare de studerende praksis.

Afhandlingen indeholder empiriske eksempler og beskrivelser fra feltet af studerendes samarbejdspraksis, som gennem analyse og i dialogen mellem data og ideer bliver til kategorier, koncepter og modeller. Blandt andet, foreslår og argumenter jeg for en forståelse af de studerendes samarbejde som en balancering de seks dimensioner: Social/Faglig, PBL-kollaboration/PBL-kooperation, Individuelt/Delt, Planlægning/ Improvisation, Rutine/Ad-hoc, og Sammen/Adskilt. Dimensionerne underbygger, at projektarbejdet kan antage flere former og viser, at der ikke findes et specifikt balancepunkt, som projektgrupperne kan stræbe efter. De seks dimensioner af gruppearbejde har både analytisk og praktisk potentiale idét de danner grundlag for analytiske spørgsmål til de studerendes samarbejdspraksis og spørgsmål, som fordrer de studerende til at reflektere over egen samarbejdspraksis.

Ydermere, viser afhandlingen, at en lineær kausalitetstænkning mellem teknologi og praksis kan være problematisk, og at det ikke er muligt at give noget entydigt svar på hvad teknologi *gør* eller *bringer* til de studerendes samarbejde. Den underbygger at teknologien spiller en vital rolle i studerendes samarbejde og giver forskellige eksempler på dette. Teknologien kan hjælpe til at strukturere samarbejdet og samtidigt

tilbyde fleksibilitet og fordre fluiditet. Digitale og analoge teknologier udgør, hver for sig og i sammenspil, vigtige værktøjer i projektarbejdet. Derudover kan teknologien agere som sted, og spiller en vigtig rolle i de studerendes konstruktion af arbejdspladsen. Det understreger, at anvendelse af teknologi til at understøtte projektsamarbejde ikke kan reduceres til valg af de rette værktøjer og anvendelse af disse på rette måde. Det handler også om at konstruere en arbejdsplads og skabe et rum for læring og samarbejde. Denne konstruktion af arbejdsplads rummer forhandlinger af grænserne mellem onsite og online samt mellem kontekster og roller i og udenfor universitetet.

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CHAPTER 1. INTRODUCTION

At a university's library filial, four students are sprawled in a sofa corner with their laptops. One lies stretched out on a three-person sofa with his laptop standing on a chair in front of him. Another has her feet on the coffee table. They are reading articles in preparation for their project and joint report. The sofa corner is the group's favourite meeting place. Tomorrow they will meet at the other end of town – they have booked a meeting room on campus for a supervisor meeting. A Google Docs document for planning shows that they will work from home the day after tomorrow. However, the group often changes plans and adjusts the meeting times – sometimes on short notice – in an online conversation in Facebook Messenger.

In the dorm apartment, four laptops cover a small dining table. The screen on the four laptops looks similar – a browser window with the Google Docs document "total.doc" containing text sections for the group's project report. It has been about a week since the group last met, and in all probability, the next meeting will be in a week. Between the weekly meetings, the members work on individual writing assignments. Practice and procedure at the individual meetings are similar; the members review the text written together since the last meeting, after which they distribute writing assignments for the coming week.

In a group room, four group members work on individual tasks; one writes a report section in Overleaf, another does calculations in MATLAB, a third creates a 3D model in Solid Works, and the fourth is about to go to the workshop to build a cardboard model. The members meet daily in the group room from 8 am to 4 pm. They have furnished the room with a refrigerator, a coffee machine, coffee syrup, a music system, and desktop screens. On the blackboards are model drafts and an outdated task list.

In a laboratory, four group members meet for their daily scrum meeting at 9; they quickly review the day's tasks and the problems they encountered in yesterday's work. Today they must continue the programming of a robot. Depending on the activity, the meeting takes place in the laboratory, in the group room, or virtually. Often, they decide the day before. On days dedicated to writing, they work together virtually, connected throughout the workday. They ask each other for advice and alternate dynamically between working individually, in pairs, or all four members together.

In the open study area, the six members occupy a table, each sitting with a laptop in front of them. It is lunchtime. Some focus on the screens, working on the project while eating; others use the time for social small-talk. Lunch proceeds smoothly into more concentrated work, and each student is involved in individual tasks. Simultaneously, a joint conversation occurs, alternating between project-related and social issues. It seems like the students are both supporting and disrupting each other.

The above descriptions are from my field studies of student collaboration in a project- and problem-based learning environment. In five different locations, five project groups are working on their projects. The collaboration practice of the groups, the way they work together, and their meeting places, meeting frequencies, work constellations, and routines vary. Some meet daily, others meet once a week. In other groups, the ratio varies between meeting days and homework days during the project period. Some groups have group rooms, while others do not have a steady workplace; their meeting places vary between, among others, the library, open study areas, booked meeting rooms, and a member's dormitory. Some groups divide the majority of the work into individual tasks, while others vary dynamically between working individually, in subgroups and with all members together. Some groups have regular routines, such as daily meetings or particular reviewing practices, while others plan ad-hoc. Technology is an integrated part of their collaboration practice; the function, meaning, and role depend on the group and the particular situation. The learning environment is hybrid; the online and onsite and the digital and analogue are interwoven and cannot be understood in isolation. In this dissertation, I explore the students' orchestration of their project collaboration, aiming to conceptually capture student collaboration practice and the diversity in practice inside and across project groups, including the various roles of technology.

The number of studies in student self-organised collaborative hybrid practice is limited. Existing literature shows that the student collaboration practice implies a complexity that we do not yet fully understand. In this introductory chapter, I briefly review this research gap and present the context for my studies of students' hybrid collaboration practice.

1.1. STUDENTS' SELF-ORGANISED COLLABORATIVE HYBRID PRACTICE

In the following, I highlight the gap of studies in students' self-organised collaborative hybrid practice. I do this by zooming in on the students' self-organised practice with technology, collaborative practice, and hybrid practice, respectively.

Students' self-organised practice

Technology is an integral part of higher education; technologies, how we apply technology, and how we approach the interrelation between us and technology are constantly changing. Students increasingly use technology to organise learning and

bring informal digital social practices into the formal educational arena (Deng & Tavares, 2015; Greenhow & Lewin, 2016). However, while much of the literature in educational technology tends to focus on the design of technology-enhanced learning, our knowledge of students' self-organised use of technology is still limited.

Henderson, Selwyn, and Aston (2015) argue that there is a need to more closely scrutinize why students engage with specific technology and what significance it has for their learning:

> More attention therefore needs to be paid towards the reasons why students engage with specific forms of digital technologies during their studies. This raises questions about the roles that these technologies are playing in student learning, the meanings that are being attached to different digital practices, and the outcomes and consequences of any use (p. 2)

While several studies have mapped out *which* technologies students use, we still have limited insight into *how* and *why* students engage with the specific technologies.

Henderson, Selwyn, and Aston (2015) study individual students' motives and rationales for engaging with technology at an Australian University, emphasising the distinction between how students *actually* use technology and the ideals and narratives often told about the students' use of technology. In an open-ended survey, they asked the students, "What has been the most useful examples of technology-based learning that you've experienced so far in your university course?" In the analysis, themes diverged into two categories; practices related to logistics such as "organising and managing the logistics of studying", "flexibility of place and location", and "saving time", and practices related to learning like "researching information" and "seeing information in different ways". The study shows that the first category, the logistic, was most prominent in the students' reasoning, while the learning-related themes, in comparison, were represented meagrely. According to Henderson, Selwyn and Aston (2015), this suggests that "the nature of university students' engagements with digital technology is notably bounded" (p. 9) and "digital technologies are clearly not 'transforming' the nature of university teaching and learning" (p. 11); student digital practices are "largely 'safe', bounded and outcome-focused" (p. 12) and "not the most expansive, expressive, empowering, enlightening or even exciting ways that digital technologies *could* be used" (p. 12). The nature of student use reflects that only certain digital practices are institutionally legitimised; students find the use that works best in the context. Henderson, Selwyn and Aston (2015) therefore call for alternative teaching and learning contexts to legitimise "alternative (perhaps more active, more participatory or more creative) uses of digital technology" (p. 12).

Henderson, Selwyn, Finger, et al. (2015) distinguish between "state of the art" and "state of actual". The denotations connote "what we know *might* be achieved through technology-enabled learning" and "the realities of technology use within contemporary university contexts" (p. 308). This distinction emphasises that academic

discussion has focused primarily on "state of the art" and demands renewed attention on "state of the actual". As I expound further in the next chapter, literature on educational technology often includes promises or high expectations on how technology changes education, often for the better. In contrast, technology is, in practice, often an embedded and unremarkable feature. The distinction of "state of the art" and "state of the actual" also concerns the students' abilities and competencies to apply technology. Students are often portrayed as a homogeneous group – as either competent or uncritical digital learners. However, there is a broad consensus that both portrayals are too one-sided.

Students' collaborative practice

In the literature focusing on students' self-organised digital practice, the majority tend to focus on the individual use of technology; only a limited number of studies deal with technology use in small groups of students. Recent studies, such as Rossitto et al. (2014), Ryberg, Davidsen, et al. (2018), and Spence (2020), are some of the exceptions.

Rossitto et al. (2014) study nomadic groups and their orchestration of technologies to manage their projects across different locations coping with the absence of a steady workplace. The study shows a wide variety of digital tools and artefacts that groups use. Orchestration refers to "the situated moments whereby the use of specific technologies within a potential constellation, is planned, negotiated and instantiated within a given group" (p. 145). In studying student orchestration of technology, Rossitto et al. (2014) go beyond the applications of single tools and instead focus on situated collaborative use. They reveal how the students orchestrate constellations of technologies to manage place and time issues and create suitable workspaces. Rossitto et al. (2014) emphasise that a constellation is "unique to a group and it is negotiated together with other shared values, routines, and division of work" (p. 155) and that the constellation is partly aligned in advance and partly improvised, which is why a given constellation is difficult to predict.

Building on Rossitto (2014)'s work, Ryberg, Davidsen, et al. (2018) study student group practices. They identify three types of nomadic practices: orchestration of work phases, spaces, and activities; orchestration of multiple technologies; and orchestration of togetherness (for further category descriptions, see Section 2.3.3.1). By the three categories, Ryberg, Davidsen, et al. emphasise "the entangled nature of space, time, activities, social aspects, and technologies in the students' orchestration of their work phases and activities" (p. 239). They highlight how students' choices of workspace depend on the given activity and how students' constellation of technology implies a combination of analogue and digital tools. Additionally, they emphasise the importance of social coherence for group work. In conclusion, Ryberg, Davidsen, et al. (2018) highlight that there is much we still do not understand about the students' collaborative practice:

> We are only beginning to understand the complexity of student practices that are involved in nomadic collaborative learning groups and the extent they involve mixtures of digital and physical spaces, activities, social cohesion and technologies (p. 246)

Spence (2020) studies how students collaboratively create knowledge focusing on epistemic objects and infrastructures. Compared to individual problem-solving, the amount of research attention paid to group problem-solving is very limited. Spence's (2020) studies of seven project groups show that technology is a crucial part of the infrastructure for knowledge construction; they also show diversity in both project groups' use of technology and management of working together.

Each in its own way, the three studies show that technology plays a crucial role in student collaboration practices and that these practices imply a complexity that we may not fully understand yet.

Students' hybrid practice

The students work in *hybrid* learning environments. As briefly touched on, hybrid refers to the fusion or cross-breeding of seemingly opposite tendencies, such as digital/analogue and onsite/online; the digital and analogue or online and onsite are interwoven to such an extent that they cannot be understood in isolation. Students collaborate across onsite and online spaces and contexts, using digital and analogue tools in interplay, also reflected in the three studies described above. Like technology-enhanced learning, most literature on hybrid learning tends to have a design perspective and focus on teacher, rather than student, orchestration of hybrid learning. Coincidently, the literature on collaborative groups focuses on online or face-to-face collaboration (Ryberg, Davidsen, et al., 2018). We need more insights into this interwovenness and what technology and hybrid spaces mean for student practices.

Carvalho, Goodyear, and de Laat (2017) argue there is a need to understand and conceptualise the interplay between digital and physical spaces and artefacts. Ellis et al. (2018) describe how technology and other material objects participate in shaping practice as a core challenge in educational research:

> People, things and ideas flow together, combine for a time and then go their separate ways. Practices depend upon such temporary confluences and places are created by them. Understanding how technological and other material things participate in spatialised practices of teaching and learning thereby becomes a core challenge for contemporary educational research (p. 3)

Ellis and Goodyear (2016) point out a missing recognition that students' learning activities move across spaces and contexts. They demand a more student-centred approach to learning space research, which is open and agile to follow ideas, activities, and materials across spaces;

> observing what students actually do—how they move in, inhabit and reconfigure space, how they create congenial learning places, how they assemble tools and other artefacts in their work as students—is the best way of gaining insights into likely mechanisms; so too is talking with students (and teachers and other stakeholders) to gain their sense of what they are doing and why, how they experience different spaces, what they believe to work best for them, in each of the diverse activities making up their studies. Combining observational and experiential data is still relatively rare, yet vital (p. 181)

1.2. GROUP WORK AT AALBORG UNIVERSITY

In Aalborg, Denmark, university students work under a unique problem-based and project-oriented pedagogical model. The students collaborate in small groups most often of a semester duration (three to four months) on projects based on an authentic and self-chosen problem. In this process, students have a high degree of autonomy; in the groups, they manage how they collaborate on the project, including meeting places, frequency, planning, division of labour and work constellations, choice of technologies, and how they use these to support the project work. In the project groups, members negotiate and develop collaborative practices and use technology in an active learning context. The project- and problem-based learning environment at Aalborg University (AAU) constitutes an eligible setting for studying students' collaborative hybrid practices. It poses a potential response to Henderson, Selwyn, and Aston's (2015) call for alternative teaching and learning contexts to legitimise "alternative (perhaps more active, more participatory or more creative) uses of digital technology" (p. 12).

1.2.1. THE SIX PRINCIPLES OF THE AAU MODEL

The PBL model practised across AAU, the Aalborg model, is based on the following six basic principles (AAU, 2015):

1. **The problem as a point of departure:** A problem constitutes a point of departure for the student's work. It can have different characters – theoretical or practical. The problem is scientific and authentic, i.e., can be understood and treated theoretically and methodologically within their subject, and has relevance outside academia. Thus, the problem is considered the focal point and as guiding the students' learning process

2. **Project organisation creates the framework of problem-based learning:** The project work consists of formulating, analysing, and processing the project's problem. The project period is typically a semester long (three to four months). It ends with the submittal of a tangible product, e.g., a project report. The report reflects the process from the problem formulation to the

solution, including problem identification, problem formulation, theoretical and methodological inquiry, data collection, analysis, and discussion and can be considered research on a smaller scale

3. **Courses support the project work:** The study time is evenly distributed between project work and course activity, supporting the students' project work. Further, the course activity ensures that the students gain a broad knowledge of theories and methods within their subject. Course activity and project work are most often organised in such a way that the proportion of course activity is largest at the beginning of the project period, after which it gradually decreases as submission approaches.

4. **Cooperation is a driving force in problem-based project work:** The students work closely together on the project in groups of typically four to six members. The group work encompasses knowledge sharing, professional discussions, collective decision-making, and mutual critical feedback. The group has assigned a supervisor acting as a sparring partner and professional support in the project work. In addition, groups can work in cooperation with external partners.

5. **The group's problem-based project work must be exemplary:** The learning outcomes in the project work must be transferable to similar situations and applicable in broader contexts than the project itself.

6. **The students are responsible for their learning achievements:** The students are responsible for the project and manage group collaboration and project work. Thus, the students are responsible for their learning and critical reflection on their knowledge base concerning the project's problem.

1.2.2. PROBLEM ORIENTATION AND PARTICIPANT DIRECTION

The inauguration of the AAU in 1974, and the sister university in Roskilde two years earlier, occurred in the swell of the student revolts of 1968, characterised by a settlement of the traditional professorial model and by student demands for influence and ownership of their learning, inspired by a Marxist critique of bourgeois education (Servant, 2016). Both universities base themselves on a problem-oriented and project-based pedagogy, an alternative pedagogy established primarily on the ideas of the Danish learning theorist Knud Illeris. Illeris (1974) finds his inspiration in critical theory (among other Freire (1970)) and German critical didactic tradition (including Negt (1968)). He discerns between three categories of qualifications that students must acquire through education, i.e., skill, adaptive, and creative qualifications (pp. 33-36), and points out the tension between adaptive and creative qualifications. While adaptive qualifications include adapting in organisational work forms and accepting existing societal norms, creative qualifications involve independence, interrelation,

and critical thinking and presuppose the ability to go beyond the status quo. To develop an education system that supports and produces skills qualifications, adaptive qualifications, and creative qualifications, Illeris argues for the two central didactic principles: problem orientation and participant-direction. The principle of problem-orientation emphasises that the starting point for teaching must be a present problem existing here and now, rather than being defined by disciplinary subjects constituted in the past. The choice of theories and methods for dealing with a problem depends on relevance to the given problem (p. 81). The principle of participant-direction concerns the question "Who decides what problems are, what problems to work with, and how to work with them?" (p. 82). Illeris argues that a definition of the problem based on traditional professional boundaries or political ties can prevent the development of the desired creativity and flexibility. Instead, he highlights the importance of student co-determination and ownership of the problem. He does not argue for full student governance. Instead, he proposes a framework/rules for problem formulation, including a thematic framework and a principle of exemplarity.

Since the inauguration, the problem-oriented and project-oriented model has been practised and developed across AAU. Both practice and theoretical foundation for the pedagogical model have been developed over the years. Among others, they have turned towards social learning theories, while the political and Marxist inspirations have slipped more into the background. Descriptions of the pedagogical foundation for the Aalborg model include various learning theorists. Among others, Piaget, Dewey, Lewin, Kolb, Gardner, and Lave and Wenger are mentioned, whose common denominator is that the acquisition of experience is considered a central aspect, starting point, and motivation for learning (Kolmos et al., 2004).

1.2.3. MULTIPLE SHAPES OF PROBLEM-BASED LEARNING

The problem- and project-based model, which has been practised at AAU since the university's inauguration, has been known as the Aalborg model (Kolmos et al., 2004) and Problem-Oriented Project Pedagogy (Dirckinck-Holmfeld, 2002). In the 1990s, AAU began to refer to the pedagogical model as problem-based learning (PBL) and call itself PBL University. The AAU model was firstly written under the more internationally recognised label in the academic world when Kolmos (1996) reflected on project work and problem-based learning, and later, in earnest, when De Graaff and Kolmos (2003) compared the AAU model with the PBL model practised at MacMaster and Maastricht Universities. Initially, PBL were developed as pedagogical models at McMaster and Maastricht Universities, conceived in medical education in 1969 and 1974 (Servant, 2016). With designed problems formed as patient cases, and small groups and tutoring as main learning strategies, the students should apply knowledge in practice by identifying health problems and searching for information to resolve these. It is based on two primary assumptions: Learning through working with problem situations is more effective than memory-based learning, and problem-

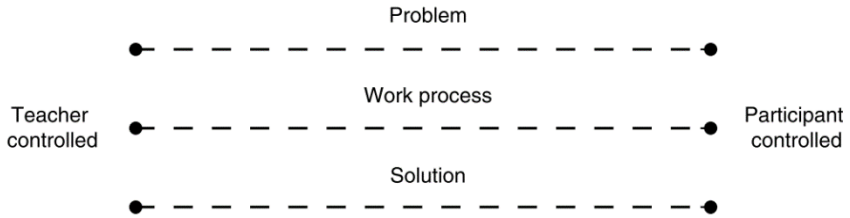


Figure 1-1 Continia between teacher and participant control (Ryberg, 2019; Ryberg et al., 2006).

solving skills are more critical than memory skills in treating patients (Savin-Baden, 2001).

PBL models and pedagogies have arisen from different social and political contexts and didactic and learning theoretical starting points. The variation in PBL means that it is impossible to create a narrow definition; instead, the pedagogy can be described based on general principles. Examples of common PBL principles are the problem (well-structured or ill-structured) as a starting point for the learning process, team-based learning (learning through dialogue and communication), participatory-directed (collective ownership of the learning process), interdisciplinary learning (across traditional subject-related boundaries), and exemplary practice (ensuring that the learning objective is exemplary to the overall educational objectives) (Kolmos & de Graaff, 2014). Some of the critical variations in PBL practice concern the definition of the problem and the organisation of the PBL work, as shown by the differences between the Aalborg and McMaster-Maastricht models. The organisation can be either project-organised or case-based; in project-organised PBL, groups must create a shared product, whereas groups in case-based PBL often act as pairs for joint discussion without a shared product as an outcome. Another variation relates to the implementation of PBL; most often the PBL principles are implemented on a course level (Savin-Baden, 2014). Together with Roskilde University, the Aalborg model stands out for the uniqueness of its problem-based and project-oriented model implemented across the university, where students work on self-defined problems.

Ryberg et al. (2006) have developed a model that helps to conceptualise the multitude of shapes that PBL pedagogy takes. The model suggests three dimensions, i.e., the problem, the working process, and the solution, and considers the dimensions as continua between teacher and participant control in PBL processes (Figure 2.1). The model raises questions such as: Who formulates and owns the problem? Is the problem teacher-designed, formulated by external partners, or do the participants identify the problem themselves? How is the work process organised? Who controls the work process? Do the participants decide how they investigate the problem and what methods and theories they use or do they follow a teacher-designed work plan? Who owns the solution? Are participants expected to reach a predefined solution or interact

in an explorative and knowledge-constructing process with an open-ended solution space? (Ryberg, 2019; Ryberg et al., 2006).

Across AAU, there are variations in the organisation and practice of the university's pedagogical model. Variations relate, among other things, to initial choices and the formulation of the project problem and the organisation of the work process. However, a characteristic across educational programmes is that problem, work process, and solution are mainly participant controlled.

1.2.4. STUDENTS' TECHNOLOGY USE – ROUTINE OR CREATIVE?

The students use several digital tools to support their project work. They use technology for information searching, inquiry, and exploration. They share and manage various resources through sharing, storing, and annotating. They use technology for (co-)writing and (co-)production. They use technology for communication and dialogue, short logistical messages, and virtual meeting activities. They use technology when they are co-located and when they are distributed. Shortly, technology is ubiquitous in students' project work.

At AAU, the project groups themselves choose and manage which technologies they use. The introduction and support that students receive regarding which technology to use, and how, in support of PBL project work and collaboration vary among educational programmes; in most cases, the students have limited or no introduction (Sørensen et al., 2017). The university provides MS Office for all students during their study time. However, MS Word is less prevalent for co-writing in project groups; instead, most prefer Google Docs for that purpose. Studies show that tools such as Facebook, Google Docs, and Drive are present across the project groups (Rongbutsri et al., 2011; Sørensen et al., 2017) and argue that a gap arises between the students' use of technology and more academically oriented tools and practices (Rongbutsri, 2017; Thomsen et al., 2016).

Studies of student motives and rationales for their choice of technology show that students choose tools with which they are already familiar and that they find easy to use (Sørensen, 2018; Thomsen et al., 2016). The students' reasoning for choosing technology appears first and foremost to concern efficiency and product optimisation; technology should free up time to prepare the joint project report and make the group collaboration 'easier'. The students' choice of technology seems to be based on rapid cost-benefit analysis; the immediate benefits of using a specific tool are weighed against the time it takes to master the tool. From this perspective, students' choice of technology appears pragmatic, outcome-focused, routine, and a minor degree explorative. On the other hand, studies show that students manage, on their own, to build well-functioning infrastructures and associated practices that make project work easier (Sørensen, 2018). In line with this, other studies of project groups' use of technology at AAU indicate that creative practices *hide* behind these simple

reasonings. Tolsby (2009) shows how the students use a virtual environment to create shared spaces that are accommodated and structured according to their practices. Ryberg, Davidsen, et al. (2018) find that the students shift dynamically between technologies; they choose technology accommodating the task and the phase of their project work and create successful transitions between the different technologies and between the physical and digital spaces (see also Section 2.3.3.1).

The pragmatic approach and the choice of commercial tools rather than professional tools suggest that students need support to develop a more advanced (and academic) digital practice. A tension arises between students' need for support to advance their digital practice while they are simultaneously creating successful digital infrastructures and associated collaboration practices (Ryberg, 2019; Sørensen, 2018). Ryberg (2019) describes the current situation as contradictory;

> we can learn a great deal from the students' creative practices, but also that students need help and support to develop good academic and scholarly practices (p. 604)

The tension between the students' need for support to advance their digital practice and the students' creation of successful digital infrastructure and associated collaborative practices can be explained from the two perspectives, state-of-act and state-of-actual. From a state-of-act perspective, the students' practice does not appear to be advanced as it could or ought to be, or that we might wish for. On the other hand, from a state-of-actual perspective, the picture changes; from a more pragmatic perspective, student creative practice supporting the project collaboration stands out more clearly (Caviglia et al., 2018; Sørensen, 2018). More insights and an increased understanding of the students' actual hybrid collaboration practice are needed to bridge the gap between state-of-art and state-of-actual. By an ethnographical study of the student orchestration of problem- and project-based work and the role of technology, I hope this dissertation can contribute to this.

1.3. A FIELD STUDY OF STUDENTS ORCHESTRATING HYBRID COLLABORATION

This dissertation reports a field study of PBL groups' collaborative practice and the role of technology. The field studies take the form of a multi-sited, connective ethnographical study. During a semester, I followed project groups across onsite meetings and online platforms. I attended the studies with an explorative approach and the open-ended research question:

How do students orchestrate project- and problem-based group work, and what is the role of technology?

In the field, I experienced a high degree of diversity in student collaboration practice. Tangibly, I found significant variation in meeting frequency, meeting places, work constellations, project planning, and project organisation among the project groups, illustrated in the short narratives at the beginning of this chapter. At the same time, I experienced flexibility and changeability in the student practices continuously negotiated and adjusted in the project groups. I experienced dynamic interplays between digital and analogue, online and onsite, between contexts and roles in the project work. The technology was an integral part of the students' collaborative practice; however, it was challenging to determine its impact and role concerning practice. Technology had multiple roles. Through this dissertation, I seek to describe and conceptualise the diversity and dynamics of student practice and the role(s) of technology that I experienced through the field studies.

1.3.1. PBL FUTURE

The PhD project is part of the project, *Future Directions for PBL in a Digital Age* (PBL Future – www.pblfuture.aau.dk) (2017-2020). PBL Future is a cross-faculty project aiming to develop research-based directions for problem-based and project-oriented learning at AAU. The project addresses the contemporary challenges of PBL. These challenges include which competencies the AAU PBL model supports, how the problem identification process affects the learning process, the integration of digital technologies and collaboration skills, the interplay of projects and courses and digital technologies' impact on this, and individual reflection on PBL competencies.

The PhD is a part of the subproject "Emerging PBL Collaboration Skills for a Digital Age", which focuses on the integration of digital technologies and collaboration skills by addressing the research questions:

> 1) What is the impact of new technologies and hybrid spaces on students' collaboration in a PBL environment?
>
> 2) What are the PBL practices and collaboration skills that emerge out of this meeting and how do these translate into wider PBL competencies that students develop or need to develop throughout their study? (PBL-Future, n.d.)

This PhD project contributes primarily to the response to the first of the two above questions, focusing on student perspective, what students *actually* do, and the role of technology in the student PBL collaboration.

1.4. GUIDE TO THE DISSERTATION STRUCTURE

This section provides a brief overview of the chapters of the dissertation.

Chapter 1 introduces the project and research questions. I have argued for a research gap and demand for studies of students' self-organised collaborative practice and presented the context of research, the AAU model, the history, and the student autonomy and digital practice.

Chapter 2 constitutes the frame of research for the PhD studies. It contains a short overview of research and perspectives on human-technology interrelations, student engagement with technology, and group collaboration. It concludes with five guiding directions for the PhD studies.

Chapter 3 presents the methodology and fieldwork of the project. In this chapter, I argue for the choice of a multi-sited, connective ethnographical approach and present the fieldwork, how I accessed the field, made data, and in a dialogue between data and ideas identified which analytical stories to pursue.

Chapters 4, 5, 6, and 7 constitute the analysis of this dissertation. Chapters 4, 5, and 6 present and analyse situations from the fieldwork to enlighten the dynamic and diversity in student collaboration practice and the construction of hybrid workspaces, which I experienced in the field. Chapter 7 proposes an overall conceptualisation in the form of five dimensions of group work.

Chapter 8 discusses the findings and conceptualisation presented in the previous chapters. Chapter 9 concludes the dissertation with a summary of contributions and final reflections on methodology and future research.

CHAPTER 2. FRAME OF RESEARCH

This chapter constitutes a research frame for my PhD studies. It is divided into the following four sections:

The first section, *Interrelations of human and technology*, describes different perspectives on the relationship between humans and technology. The section offers an overview and description of general tendencies or movements for research in educational technology, from technology determinism to multiple understandings of technology, from learning as a solely personal and social process to a socio-materialistic approach, and from digital dualism to hybrid and postdigital.

The second section, *Student engagement with technology*, deals with students' abilities and competencies to use technology for learning. The section first deals with generational portraits, primarily digital natives and the critique thereof. Next, I depict the breadth of the concept of digital literacy. Digital literacy is a controversial concept surrounded by a high degree of ambiguity or, as Gourlay and Oliver (2013) express it: "a contested term with mismatching theoretical reference points" (p. 79). The term concerns technical skills and socio-emotional competencies, goes across politics and research, and takes its form as a 'check' list or situated practice.

The third section presents different perspectives on group work, inspiring my approach to studying and analysing the project groups' collaborative practices. Each perspective is followed by a subsection on how it is reflected in a PBL context.

The fourth section concludes the chapter by summing it up into five guiding directions for my PhD studies.

2.1. INTERRELATIONS OF HUMANS AND TECHNOLOGY

Technology has continuously changed and brought new possibilities to education. In the past 20 years, the entry of social technology has brought new pedagogical ideals and expectations regarding technology; from technology broadcasting and the enabling flexible delivery of content to the individual student to the primary purpose of technology becoming a foundation for dialogue and collaboration (Conole, 2007; Weller, 2007). However, the narrative of technology and education seems unilateral; it often appears that technology automatically transforms education or that we can solve educational problems by merely designing and using technology. Most dominant are the positive narratives in which technology transforms education for the better and meets expectations and promises to increase student participation, motivation, and commitment, resulting in higher competencies and skills.

The narrative of technology autonomously transforming education is widespread in research, education management, and the public debate. The same is true of the criticism hereof. Several have assessed it as unrealistic and uncritical and characterised it as utopian realities, digital dreams, and similar (see, e.g., Gourlay & Oliver (2018), Oliver (2011), and Selwyn (2014)). Among others, Selwyn has pointed out the gap between the discourse on digital technology on the one hand and the messy reality of technologies, intentions, and actual use in higher education on the other. Researchers tend to be concerned about "what *should* happen, and what *could* happen once individual learners engage with digital technologies“ (Selwyn, 2012, p. 81). In practice, technology is considered an unremarkable feature and an expected part of higher education and student practice.

2.1.1. TECHNOLOGY DETERMINISM AND INSTRUMENTALISM

The understanding of technology beyond these 'utopian realities' is rarely explicated. However, they lead to uniform understandings of technology, which can be considered technology determinism or instrumentalism. The deterministic technology perspective considers technology as an autonomous force capable of changing society. Conversely, instrumentalist perspectives see technology as neutral instruments or tools available to its user, which "… acts out the meanings incorporated in it by humans through its appropriation by humans” (Berg, 1998, p. 467). Although these perspectives are initially very different, they have common characteristics leading to similar narratives about technology and education (Hamilton & Friesen, 2013).

Technology determinism and instrumentalism are not theories about technology but, rather, perspectives from common logic and an everyday view of technology. More researchers have pointed out that while learning is well-discussed in the field of learning technology, the understanding of technology is under-theorised (Hamilton & Friesen, 2013; Oliver, 2013).

Hamilton and Friesen (2013) appoint common characteristics and critiques of the two perspectives, including:

- *Immutable depiction of technology*: Although the depiction of technology is different between the two perspectives, both consider technology as having a fixed form or function. By limiting the interest to what technology is or what it does, both perspectives disregard how it has acquired its form and may change.
- *Separation of technology and society:* Both perspectives separate the social and the technological. Technology determinism considers that technology drives change and social practice, while humans follow and adapt to technical requirements. The relation between technology and society is a uni-linear and mono-causal one; the implication of technology results in a specific effect. According to instrumentalism, on the other hand,

technology serves human interest; technology is a neutral tool, and its use reflects human motives. The primary difference in perspectives is the allocation of agency on whose terms and interests it happens.

- *Removal of technology from history:* Both instrumentalism and determinism reduce technology in history to progress and success and disregard any decline and failures. With technology deterministic glasses, human progress is a product of technical changes – a kind of natural technical evolution. Instrumentalism sees technology as a means to achieve social goals, whereby technological development is driven and motivated by human and societal needs.
- *Separation of technologies and values*: Followed by the separation of technology and society, both perspectives cut off discussions about technology and values. By considering the meaning and effects of technology as predefined, technology determinism reduces the value to question for or against the technology. According to Hamilton and Friesen (2013), a deterministic technology perspective refuses "potentially fruitful dialogue between pedagogical values, educational philosophy and technological design" and offer two options: "we must simply accept technology and adapt to it or reject it out of hand" (p. 14). According to instrumentalism, technology is a neutral tool, whereby questions of technology and values become a matter of free choices. From the two perspectives, value is either a question of selecting or deselecting technology effects or about human choices. With this, it is not possible to direct criticism towards technology. Hamilton and Friesen (2013) sum it up: "And so neither instrumentalism nor essentialism can ground a normative critique of technology nor admit of how the choice of technology also involves a debate about what kind of future we want" (p. 14).

The deterministic technology positions of being 'for' or 'against' a technology have dominated academic debates regarding education and technology and have led to conversational and polarised discussions. Technology becomes a use-or-not-use question. Selwyn (2014) illustrates it by distinguishing between celebratory discourse and doomster discourse. With celebratory discourse, Selwyn refers to exaggerated predictions for the technology to transform education for the better – as described in the introduction to this section. Conversely, doomster discourse refers to a position in which technology is associated primarily with general universal problems, such as the risk of reduced learning and general disengagement in education, and considerations that society and education suffer from the increasing acceptance of new digital technology. Social media use in education is an example of a conversational and polarised debate consisting of simple ‘for’ and ‘against’ arguments (Sørensen, 2018).

2.1.2. BEYOND THE TECHNOLOGY DETERMINISM

More researchers have positioned themselves as opposed to the technology deterministic position, which has constituted a 'critical turn' in educational research. Instead of seeing technology as having a uniform and non-contextualised nature, they emphasise a 'messy' day-to-day practice (Gourlay, 2015). Concurrently, more educational researchers have searched towards socio-materialistic theory in their study of learning and technology. They have found inspiration and a standpoint in, among others, the field of Science and Technology (STS), which has consolidated turning the understanding of technology from deterministic to multiple.

STS is a diverse and interdisciplinary field. STS researchers have argued against the separation of technology and society, characterising both technology determinism and instrumentalism. In the field, there exist various perceptions of the interrelation between technology and society. This section makes three impacts in STS; Social Construction of Technology (SCOT), Actor Networks Theory (ANT), and Post-ANT.

In the mid-80s, there was great interest within STS in describing technology as a social construction, which has been gathered under the umbrella term "the social shaping of technology" (Lauritsen, 2007; Williams & Edge, 1996). The term covers a heterogeneous field, held together primarily by a critical stance on the prevailing technology perception; technology is separate from society and social relations and has social effects but is not a social phenomenon. SCOT is a significant – and probably the best-known – perspective within "the social shaping of technology". SCOT was a part of a social constructivist current. The approach to technology was radical constructivist; not only has the social influenced technology, but technology is a product or consequence of social relations and negotiations. This perspective settles from technology as a clearly defined product. It opens the door to interpretative flexibility, meaning that various actors have different experiences and interpretations of a given technology's meaning and value. SCOT analysis identifies possible interpretations of the technology and the conflict or controversies caused by divergent interpretations. These conflicts are considered to subside over time. SCOT analysis focuses primarily on new and innovative technology and when and how the technology reached the "closure", indicating the stage at which the technology has reached a relatively fixed form and meaning.

SCOT also criticises the linear understanding of technology's historical development; new technology can be traced back to, and builds on, an older version of the technology, and technology development is a gradual realisation of untapped potential in the technology. This linear understanding also involves the notion that deviations from the "main-line" were considered errors or missed shots. SCOT's understanding of technology development is instead multidirectional; several versions of an artefact compete, and historical circumstances determine which one 'wins' (Lauritsen, 2007). Pinch and Bijker's (1984) study of the bicycle illustrates both the multidirectional

perpetuation of technology and the analysis of possible interpretations and stabilisation and closer to the bicycle's shape and meaning.

SCOT was a response in reaction to technology-deterministic studies; it may go to the other extreme and can be characterised as "social deterministic" (Oliver, 2011). It turns around the cause-effect-arrow: Reverse technology leads to social change; society causes and is the root of technological change. The SCOT perspective can be criticised for ignoring how technology might shape practice.

ANT is a perspective raised from STS, which has gained a footing in various research areas, including education and educational technology (Fenwick, 2010; Fenwick et al., 2012). ANT was initially associated with researchers such as Latour, Law, and Callon and their studies of laboratory practices. These studies intend to show that scientific practice cannot be reduced to objective linear processes but are hybrids of social, technical, and natural elements.

ANT is not a specific theoretical framework; it relies on empirical case studies, which are done differently and draw on different theoretical sources. In his review of ANT's history, Law (2009) describes:

> Actor-network theory is a disparate family of material-semiotic tools, sensibilities, and methods of analysis that treat everything in the social and natural worlds as a continuously generated effect of the webs of relations within which they are located (p. 141)

Common is a material-semiotic sensibility and the idea of how everything exists in heterogeneous networks. The metaphor of assemblages describes how entities fluidly and loosely connect in these networks. People and things cannot be understood as stable and predefined subjects and objects; instead, they must be understood according to the connections in the assemblages. The different actors define each other in a translation process, where entities come together and link in a network. ANT seeks to trace the formation and stabilisation of elements in the assemblies. It is descriptive rather than explanatory; the primary interest is how the networks are created, not why (Law, 2009). Maybe this is one of the reasons why the approach has been found to be inspiring and refreshing regarding the disposition of the cause-effect thinking of technology determinism (Oliver, 2011).

A central principle within ANT is general symmetry; it involves the human and the non-human actor being treated and weighted equally. Following a pure principle of symmetry, non-human agents act on an equal footing with human agents, and agency becomes a question of the network's effect. In this way, ANT deprives the human of his central position and intentionality. The symmetry principle also includes a settlement of other dualities than the human/non-human; dualities like micro/macro, social/technical, and culture/nature are not fundamental categories for describing the world. Thus, ANT is considered a tool to go beyond the taken-for-granted and let the

actors speak for themselves without the researchers, on the forehand, judging and defining the actors.

The relations and boundaries between ANT and Post-ANT are not always clear. Post-ANT consists of various discussions of ANT and is associated with the book *Actor Networks Theory and After* (Law & Hassard, 1999) as well as ideas such as multiplicity and fluidity.

Mol (2002) is the first to introduce the idea of multiplicity. In her ethnographic study of atherosclerosis, she finds that the doctor practices could be described as various unique assemblages of routines, languages, and instruments. She concludes that the disease enacts different things itself. Mol argues that multiple realities are created through practice, and the actors are thereby active in creating the different realities. In this way, Mol points out a need for multiple ontologies and pushes the original ideas of ANT that networks generate more or less stable and coherent realities depending on the translation process. With multiple ontologies, questions about the relationship between relativism and reality become critical: How do we cope with the different realities? How do we rank them? Or are they all equally valid? Mol rejects the possibility of comparing and assessing perspectives as discrete entities. Different realities exist simultaneously and do not necessarily exclude each other; some versions are interplayed, internally dependent, or even filtered together. Another related challenge within Post-ANT is how the researcher "cuts" the network and limits his project. Post-ANT does not provide a clear answer; instead, it emphasises the researcher being active, open, and sensitive to diversity (Gad & Jensen, 2007).

2.1.3. FROM CONTAINER-LIKE CONTEXTS TO SOCIAL-MATERIALISTIC SENSITIVITY

The socio-materialistic approach has gained a foothold in the research of education and learning technology. The interest of the socio-material, including STS perspectives, is part of a reaction and a search for an alternative to technology determinism (Selwyn, 2012).

In the book *Emerging Approaches to Educational Research*, Fenwick, Edwards, and Sawchuk (2012) discuss four socio-materialistic areas that are well-established in educational research; complexity theory, Culture Historical Activity Theory (CHAT), ANT, and spherical theory. They emphasise several similarities among the four areas and outline a 'material turn' in educational research. The four areas share the conceptualisation of humans and things being entangled in hybrid constellations and cannot be determined and understood as delimited entities. Socio-material studies seek to reveal or untangle practice by focusing on connections and boundary-making rather than separate entities. The studies often take their starting point in the local, follow everyday interactions, and focus on minute-dynamic. Also common is the decentring of people as the focal point for the analysis of learning and education. Most

learning theories, originating from the 20th century, place the human in the centre of a learning process and consider the learning process a solely personal and social issue. In this context, materiality is often examined as either simple tools, objects for investigation, or a container-like context.

According to Fenwick et al. (2012), the socio-material perspective requires us to question taken-for-granted concepts and helps us to capture and accept the complexity by making visible material entanglements that we otherwise posit or do not notice;

> Most of all, they (red. socio-material theories) help us to delineate and accept the difference in a wildly complex world, rather than always seeking relations, singularity and seamless continuity (Fenwick et al., 2012, p. 187)

However, Fenwick et al. (2012) emphasise the ability to capture and trace complexity as one of the primary strengths of socio-materiality; they also point out the danger of focusing merely on delineating complexity;

> There is a danger in becoming overly fascinated with conceptions that trace complexity, without asking why such analysis is any more productive in understanding and responding to educational concerns (p. 14)

The socio-material is not one approach to learning, nor can it be considered a theory or a set of research methods (Fenwick et al., 2012). Overall, socio-materialism is the sensibility emanating from considering practice and space as hybrid constellations of humans and things.

2.1.4. AGENCY AND AFFORDANCE

A primary difference between technology determinism and instrumentalism is the allocation of agency – is it the technology or the human who possesses the ability to act? Socio-materialism transforms the agency question from either-or to a relational question. However, socio-materialism does not hold a particular approach to human and non-human agency; the agency debate is an ongoing "source of conceptual strain and confusion" (Fenwick et al., 2012, p. 171). In a discussion of agency, Fenwick et al. (2012) point to the importance of dynamic relationships, time, and meaning, and end up describing it as a matter of manoeuvrabilit*y*:

> Agency is made, remade, contested and transformed, as well as experienced by people or subjects in these terms. However, humans alone are not the source of agency […] Locations in space-time and in relational assemblages are fundamental to defining the possibilities or degrees of manoeuvrability (p. 72)

Following Fenwick et al. (2012), the non-human agency becomes an affordance to change, co-defining human manoeuvrability.

Agency connects closely to a relational or ecological orientation of affordance (Jones, 2015). Affordance is one of the most commonly used and debated concepts in the field of educational technology. Since J.J. Gibson initially introduced affordance, several researchers have developed the concept. It has led to various understandings and different types of affordances.

Gibson describes affordance in the relationship between animal and environment; affordance is what the environment *offers*, *provides*, or *furnishes* the animal. According to Gibson, affordance is ecological and relational; this means that affordance is neither external nor inherent qualities but, rather, relates to the possibilities of action that arise and emerge in the relationship between agent and object (or animal and environment) *in a given context* and *for a given user* (Olesen, 2016, p. 1).

Later, D. Norman develops the concept within the field of design. With the distinction between *perceived affordances* (*the affordances that an agent assumes by perceiving an object)* and *real affordances* (*the affordances that an object actually has, or the possibilities it really enables)* (Olesen, 2016, p. 1), Norman applies affordance "*as a measure of design*" (p. 3). Poor design is characterised by a lack of correspondence between perceived and real affordance, while successful design provides the user with the right visual cues, making it easy to use. Norman's perspective on affordance differs markedly from Gibson's original ideas, among others, by perceiving it as fundamental features of things. Several researchers have further developed Norman's ideas about affordance and design.

Roughly, the theory of affordance is divided into two traditions; an ecological and relational version, based primarily on Gibson's ordinate ideas, and an instrumentally-oriented version, which develops on the ideas of Norman (Olesen, 2016).

An instrumentally-oriented version of the concept, considering affordance as internal features of technology, has been dominant in educational technology research. The wide use of affordance in the educational technology field has met strong criticism, and usage of the term has been considered inconsistent and often inappropriate (Derry, 2007; Jones, 2015).

According to Oliver (2005, 2011), the concept of affordance is unsuitable in the analysis of technology and learning, no matter which 'version';

> this tradition is positivistic and essentialist, at odds with contemporary educational thought (Oliver, 2005, p. 410)

> the idea of 'affordance' [is] something that was widely invoked as an explanation of technological effects (…) affordance neatly illustrates the concept of technological determinism (Oliver, 2011, p. 274)

Jones (2015), in contrast, defends the origin and relational version of affordance as a *necessary* and *useful* term in the research of learning and technology;

> My argument is that affordance is a necessary and useful term because it points to the materiality of technology and the limits this materiality places on interpretation. Affordance is a term that can bridge the division between objectivist realism and relativist constructivism (p. 34)

2.1.5. FROM DIGITAL DUALISM TO HYBRID AND POSTDIGITAL

If we focus strongly on the digital, we risk taking non-digital elements and practices for granted and overlooking essential elements of practices involving a combination of physical and digital elements. However, digital dualism, "… [the] *bias to see the digital and the physical as separate"* (Jurgensen, 2011), lives firmly both in everyday discourse and higher education research (Gourlay & Oliver, 2018). Digital dualism is strongly related to technology determinism and utopian realities. When the digital and the physical are perceived as separate domains, the digital becomes free-floating, detached from time and space, de-embodied and decontextualised. It follows from the idea that digital enables learning and education to happen *anywhere* and *anytime*. Additionally, Gourlay and Oliver (2018) argue that "the novelty of the digital has led to being reified as prototypically technical" (p. 23), while print or analogue technology for inscription and communication has become given and invisible. This reflects the general usage of the term technology, often presupposing that technology is digital.

Digital technology is ubiquitous – and it becomes increasingly difficult to preserve the idea of the digital and the physical as two separate domains. The socio-material reminds us that the digital is always physically rooted. More ecological perspectives on learning and technology, such as hybrid learning and post-digital education, have gained ground, positing themselves in opposition to digital dualism.

Hybrid learning and pedagogy are based on the fact that the boundaries between the online and the onsite are blurred and that they cannot be isolated. Both blended and hybrid learning involve online and offline elements; the crucial difference is the relations between online and offline. Blended learning concerns various configurations of online and offline modes or teaching methods, which are often mixed so that the individual modes do not become "disrupted" or blurred (Cohen et al., 2020). Hybridity indicates a more complex relation between online and offline. Hilli et al. (2019) describe the origin of the word hybridity:

> As a term, hybridity originates from Latin and has its roots in biology where it refers to cross-fertilisation or the fusion of separate parts or species into a new one (p. 68)

Thus, hybridity describes a simultaneous presence of the separate parts or modes, in this context online and offline, and this simultaneous presence in itself creates something new. Hybridity contains a degree of unpredictability and a movement towards something new. As a term, hybridity is not delimited by the question of the digital and physical learning space or online and offline resources. It is a multidimensional concept used by researchers who want to dissolve the dichotomies in HE research. It includes digital/analogue, online/offline, physical/virtual, formal/informal, academic product/learning process, student/teacher roles, and use of tools/critical engagement with tools (Hilli et al., 2019).

The postdigital perspective has recently gained a footing in education research, which manifested with the establishment of the journal "Postdigital Science and Education" in 2019 (Jandrić, 2019). In the editorial "Postdigital Science and Education", the editors introduce the idea and inducement behind the journal (Jandrić et al., 2018). They introduce a postdigital perspective with quotes from Negroponte (1998) and Cramer (2013):

> its literal form, the technology, is already beginning to be taken for granted, and its connotation will become tomorrow's commercial and cultural compost for new ideas. Like air and drinking water, being digital will be noticed only by its absence, not its presence (Negroponte, 1998)

> It is an approach to digital media that no longer seeks technical innovation or improvement, but considers digitisation something that already happened and can be played (Cramer, 2013)

The prefix 'post' is not a rejection of the digital but, rather, a continuation, reinterpretation, and critical reflection on the digital and rupture of the digital as something unique, distinctive, and separable from the physical. A postdigital perspective on education builds on posthuman and socio-materialistic perspectives and refers to research in related areas such as critical pedagogy, digital learning, and network learning.

Regarding a definition of the postdigital, Jandrić et al. (2018) state:

> The postdigital is hard to define; messy; unpredictable e; digital and analogue; technological and non-technological; biological and informational. The postdigital is both a rupture in our existing theories and their continuation. However, such messiness seems to be inherent to the contemporary human condition (p. 895)

They conclude:

> the postdigital condition is one of today's grand challenges in science, education, arts, and various other areas of human interest (p. 896)

The postdigital highlights a need for attention being paid to technology that seems to be invisible, taken for granted, and apparently absent, and for caution in simplifying the complex relationship between humans and technology to avoid over-emphasising the effect of technology (Arndt et al., 2019).

2.1.6. ACROSS LEARNING SPACES

Within educational research, there has been an increased interest in learning spaces and place-based learning (Carvalho et al., 2016; Ellis & Goodyear, 2018). However, spaces for learning in higher education have been an under-researched area. Several researchers point out a need for a better and more nuanced understanding of place and learning interrelations (Ellis & Goodyear, 2016; Temple, 2008). The conversation regarding learning and space is yet another discussion, which contrasting perspectives have dominated; learning spaces as neutral boxes, into which people learn, and learning space determining practice – new place equals new practice (Mulcahy, 2018).

In a review of learning space research, Ellis and Goodyear (2016) provide an overview of the field and illustrate "a deep fracture in conceptualisations of university space" (p. 149). The field involves various research areas, including studies of physical learning spaces from architecture and environmental psychology, studies from learning research, and studies of virtual learning spaces and tools (among these, studies from Computer-Supported Collaborative Learning (CSCL) and Human-Computer Interaction (HCI)).

According to Ellis and Goodyear (2016), the conceptualisation, research, and management of learning spaces are pressing and complex. For one thing, this leads to new practices and expectations due to new technology. The students' use of technology to discover and construct knowledge and technology permitting and promoting the redistribution of study activity in space and time has created new practices, demands, and expectations for learning spaces. Hence, there follow demands on digital infrastructure and resource access and student expectations of a high degree of flexibility, including the personal flexibility to fit the study to other elements in their lives. The boundaries between the physical and the virtual becoming less transparent and more permeable make both the research and management of learning spaces more complex, and existing knowledge falls short (Ellis & Goodyear, 2016).

Ellis and Goodyear (2016) describe learning space research by viewing the field as composed of three dimensions. The first dimension is between physical, hybrid, and virtual learning spaces. The second is a formal-informal dimension; formal learning spaces are often characterised by co-presenting teachers and students and teacher-centred or supported activities, while students engage in activities without direct

supervision in informal spaces. The third dimension is whether the learning place, tool, or artefact is provided by universities, third parties, or students. When students engage in learning activities, it often involves a mix of these three.

In a recent article on learning design, Goodyear (2020) emphasises the students' role when adapting learning spaces which brings complexity, unpredictability and increases the need for insights into students' practice when doing learning space design:

> Students often play an active role in adapting the learning spaces, tools and tasks that have been designed for them, to better match their own requirements. This fact makes learning space design more complex and its consequences less predictable (p. 1048)

As mentioned and quoted in the introduction, Ellis and Goodyear (2016) also demand that future research take a student's perspective and move across learning spaces (see Section 1.1). In the field of mobile learning, Traxler and Kukulska-Hulme (2016) also emphasise an increasing demand for researchers to move across sites. They draw a line from the early stage of research, from mobile learning being techno-centric (the use of mobile digital devices in itself was a defining feature) to the institutionalised and teacher-designed. Until now, mobile learning's primary potential relates to contextualisation, user generation, and a mobile and connected society. They characterise this shift as a transformation of mobile learning "from the mobile component of learning, actually e-learning, to the educational component of mobility and mobile societies" (p. 210). Such a shift requires new theorisations and methods, which, according to Traxler and Kukulska-Hulme (2016) – referring to, among others, Büscher and Urry (2009) – may include the sociology of mobilities and mobile methods.

2.2. STUDENT ENGAGEMENT WITH TECHNOLOGY

The utopian and dystopian depictions of technology in education follow binary images of students; e.g., active/passive and digital/non-digital are commonly used binarities to classify student engagement (Gourlay & Oliver, 2018). This section describes these binaries of students' digital engagement, critique, and alternative perspectives. It highlights the importance of moving beyond the normative concerning what students are and do or should be and do.

2.2.1. DIGITAL NATIVES – DIGITAL THINKERS OR UNCRITICAL DIGITAL LEARNERS?

Generation portrayals such as the Net Generation (Tapscott, 1998) and Digital Natives (Prensky, 2001a, 2001b) have influenced public and political discourse and academic discussions regarding student capacity to learn with technology. Net Generation and

Digital Natives are two of several generation portraits that illustrate a notable gap between a digital and non-digital generation – and claim that the younger generation thinks and learns differently by virtue of the adjacent technology. Significantly, Prensky's language-inspired metaphor portraying students as digital natives – and contrary labelling of teachers and lecturers as digital immigrants – immediately gained ground in research regarding technology and education. He characterises the generation:

> Digital Natives accustomed to the twitch-speed, multitasking, random-access, graphics-first, active, connected, fun, fantasy, quick-payoff world of their video games, MTV, and internet are bored by most of today's education, well meaning as it may be. But worse, the many skills that new technologies have actually enhanced (e.g., parallel processing, graphics awareness, and random access) – which have profound implications for their learning – are almost totally ignored by educators (Prensky, 2001b, p. 5)

According to Prensky and others, these characteristics provide the digital native with empowerment and several learning benefits (Selwyn, 2009; Thompson, 2013). Young people are digital jugglers, creating an individualised learning path through an explorative and creative use of technology. Additionally, they are good collaborators due to their use of social – or Web 2.0 – technologies. Further, they have a particular capability to progress information quickly, non-linearly, and from multiple perspectives – not because of technical skills but, rather, because of the cognitive and neurological benefits they possess. According to Prensky (2001b, 2010), it is necessary to rethink the teacher-student relationship and adapt teaching to the learning preferences and capabilities of the new generation; students are the technology experts and digital thinkers, while the teacher's primary role is to ask questions, coach, and guide.

The digital native generation is usually described in favourable terms; however, several have expressed concerns and pointed out learning risks associated with this generation of learners. The craving for speed and preferences for multitasking interfere with in-depth reading and reflection; they sustain a potential loss of ability to read linearly even when this is advantageous (Thompson, 2013). Young people's use of technology has been associated with an intellectual and academic "dumbing-down", rash behaviour, poor judgement, the cutting of corners, and uncritically "Googling their way" (Selwyn, 2009). Goodfellow (2011) designates the worrying part of the digital native discourse as a "literacy crisis" rhetoric, which comprehends a prediction of the decline of traditional academic activities favouring online recreational activities.

Though the representation of students as digital natives was quickly adopted, several voices have heavily criticised the generation characterisation for being simple, unsubstantiated, and directly misleading. This critique is often followed by a demand

for more studies of student concrete digital practices, which are more complex and diverse than these generational portrays tell us.

Both empirical studies and theoretically grounded critiques challenge Prensky's generation portrait. A few examples of the critic follow:

Through major surveys, Kennedy and colleagues show diversity in students' learning preferences and technical ability (Kennedy et al., 2010; Kennedy et al., 2008). Few students are "power users", who use a wide range of technologies, while most are basic mobile and internet users. These studies argue against the one-fits-all approach that underlies the digital native discourse and against the consideration of technological immersion being age-dependent. Margaryan et al. (2011) show that university students have the skills and expertise to apply technology (often to a greater degree than teachers) but have a limited understanding of how technology can support them in a learning process. Pechenkina and Aeschliman (2017) characterise university students' use of educational technology as narrow, noting that students rarely engage with digital tools unless these tools are familiar or presented as an integral part of learning processes.

Bennett et al. (2008) criticise the characteristic for being too general and the empirical and theoretical foundation of the related debate about youth and education for being inadequate. They warn that, through generalisations such as digital natives, we risk overlooking the impact of socio-economic and cultural factors. Both Bennett et al. (2008) and Selwyn (2009) notice the technological determinism underpinning the digital native discourse. Selwyn (2009) emphasises the uni-linear causality of digital technologies causing societal changes and ""impact" (for better or worse) on young users in ways which were consistent regardless of circumstance or context" (p. 371). Bennett et al. (2008) point to the underlying assumption that change is inevitable; we must keep up and adapt, and our potential concerns are not considered legitimate.

Although there is widespread agreement in the critique, digital natives are still 'haunting' in educational debates. When Prensky initially described the digital native generation, he referred to people born after 1980. However, both the term and the ideas of Prensky are applied in the character of the current student generation. Then, the current generation, often labelled Generation Z (born from 1995 to 2010), is considered "authentic digital natives" (Hernandez-de-Menendez et al., 2020). Along the line of Prensky (2001b), Hernandez-de-Menendez et al. (2020) refer to a need for a better adaption of the learning preferences of the current generation in educational institutions:

> The next generation of students in higher education is a key variable in any educational model. Millennials are tech experts, but Gen Z students are tech natives, having spent their lives immersed in technologies that are crucial to living and teaching and learning. Professors need to adapt their

> classes. Gen Z is accustomed to personalising most of their things. This leads to the expectation that Gen Z will be able to pick and choose what they want. These attitudes will influence education, and institutions need to adapt and change (p. 857)

Nevertheless, similar to the previous generation, students' digital use, abilities, and preferences tend to be more nuanced and varied than those described in binaries and simple lists of characteristics.

2.2.2. DIGITAL LITERACY – FROM TECHNICAL CHECKLIST TO SITUATED SOCIAL PRACTICES

It is generally accepted that Gilster (1997) was the first to introduce digital literacy in the form in which the concept is generally used (Bawden, 2008). According to Gilster (1997), digital literacy is “the ability to understand and use information in multiple formats from a wide range of sources when presented via computers" (p. 1). This definition is more or less a translation of the traditional idea of literacy (the ability to read, write, and deal with information) into the digital age (Bawden, 2008). Since Gilster, the concept has developed in several directions, varying in both form and content. Definitions span from lists of specific skills and competencies to general awareness and perspectives and from technical skills to socio-emotional competencies. While some have operationalised the concept into lists or frameworks of generic cognitive skills, others consider literacy a socio-cultural phenomenon and a matter of social practice, meaning-making, and application of knowledge for specific purposes in specific situations.

The term relates to and overlaps with several others literacy or competence concepts, including digital competencies, digital scholarship, ICT literacy, and information literacy. Many consider digital literacy to be an inclusive term, encompassing various literacies and skill-sets (Bawden, 2008).

Though inconsistency characterises the field, in a recent review of digital literacy and competence in HE, Spante et al. (2018) find that a majority of the reviewed publications use the concepts without any reference to either previous research or policy documents.

2.2.2.1 Technical skills and socio-emotional competencies

Bawden (2008) identifies an inconsistency in the digital literacy concept concerning social-emotional competencies and technical skills:

> a particular inconsistency between those who regard digital literacy as primarily concerned with technical skills and those who see it as focused on cognitive and socio-emotional aspects of working in a digital environment (Bawden, 2008, p. 24)

The inconsistency or ambiguity relates to differences between Gilster's original definition and other related literacy concepts, such as computer and information literacy, which can be considered origins of digital literacy (Bawden, 2008). Broadly, both computer and information literacy take form as skill-sets; computer literacy focuses on the ability to effectively employ commonly used software, and information literacy centres on the handling and choosing of information. Computer literacy's limitations to specific technologies and information literacy's implication of specific ways of handling information differ markedly from Gilster's broad definition of digital literacy, focusing on personal capabilities and attributes. For Gilster, critical thinking, rather than technical competencies, is the core of digital literacy; it is about "mastering ideas, not keystrokes" (Gilster, 1997).

2.2.2.2 Across politics and research

Digital literacy is often associated with political documents and attributes demonstrating graduate employability. Educational policy strategies and objectives regarding digital literacy target primarily primary and secondary school, while HE is less bounded by political regulations (Ilomäki et al., 2016).

Organisations such as the OECD, UNESCO, and the EU have contributed to different definitions and frameworks telling and predicting what a future labour market requires in terms of competencies and skills. Martin and Grudziecki's (2006) work on the EU project DigEuLit is one of several frameworks that have influenced political decisions and are well-cited in digital literacy research. They have a more socio-emotional – rather than technical – approach and define digital literacy according to 13 literacy processes, including communication, interpretation, accession, analysis, and reflection.

In a review of the familiar term digital competencies, Ilomäki et al. (2016) characterise it as a boundary concept that goes across research and politics and across research domains:

> It is seldom defined in an exact way, and various actors give a somewhat different meaning to it, but it is explicit enough to initiate general and collaborative discussions between various cultures (…) [boundary concepts] must be imprecise and open enough to allow people from different traditions to join in their use (pp. 669-70)

They identify five domains; technology studies, library studies, media studies, society approach, and literacy studies. Each domain has its history, traditions, and backbone of research.

Recent political and organisational working papers and reports suggest a particular focus on the lack and necessity of a global standard for the definition and assessment of digital literacy, which includes technical skills as well as socio-emotional

competencies (Laanpere, 2019; Lyons et al., 2019; van der Vlies, 2019). Thus, the primary goal and intention are to increase the number of youth and adults who have the skills and competencies needed in the current and future global labour market.

2.2.2.3 From checklists to situated practice

Digital literacy is often considered decontextualised, individual, and binary – something you have or do not have. A socio-cultural strand of literacy research directs a strong critique of this binarity and de-contextuality. The critique is directed at both 'overt' (technical and socio-emotional) checklists and conceptualising frameworks. In a general critique of digital literacy frameworks, Gourlay and Oliver (2018) point out a risk of moving from *thoughtful empirical work* to *normativity*:

> If the specificity of the framework's origin is lost, all that remains is a free floating model assumed to have universal applicability (p. 53)

As is the case with Martin and Grudziecki (2006), several works with general frameworks point to the importance of context. According to Gourlay and Oliver (2018), this often happens in terms of barriers and constraints and may be considered 'soft determinism'.

Significantly, the broad strand of work known as New Literacy Studies (NLS) has pushed literacy research through the so-called 'socio-cultural turn'. NLS has roots in social anthropology, is based on linguistics, social semiotics, and discourse theories, and applies ethnography-inspired methods. Historically, the NLS opposes the traditional psychological approach to literacy of the 1980s, when literacy was considered a mental and cognitive phenomenon and was described in terms of decoding, retrieving information, comprehension, inferencing, and similar (Gee, 2000). Opposing the idea of reading and writing occurring in the brain, NLS argues that they are social and cultural practices varying across social contexts and cultures. Hence, it follows that 'literacy' incorporates different kinds of 'literacies', which is why it is consistently referred to as plural. Knobel and Lankshear (2006) describe it in this way:

> reading and writing are always «reading and writing with meaning» and this meaning is not primarily, or even substantially, a function of some "skill" or "technique" that might be called "comprehension." It is predominantly a function of social practice, social context, and Discourse (p. 16)

Knobel and Lankshear (2006) argue against the autonomous model initially described by Street (1984), distinguishing between an autonomous model and an ideological model. According to the autonomous model, the cognitive effects of literacy and school cognitive effects are a natural endpoint of developmental progression and depend on intelligence and technology rather than context and culture (Gee, 2000).

On the other hand, according to the ideological model, literacy takes shape and influences according to the cultural, social, historical, and ideological context in which it is embedded, which is why it should be understood in terms of concrete social practice.

The socio-cultural turn in studies of digital literacies, or literacies in general, can be described as a turn away from the autonomous model towards the ideological model – or away from checklists and wishlists towards what students actually do.

2.2.2.4 Socio-materialistic perspective on digital literacy

A socio-material perspective emphasises embodied materiality: which artefacts and resources are involved in student practice, what they do with it, and where they do it. It shares NLS's critique of decontextualised checklists of individual skills and considering literacy as a situational social practice.

When reporting a study of a student's day-to-day practice in HE, Gourlay and Oliver (2013) describe digital literacy through a 'sociomaterial lens':

> the situated and emergent nature of students' day-to-day interaction with technology [is] a key feature of digital literacies (p. 79)
>
> Through a sociomaterial lens, 'digital literacy' involves the ability to create spaces in which to engage in academic, professional or personal tasks by coordinating material objects, digital object and other human actors. A sociomaterialistic analysis paying attention to the detail of 'lived' practice, can identify areas of struggle or breakdown, such as problems with the library computers taking 10-20 minutes to log into (p. 94)

In the book *Student Engagement in the Digital University*, Gourlay and Oliver (2018) elaborate on the situated and emergent nature of students' day-to-day interaction with technology, which they consider assemblies of digital and analogue elements and humane and non-humane actors. The book settles with "mainstream consumptions of student engagement in the digital university". According to Gourlay and Oliver, educational policymakers have not yet picked up insights into the importance of meaning-making practices in HE, funded within NLS and the multimodal literacy field. Instead, they keep their primary focus on skills and learning outcomes.

As an alternative to the mainstream consumptions, and with inspiration in ANT, Gourlay and Oliver (2018) propose assemblages as an analytical approach in studies of student digital engagement. They characterise the student study practice as "distributed; complex and emergent; bringing together digital, material and social elements; and unfolding moment-to-moment, from day-to-day" (pp. 60-61).

Gourlay and Oliver's (2018) study of students' day-to-day practice shows student engagement as a complex entanglement of digital and analogue elements, time, and space; "students' relationship with technology is complex, evolving and constantly renegotiated" (p. 78). They consider the interplay between students and technology as a matter of relational agency or as a 'complex interplay of different agencies' (p. 79):

> technologies have acted as *mediators* rather than *intermediaries*, translating, distorting and moderating meaning rather than simply carrying it in some transparent way. This undermines the idea that students can be understood simply as users of tools (p. 93)
>
> Students are living with technologies. They touch it, carry it and form attachments to it – or find that it makes them uncomfortable, resent it and leave it behind. They take their technology into the private, intimate spaces – the bed, the bath – in order to create the environments that they need in order to study. These are not simply 'found' contexts, spaces for them to occupy or to float through unencumbered by material concerns. These places are full of things that push back, reshaping students at the same time that they are being reshaped (p. 94)

2.3. PERSPECTIVES ON GROUP WORK AND COLLABORATION

This section describes four perspectives on group work and collaboration: communities of practice, cooperation and collaboration, nomadic work, and knotworking and adhocracies. Common to these perspectives is a social and situated view of learning. They have inspired my approach and understanding of project groups and PBL collaboration in various ways. The following sections briefly describe the perspective, then discuss how the approach can contribute to our understanding of PBL collaboration.

2.3.1. COMMUNITIES OF PRACTICES

Communities of practice were initially introduced in 1991 by Lave and Wenger (2019) concerning studies of craftworkers. In 1998, Wenger (2019) developed a broad framework for analysing modern management practice and creating a foundation for a social learning theory. According to Wenger, learning happens through participation in communities of practice. Communities of practice are "groups of people who share a concern or a passion for something they do and learn how to do it better as they interact regularly" (Wenger, 2011, p. 1) and are characterised by mutual engagement, joint enterprise, and a shared repertoire.

According to Wenger (2019), practice is about meaning as an experience of everyday life, and this meaning is located in the process of meaning negotiation (p. 52). He describes the process of meaning negotiation as a duality of participation and reification, which he illustrates in a figure of yin and yang (p. 63). Participation is

active involvement in a social process and involves action, conversation, thinking, feeling, and belonging. Reignition, etymologically meaning "making into things", is a formation and abstraction of practice. Wenger describes it as forming our experience into an object. Through reification, a part of practice congeals, whereby the practice becomes shareable. Practice is capturable in several kinds of representations (e.g., words, rules, and tools). Participation and reification constitute a duality; they are mutual processes that presuppose each other. Reification happens through active participation and can reinforce the ongoing activity by making it easier to handle. Reification serves as guides or standardisations and the stabilisation of practice; it demarcates participation and constitutes a foundation for the renegotiation of practice. Participation and reification cannot be understood in isolation, and the boundaries between them may appear blurred.

In the book *Digital Habitats*, Wenger, White, and Smith (2009) emphasise that technologies have opened up new facets of the dimensions that characterise communities of practice. They define three *polarities* that describe challenges when communities adopt technology:

- *Rhythms – togetherness and separation:* Communities of practice require mutual engagement over time. Technology enables new forms of participation across time and space. "Finding a productive rhythm of togetherness and separation in space and time is a fundamental community challenge (Kindle Locations 1466-1467)", point out Wenger, White, and Smith (2009).
- *Interactions – participation and reification:* By enabling new forms of participation (including new ways to connect and be together) and reification (including producing, storing, sharing, and organising resources and artefacts), technology affords new combinations and interactions between participation and reification.
- *Identities – individual and group:* A community of practice is rarely a homogenous group and implies disagreement and divergent views. These disagreements and divergent views are both a challenge and a resource for the community. According to Wenger, White, and Smith (2009), technology increases the complexity of the individual/group polarity for two primary reasons; technology offers possibilities of extreme multi-membership, and individuals are often alone when they use the technology designed for groups.

Wenger, White, and Smith (2009) define the categories as polarities to highlight the internal dependence and the constant balancing between the two poles.

The theory of communities of practice and legitimate peripheral participation is one of the most influential theories and 'a standard lens' in educational technology research (Jones, 2015). According to Oliver (2011), the framework offers an alternative to the

technology deterministic perspective. Technology can be considered reification, which includes an interpretation of current social practice. Practice is reshaped in reference to the technology, but always in the social context; technology cannot force a change in practice, as the community can always choose to ignore the technology.

2.3.1.1 PBL group as a community of practice

Project groups can be considered small communities of practice; they develop a shared repertoire of resources, routines, and practices through participation and ongoing meaning negotiations and with mutual engagement in the project topic and the shared goal of writing the project report.

The book, "PBL – Problembaseret læring og projekt arbejde ved de videregående uddannelse" (trans. PBL – Problem-based learning and project work in higher education) intends to be a starting point for both students and teachers who want to work with the problem-based and project-oriented work forms and are used across AAU to introduce new students to the pedagogical model in the university (Holgaard et al., 2020). The authors make parallels between the project group and a community of practice. The community of practice, aka the project group, is a breeding ground for producing the joint project report and social space for mutual learning and personal development (p. 83). The project work can also be considered an alternation between participation and reification. There must be room for open, dynamic participatory processes, including exploration, brainstorming, and perhaps ambiguity. However, after this, the project group must stop short and find a common direction through reification (p. 132).

2.3.2. COLLABORATION AND COOPERATION

Collaboration and cooperation are often applied synonymously. In the comprehension of the breadth and variety of the understanding of collaborative learning, Dillenbourg (1999) discerns between collaboration and cooperation according to the degree of division of labour and mutual engagement. In cooperation, the task is split into subtasks among the members, solved individually, whereafter the partial results are assembled to an outcome. Collaboration means "working together" and involves a low degree of labour division. Division of labour is inevitable, but the character of the division and interdependence differ. Dillenbourg discerns between horizontal and vertical division. Collaboration is characterised by horizontal division, where the subjects and subtasks are highly interdependent and intertwined, and the roles are often unstable and can shift every few minutes. It opposes cooperation, characterised by vertical division in independent subtasks and often involving a fixed division. Concerning technology-mediated communication, Dillenbourg points out that cooperation is often connected to asynchronous communication, while collaboration assumes synchronicity. According to Dillenbourg, synchronicity is a social issue and, to a lesser extent, a technical parameter. Synchronicity is primarily about the

subjective feeling of synchronicity of reasoning; if the media does not support technical and time-wise synchronicity, the members find creative ways to maintain the feeling of synchronicity.

The distinction between collaboration and cooperation, which Dillenbourg presents, is most often applied. However, other definitions of the concepts are found in the CSCL literature. For instance, Johnson and Johnson (1996) characterise cooperation learning as the instructional use of small groups and describe collaborative learning as more student-directed and complex compared to cooperation.

2.3.2.1 Collaboration and cooperation in PBL groups

Holgaard et al. (2020) distinguish between the three collaboration processes with an increasing degree of commitment, collaboration intensity, and need for communication and dialogue: coordination/communication, cooperation, and collaboration (p. 123). Coordination/communication concern "simple planning". Cooperation and collaboration correspond to Dillenbourg's definitions; cooperation refers to the distribution of work tasks, while collaboration deals with ongoing negotiation and discussion. The authors point out that the three forms of collaboration include and presuppose each other; cooperation and collaboration require ongoing communication and coordination. Therefore, the project group must continuously consider what type of collaboration and communication is needed.

Ryberg, Davidsen, et al. (2018) show that the relationship between collaboration and cooperation varies over a PBL project period. The demand for collaboration is often most significant at the beginning and the end of the project period. In the beginning, the members must agree on the project problem and how to approach it. In the last part of the period, the project group must make the final adjustments and ensure a common thread in the joint project report before submission. In the intervening period, the need varies, and it is often more efficient to work cooperatively with individual writing assignments.

However, Ryberg, Davidsen, et al. (2018) point out that the distinction between cooperation and collaboration is blurred when one zooms into the student practice;

> [T]he distinctions between cooperative and collaborative modes of work seem to blur when we zoom in closer, as in practice they alternate dynamically between cooperative and collaborative patterns of work (p. 140)

2.3.3. NOMADIC WORK

Within the CSCW literature, nomadic work describes the engagement with work activities across locations (Ciolfi & de Carvalho, 2014). Knowledge workers deal mainly with digitally represented work, which they can access from different locations

besides stable workspaces. As a term, nomadic work is often associated and used interchangeably with mobility and mobile work (Ciolfi & de Carvalho, 2014; Rossitto, 2009). According to Ciolfi and De Carvalho (2014), the terms should be understood separately. Mobile work indicates a movement in location to accomplish work assignments (e.g., driver and sailor). In contrast, nomadic work involves;

> both the movement of people and things but also the work in preparing for such movement and following the movement in creating conditions involve engaging in work and life activities. (Ciolfi & de Carvalho, 2014, p. 121)

de Carvalho (2013) identifies four prominent perspectives on nomadicity (also presented in Ciolfi and De Carvalho (2014)):

- A **technology-centred approach** stands forth as the earliest approach to nomadicity, focusing on anywhere/anytime access and developing and providing technical support for people to work across locations or even offer location-independency.
- Contrary to the technical-centred approach lifted from contextual and social aspects of nomadic work, a **practice-centred approach** focuses on *nomadic strategies* for work, with interest in formal work activities and the supporting activities, which mobilise the work. The approach looks into the mediated role of technology on nomadic work practices. It does not fully take into account different locations, including the difficulty of working across locations and the impact of the specific locations.
- In contrast to this, a **place-centred approach** focuses on "how places are created and experienced as nomadicity unfolds" (Ciolfi & de Carvalho, 2014, p. 126). This approach considers work activities as situated and the connection between activities and place as relational; by engaging in nomadic work, people create spaces for their work, all while the place influences the activities by offering affordances. With this approach, nomadicity is limited to work across locations.
- With the last approach, the nomadicity concept expands to go across work and home. Nomadic work has become widespread; technology makes it easy to bring 'work to home' and 'home to work' and offers a high degree of flexibility. This **work-life boundary-centred** approach focuses on how people manage the separation and blurredness of work and non-work.

Each approach above presents essential elements of nomadicity, which must all be taken into account when studying the phenomenon (Ciolfi & de Carvalho, 2014; de Carvalho, 2013). Nomadic work cannot be limited to technological infrastructures, working strategies, or work-life balance and a concern isolated to work. According to de Carvalho (2013), there is a need for research advancing the understanding of nomadicity. Instead, Ciolfi and de Carvalho (2014) consider nomadicity a more

complex phenomenon, "as a frame, ecologies of practices and as a social, cultural and organisational condition of work" (p. 129). With this description, they emphasise the dynamic and emergent nature and diversity of nomadic practices.

2.3.3.1 Nomadic work in a PBL context

Nomadity is a concept applied mainly to describe the organisation of work on workspaces; it is seldomly used to describe student work (Rossitto et al., 2014; Ryberg, Davidsen, et al., 2018).

In the article, "*Understanding nomadic collaborative learning group*", Ryberg, Davidsen, et al. (2018) analyse PBL groups as nomadic learning groups and identify three nomadic practice types, which take form as orchestrations of dimensions of collaboration. By describing the student collaborative practice as orchestrations of constellations, they emphasise the situatedness and ongoing negotiation, characterising the PBL collaboration. They identify the following three types of nomadic collaborative practice:

Orchestration of work phases, spaces, and activities

Ryberg, Davidsen, et al. (2018) illustrate how the choice of workspace and work constellation (for instance, whether the students work together, in pairs, or individually) reflects the current project phase and current activity. The project group negotiates workspace and work constellation almost daily based on situational needs; "the students continuously balanced their needs, tasks, spaces and technologies in relation to each other" (p. 241). The studies involve participants from two educational programmes at AAU. In the first programme, the project groups have no permanent workspace; they settle down, like nomads, and work in various spaces, including booked meeting rooms, libraries, canteens, and cafés. The project groups from the second programme have permanent workspaces. The authors illustrate how a permanent or non-permanent workplace influences the student orchestration of collaboration. Concurrently, they point out that the project group with permanent workspaces does not have more static practices or is no less nomadic than the group with no permanent workspace.

Orchestration of multiple technologies

The second category concerns how the students use a mixture of digital and non-digital technology to manage their project work. Initially, the students negotiate *potential constellations of technology* and agree on an *aligned constellation of technology* (Rossitto et al., 2014). This may concern whether the project group should use Dropbox or Google Drive for filesharing. The aligned constellation of technology in a given group depends on members' preferences and competencies, whereas the digital practice adjusts during the project period. Besides the digital technologies, non-digital (often given and invisible) technologies such as boards, pen, paper, and Post-its are integrated into the students' practice. The students move dynamically between

various digital technologies and across digital and non-digital technologies. They make transpositions across the digital and non-digital, for instance, by taking photographs of boards and printing photos funded on digital platforms. These kinds of transpositions help the students manage work across spaces.

Orchestration of togetherness

Besides orchestration of multiple technologies, the students must orchestrate and negotiate togetherness. How should they be together? Should they meet every day in the group room? Another space? Split up and work from home? Technology enables new ways of being together, and this orchestration implies figuring out both how to work together and how to "work together apart". Orchestration of togetherness relates to both the choice of workspace, the choice of work modes (collaborative/cooperative, all together, subgroups or individually), and how the students create and maintain social coherence and relations:

> Nomadic collaborative learning groups are similarly highly dependent on each other and on maintaining good social relations and presence for the work to progress. The social processes in these complex and composite "constellations of togetherness" are an equally important part of the processes for learning within nomadic groups. (Ryberg, Davidsen, et al., 2018, p. 245)

By this third category, the authors highlight the importance of social processes and a need for further insight into how nomadic collaborative groups create a sense of social cohesion and sociability.

2.3.4. KNOTWORKING AND ADHOCRACIES

In and across organisations, a multitude of forms of work organisation and collaboration have emerged. Among others, these have emerged due to the opportunities created by network technologies for working across time and national borders and new requirements for interdisciplinarity and new forms of production, including social production and an increasing degree of interaction between product and customers. The socio-materialist researchers Engeström (2008) and Spinuzzi (2015) describe these emerging organisation forms through new notions of teams by their ideas about *knotworking* and *adhocracies*. Both point out that teams, as stable, well-defined organisational units, have been challenged and increasingly supplemented and replaced by more agile, dynamic, and temporary collaboration forms.

In his book "From Teams to Knots", Engeström (2008) describes a historical development in work organisations and production and illustrates that teams are neither a universal nor ahistorical form of collaboration. He argues that a stereotypical view of teams may blind us to the emerging dynamic structures and sees the team as a stable entity as an "overrated form, among a growing multitude of fluid forms of

organizing collaborative work" (p. 94). To describe these fluid forms of collaborative work organisation, he turns to the metaphors of knots and knotworking:

> The notion of knot refers to rapidly pulsating, distributed, and partially improvised orchestration of collaborative performance between otherwise loosely connected actors and activity systems. Knotworking is characterised by a movement of tying, untying, and retying together seemingly separate threads of activity (Engeström, 2008, p. 194)

Knotworking is a metaphor describing loose-bounded types of collaboration, characterised by seeming separate threads, which involve *tying*, *untying*, and *retying together*, opposing a stable team characterised through a delimited core, a centre of activity, common rules, and routines. Knotworking reflects a need for a constant and ongoing negotiation around the collaboration, tasks, focus, and members. There is no fixed centre in the process of knotworking. On the other hand, as Engeström describes in the quote, the orchestration of the collaboration and agency is ″rapidly pulsating, distributed, and partially improvised".

Spinuzzi's idea of all-edge adhocracies has several similarities to Engeström's ideas of knotworking. Spinuzzi (2015) highlights how the mobile phone and other forms of network technology give organisations the potential to become *all edge*:

> (…) the potential for an organization to become all edge; able to rapidly link across organizational boundaries, combine into temporary work groups, swarm a project with a team of specialists, and disperse at the end of the project, often to re-form in a different configuration, with some different members, for the next project (p. 2)

All Edge Adhocracies describes how collaboration within and outside organisational boundaries forms in temporary and dynamic constellations depending on the given situation and the task at hand.

Adhocracies consist of specialists, often from several organisations, who organise themselves temporarily on a project. The team is composed due to the project at hand – just as the technology constellation is adapted to the individual project. Adhocracies are agile and dynamic in size and configuration. The members have a high degree of autonomy; all edge adhocracies are decentralised structures, and the leadership rotates among members. Members often participate in several parallel projects, whereby they participate in changing constellations of members and technology. Project management of these kinds of projects may be characterised as knotworking.

2.3.4.1 PBL groups as adhocracies

In the paper "Student groups as 'adhocracies' – challenging our understanding of PBL, collaboration and technology use", Ryberg, Sørensen et al. (2018) contrast and

compare PBL groups with adhocracies and knotworking. They invite a rethinking of the PBL model and suggest that Spinuzzi and Engeström's ideas are a starting point. They acknowledge and do not question the current model's pedagogical value but point out that it is static in form and identify potential in creating opportunities for other supplementary forms of collaboration

PBL collaboration can be characterised as stable small group collaboration, often co-located and with a fixed time frame. The PBL group is often mono-disciplinary and focuses on a single task. The collaborative orientation is inward, and the decision-making power is central. This description of PBL groups constitutes dimensions that stand in contrast to the ideas of adhocracies and knotworking. Adhocracies are characterised by interdisciplinarity and are dynamic in scale, configuration, and time (often shorter-lived). They are distributed in space and decision-making, the collaborative orientation is outward, towards *the edge*, and task focus is often parallel.

By zooming in on the student day-to-day practices, Ryberg, Sørensen, et al. (2018) see similarities between PBL groups' and adhocracies' practices. They highlight the students' choice of technology to support project work; at the beginning of the semester, the students discuss the *potential constellation of technology* and agree on an *actual constellation of technologies* adjusted and negotiated during the project period. Thus, constellations of technology vary both in groups and semesters, just as new technologies can be brought in while others are dropped during the project.

The 'nomadic' groups and the students' nomadic practices of making daily decisions about where and how to work (as described in Section 3.3.3.1) resemble knotworking and adhocracies. While students also make more long-term plans for the project, studies of the students' PBL collaboration, particularly that of Ryberg, Davidsen, et al. (2018), indicate that students' daily work is dominated by ad-hoc planning;

> although the groups are stable, and the time-period is fixed, the groups also work and attune themselves to shifting conditions and tasks; break into smaller groups to work for a period of time on shorter-lived task, untying and tying together again different activities, doing fieldwork, experiments, interviews etc. (Ryberg, Sørensen, et al., 2018, p. 7)

2.4. FIVE GUIDING DIRECTIONS FOR THE PHD

This chapter creates a frame of research for the PhD. It has described movements in educational technology research, from technology determinism and instrumentalism to a multiple understanding of technology, from digital dualism to post-digital, socio-material and place-based perspectives, and from normative student characteristics to interests in the students' situated everyday practice as complex entanglements of digital and analogue elements, time, and space. Further, the last part of the chapter describes perspectives on the student PBL group, which influence and inspire my

understanding of, and approach to studying, the students' hybrid collaboration practice.

I conclude this chapter by summing it up into five guiding principles for my PhD studies. In the PhD, I strive to follow these guiding directions:

Technology is multiple

Inspired by STS, I approach the PhD with an understanding of technology as multiple and strive to move beyond a deterministic uniform understanding of technology considering the linear human-technology relationship. It follows that the relationship between technology and PBL collaboration cannot be described in linear causalities. The technology cannot be reduced to a specific size with specific impacts on the PBL collaboration; likewise, the technology cannot be put down to causing more or less value to the student collaboration. Thus, the intention becomes to study some of the many enactments in which technology takes part in the PBL collaboration. It requires openness to the meaning of technology and context awareness of when and how students use technology.

Agency and affordance are relational

I consider that agency and affordances are defined in the relation between students and technology in the particular context. Technology co-creates the manoeuvring spaces within which students act, whereas the students have the freedom to select (or deselect) the technology or combination of technologies. Concomitantly, I distance myself from the idea of symmetry, that non-human and human agents act on equal footing and where agency becomes a matter of effect. I do not confine myself to what the students and the technology (and other entities) *do* and prevent from what they *mean* or *intend.* In striving to understand the students' collaboration practice, I find it crucial to ask questions about the rationales, intentions, and ascriptions of the meaning of the technology use, and how technology drives or impacts students' PBL collaboration.

Across onsite and online sites

The students work in a hybrid learning environment and live in a post-digital age; the digital is entangled and interwoven in the non-digital, so this distinction becomes almost meaningless. Thus, the digital-analogue or online-onsite divide is not an organising principle for the studies. Instead, I intend to explore connections and relations between digital and analogue, online and onsite.

Sensitivity of materiality and place

I find inspiration in social materialism and the understanding of practice and spaces as hybrid constellations of humans and things. Rather than an ontological question of how the world is, my interest is primarily epistemological. I am interested in how attention and sensitivity to materiality and place can help foster understanding of group collaboration in a hybrid PBL environment. A sensitivity of materiality and

place helps move beyond the digital's ‘novelty’, reveal the connections between the digital and non-digital, and formulate questions about what is taken for granted.

The students' actual practice – beyond normativity

In the PhD, I strive to move beyond normative considerations of who the students are, or should be, and what skills the students develop or ought to develop. I do not seek to evaluate the student practices. This thesis does not answer questions about which technologies are most useful or appropriate for PBL collaboration or suggest best practices for students or the university as an institution. Instead, I take a student-centred approach and, with this PhD, focus on describing and understanding students’ 'actual' practice.

CHAPTER 3. METHODOLOGY AND FIELD STUDIES

This chapter argues for a multi-sited, connective ethnographical methodological approach for studying the student orchestration of hybrid collaboration practice. I describe the challenges that the internet has brought to ethnography with Hine's (2015) framework of the embedded, embodied, and everyday internet as my point of departure.

I present the field studies on which this dissertation builds and reflections on access, participation/interaction, and observations. I describe how I – with an explorative and abductive approach – engaged with the data and identified which stories to pursue in a dialogue between data and ideas. Additionally, I present three types of situational maps (Clarke et al., 2018), which have acted as thinking tools for opening up the data, combining data from across field sites, and taking a step backwards to move beyond the taken-for-granted. The chapter concludes with an introduction to the four following chapters constituting the analysis.

3.1. AN ETHNOGRAPHICAL APPROACH

I regard the methodology approach, through which I conducted the field studies for this dissertation, as a *multi-sited*, *connective*, and *ethnographic* approach.

Defining *ethnography* is not a straightforward process; it is a widely used term that has acquired a range of meanings. Hammersley (2018) lists often-ascribed features of ethnography; 1) relatively long-term data collection process, 2) taking place in naturally occurring settings, 3) relying on participant observation or personal engagement more generally, 4) employing a range of types of data, 5) aimed at documenting what actually goes on, 6) emphasising the significance of the meanings people give to objects, including themselves, in the course of their activities, i.e., in other words, culture, and 7) holistic in focus (p. 4). He adds that what these features imply involve uncertainty and dispute. Markham (2018a) points out:

> whether or not scholars call (or are allowed to call) their work ethnography or ethnographically depends on their discipline, training or attitude (p. 653)

Ethnography can refer to data collection method combinations, an epistemology of seeking the meaning of a cultural phenomenon, or the written product of ethnographical engagement. With this dissertation, I do not strive for ethnography as a genre.

Multi-sited research implies that the researcher moves across locations to follow the flow of people, information, connections, and associations to investigate a phenomenon (Falcon, 2009; Marcus, 1995). The term *connective* indicates that the field sites span both physical and online spaces, and the focus is on tracking activities and exploring connections across online and offline field sites (Hine, 2007, 2015).

In my approach, I find inspiration in the literature of ethnography involving the internet. In particular, Christine Hine's book, *Ethnography for the Internet* (2015), has been helpful in understanding and navigating the challenges that mediated communication has brought to ethnography. I will return to her framework of the embedded, embodied, and everyday internet.

3.2. MOTIVATION FOR METHODOLOGICAL APPROACH

What is the motivation behind a multi-sited, connective ethnographical methodological approach? In this section, I argue for the choice of methodology in a quinquepartite answer.

The *firs*t answer relates to participating observation in a natural setting. Student PBL collaboration is a closed setting and appears as a black box, into which a project report and supervision meetings give only glimpses. An ethnographical approach involves close observation of what the student is *actually* doing and enables an experience of 'what is going on' from a participant's perspective.

The *second* answer relates to technology being embedded in the students' everyday lives and integrated into the PBL collaboration. Technology has become increasingly embedded in our everyday lives. Ethnography deals with the implicit, describes everyday routines and patterns, makes infrastructures visible, and questions the taken-for-granted. With this, ethnography helps us understand how technology is adopted and adapted into our lives (Hine, 2015).

A *third* answer relates to the choice of a multi-sited and connective approach. The approach relocates the focus from place and location to connections and flow of people and information and permits the following of students' collaboration *across temporal* and *spatial boundaries*. The focus on flows and connections endorses exploring the hybridity and describing the student PBL collaboration and averts online/offline dualism as an organisational rule.

When the focus is on students' use of technology, there is a tendency to take normative and deterministic positions, as argued in the previous chapter. The *fourth* answer concerns the intention to avoid falling into these positions. An ethnographical approach enables a critical stance from normative – what should be there – and deterministic – what must be there – assumptions about the meaning of technology (Hine, 2015).

The *fifth* answer relates to ethnography as an explorative method. The open-endedness in ethnographical research questions and design creates room for investigation of the unexpected and makes it impossible, at the beginning, to predict where the study ends. Agar (2006) describes ethnographical logic as iterative, recursive abduction. The three words are from the Latin for, respectively, "to repeat", "run again"/"run back", and "lead away" (often used in the sense of "kidnap"). Abduction describes the process of finding possible and suspected explanations for surprising observations. While deduction and induction are *figuring out consequences* and *fitting new experiences to what we already knew*, respectively, abduction *leads us away*, making us imagine possible explanations and develop new concepts. Iterative and recursive describe the dynamic and non-linearly nature of ethnography. I argue that this type of reasoning is necessary to explain the complexity and entangled nature of students' hybrid collaboration practice.

3.3. ETHNOGRAPHY AND THE INTERNET

The internet and mediated communication have brought changes and challenges into ethnographic methods. Originally, ethnography was a branch of anthropology concerning studies of foreign cultures; the ethnographer immerses themselves into a field, gains a detailed understanding of the culture and how the participants live their lives, and writes a thick description based on a longitudinal stay in the field. With the embracing of mediated communication, the situation of investigation cannot be considered a singularity predefined by time and place. It challenges the ethnographic promises of holism and detailed understanding and calls for a reconsideration of ethnographic concepts. Hine (2017) calls the ethnography of mediated communication both *necessary* and *doomed*:

> Ethnography of mediated communications thus seems to be both necessary and doomed simultaneously. We need ethnography in order to help us understand what is going on, but the very nature of the change taking place seems to evade ethnographic understanding (Hine, 2015, p. 5)

3.3.1. FROM EXOTIC CYBERSPACE TO EMBEDDED EVERYDAY

The approaches in ethnographical studies involving the digital have evolved and adapted concurrently to the internet's changing role. The internet has moved from exotic cyberspace to embedded everyday, and online and offline have moved from being two separate worlds to being almost inseparable. Robinson and Schulz (2009) describe this transformation in three-phased chronology:

The pioneers of the 1990s operated primarily on an online site focusing on how interaction and performance differed from offline. The internet was considered a separate domain, a particularly exotic form of space, 'cyberspace', where users could form 'societies' from the ground and experiment with alternative identities.

In the late 1990s, *Legitimising ethnographer*s shifted focus from separations to connections between online and offline. They were inquisitive about how the internet is just an embedded part of our everyday lives and had a more critical view of the internet's transformative power. They assessed how offline methods translate into the online setting. Essential ethnographical concepts, such as field sites, participation observation, and interaction, which do not immediately take the conversion, were reconsidered.

The ethnography of the internet today is *multimodal*. The term refers to the shift from Web 1.0 to Web 2.0; ethnographers of the internet should no longer relate only to text-based interactions but also navigate multimodal and user-driven content. Thus, multimodal ethnography settles with the online/offline dichotomy.

3.3.2. THE 3E INTERNET

In the book *Ethnography for the Internet*, Hine (2015) presents a multi-sited connective approach to ethnography. In the framework, Hine draws on multi-sited ethnography (Marcus, 1995), mobile methods (Büscher & Urry, 2009), and the ontological multiplicity of objects from the literature on STS (De Laet & Mol, 2000; Mol, 2002). Ethnography *for* the internet emphasises ethnography as an approach adaptive to the circumstances provided by the contemporary internet (p. 6). It is neither ethnography *of n*or *through* the internet – the internet cannot be grasped or studied as a complete entirety, just as studying the face-to-face situations, into which the internet is embedded, is often essential to understand the mediated communication (p. 7).

Hine characterises the current internet as *embedded*, *embodied*, and *everyday* (3E). This characteristic of the 3E internet serves as;

> a device for articulating some generic challenges that the contemporary Internet offers the ethnographer, as a route towards formulating transportable strategies (p. 32)

The *embedded* internet highlights how digital content intertwines in different contexts and how people are presented on multiple sites simultaneously. It challenges the field as a pre-existing entity. Originally, a field is predefined by the culture, which the ethnographer will study, and is often bound to a specific location. By contrast, the embedded internet leaves where the ethnographer should go as a question with an equivocal answer. An ethnographical study of the embedded internet cannot be planned in detail. It calls for a multi-sited approach, where the field emerges continuously due to the researcher's movements in contrast to being predefined. It is a bootstrapping and pragmatic method in which the researcher consciously makes methodical decisions based on their emerging understanding of the situation. By nature, a study of the embedded internet defies prediction and demands agility and mobility, and it might be necessary to use alternative methods to understand the

relations and connection across field sites. By the embedded internet, Hine emphasises that technology is not stabile artefacts, as it often appears from everyday discourse; instead, its meaning is shaped and becomes visible through practice. Thereby, openness to new connections and an agnostic approach to the meaning of the digital become essential. Instead of being a concern of comprehensive understanding of a predefined field, a holistic approach;

> … produces the ethnographer's openness to the unanticipated aspects of meaning-making to the emergence of forms of connections and boundaries not anticipated at the outside of the study (Hine, 2015, p. 87)

The *embodied internet* highlights the multiplicity in ways of being and notions of physicality. Being online is not a discrete form of experience but, rather, "an extension of other embodied ways of being and acting in the world" (p. 41). Being online sometimes feels like a place in which one can immerse oneself. Other times, it is a tool to inform and enrich the understanding of a given situation. Online and offline are inherently complex ways of being, and the relation between them is unpredictable and complex. The embodied internet turns our attention to the experience of the internet being unique, personal, and circumstantial. Similarly, the ethnographer's interaction with the field and experience is highly individualised. The embodied internet calls for reflections regarding what the different 'beings' entail and how and to what extent participation is possible.

The *everyday internet* refers to the internet being a mundane part of our everyday life and the ethnographical challenges accompanying it. We use the internet almost without noticing it, and often it becomes visible to us by its absence, for example, in the case of a technical breakdown. The internet often acts as infrastructures, invisible structures, making some actions more accessible and others more complex. Investigating the unspoken and making the invisible visible is both a strength and a challenge of the ethnography of the everyday internet. The ethnographer is often familiar with the field of investigation, and making the familiar strange is a common challenge. Essential questions to ask are: What do the participants take for granted? How could it look different? Likewise are the sensibility and awareness of the importance of the surroundings and the settings; what is taken for granted in one setting may be peculiar in another setting.

3.4. FIELD STUDIES

The field study of this project is divided into two; a prestudy in Autumn 2018 and the main study in Spring 2019.

In Autumn 2018, I followed a project group during their first semester in Communication and Digital Media (CDM) for two months. The primary purpose was to gain experience with the fieldwork and try different approaches to writing field

notes, the frequency and duration of presence, the relation to the students, and connections between onsite and online observation.

The participating project groups are from study programmes across the five university faculties – a decision made by the PBL Future project group. A research assistant was engaged to help with the data collection and make video recordings applicable in the PBL Future project more widely. In Autumn 2019, the research assistant, Line, and I followed five project groups from group formation to project exams across onsite and online sites.

3.4.1. ACCESSING THE FIELD

Student project collaboration – onsite meetings and digital platforms – are closed settings, and access to the field stood forth as a critical starting point. I pragmatically based the choice of study programmes on estimating the possibilities of finding a project group willing to participate and accept my physical and digital presence. I searched for sixth-semester students based on the presumption that they would have a well-established study practice. I made an exception regarding Communication and Digital Media (CDM), where I expected good opportunities to find a group through my employment. The sixth-semester students knew me as lecturer and supervisor, so I opted out of this semester and searched for a fourth-semester group instead. Table 3-1 shows an overview of the groups participating in the project. It presents the study programme, semester, members, technologies, meeting frequencies, meeting spaces, and number of visits. I had, in various ways, gained contact with the students through lecturers in the programmes. Lecturers' support was a crucial factor affecting the groups' motivation to contribute. The project groups studying CDM, Sport Science, Robotics, and Machine and Production (MP) volunteered shortly after I presented my project and query. Finding a Sociology group was a more winding path. In exchange, it ended with three contributing project groups from the study programme.

In searching for a group from Sociology, I spoke with the students during a group formation session, presented in the last 15 minutes of a lecture, and posted two messages in the semester group on Facebook, without any group volunteering for observation. However, two groups wrote that they were willing to engage in an interview. I accepted and arranged to meet with the groups. Shortly after, I received a message from a group volunteering for observation during the semester. I decided to follow the group, yet still conduct the arranged interviews with the two other groups, with which I held follow-up interviews later in the semester.

Table 3-1 shows the digital platforms that each group used for project organisation and collaboration. It does not include disciplinary tools (e.g., modelling, video editing, or statistic software) or technology used for individual study practices. The table displays overlaps and differences in the students' choice of technology supporting the project collaboration. The project groups provided me with access to

Table 3-1 Overview of groups participating in the project

Faculty	Study programme	Semester	Members	Technologies	Meeting frequency	Meeting space	Data/Visits
				Autumn 2018			
HUM	CDM	1st	2 female 2 male	Facebook Messenger Google Docs Google Drive Google Calendar *Pages* Slack	Daily meetings	Group room At home	11 visits
				Spring 2019			
MED	Sport Science	6th	2 female 2 male	Facebook Messenger Google Docs Google Drive	Varied over the project period	Library Meeting room	14 visits
HUM	CDM	4th	3 female 3 male	*Facebook Messenger* Google Calendar Google Docs Google Drive Trello *Zotero*	Varied over the project period	Meeting room Open study area	10 visits

ENG	MP	6th	1 female 3 male	Facebook Messenger MS OneDrive Overleaf MS Teams	Daily meetings	Group room Laboratory	12 visits
TECH	Robotics	6th	4 male	Discord *Facebook Messenger* Google Docs Google Drive Overleaf	Daily meetings	Group room Laboratory Online meetings	9 visits
SOC	Sociology (#1)	6th	4 female	Facebook Google Docs Google Drive	Weekly meetings	At home Meeting rooms	13 visits
	Sociology (#2)	6th	4 female	*Facebook* *Google Docs* *Google Drive*	Daily meetings	At home	2 interviews
	Sociology (#3)	6th	3 female	*Facebook* *Google Docs* *Google Drive*	50/50 meeting- and work-from-home-days	Library Meeting rooms	2 interviews

most of their digital platforms; in the table, the platforms to which I had access are written in uncial, while cursive indicates tools to which I had no access. In the search for project groups, I encountered student scepticism and restraint with regard to participation in the studies mostly because they did not want me in their online group conversation. More students explained it by the chat being *mostly social* – in contrast to project-related. The CDM and Robotics groups did not want me to access their group conversations on Facebook Messenger for similar reasons. The Robotics group described themselves as near friends and said that the conversation was more social and personal than professional. The CDM group illustrated the same by describing the conversation as containing both 'I'm delayed' messages and messages written under the influence of alcohol on the way home from a night in town. If I insisted on the group chat access, I would have asked the students to step over another line, so I did not.

To simultaneously follow five project groups required a high degree of coordination and planning. The initial plan involved weekly visits of the project groups of one to two hours in length. The weekly meetings became a general rule. Sometimes, we met the groups twice a week or planned the visit on a selected weekday to follow specific activities. Other times, exams, exam readings, requirements for the standardisation of experiments, and insoluble logistics obliged us to diverge from the plan. Line and I visited the groups together; I wanted to experience as much as possible first-hand. We split up if logistics called for it.

The visits were arranged either in the group conversations in Facebook Messenger or by mail. For two of the five groups, MP and Robotic, we more or less met at the same time every week. The three other groups could not set a fixed weekday; they decided when and where to meet on an ongoing basis and adjusted the meeting time and space with sometimes short notice. The question of where to meet with the group was therefore answered from week to week.

3.4.2. RESEARCH ETHICS

In the following, I present ethical reflections according to Tracy's (2010) distinction between procedural ethics, situational ethics, relational ethics, and exiting ethics.

Procedural ethics refers to "ethical actions dictated as universally necessary by larger organizations, institutions or governing bodies" (p. 847). I followed the university's introduction and the current European GDPR legislation; I created an informational letter on the project purpose, data handling, and participant rights (see Appendix A), followed by the rules and regulations for data storage and anonymising the participants in publications. In this dissertation, I use pseudonyms and have blurred or filtered pictures to avoid recognition. For an introduction, I arranged a meeting with the five groups that volunteered for observation, to align expectations regarding the groups' participation in the project, including access, presence, and planning. At

this meeting, the students read and signed the information letter. I perceived the students as being trustful; they generally spoke openly without much hesitation and were uninterested in receiving a copy of the letter. This made it increasingly crucial to care about situational, relational, and exiting ethics.

S*ituational ethics* refers to "ethical practices that emerge from a reasoned consideration of a context's specific circumstances" (p. 847) and requires that the researcher repeatedly reflect and reconsider ethical decisions. Visiting the groups was a continuous balance of observation and interaction or not disturbing the students' work while still asking questions. I had quite a few questions regarding what had happened since the last visit and what they were working on. Also, I wanted to check my interpretation and gain insights into the student perspectives and the sites to which I did not have direct access. I found that the balance varied among groups and between visits. In dialogue with the groups about what worked best for them, two groups preferred that I gather questions at the end of the visits. In the other groups, it depended on the day and the current situation. Some days, the students were very talkative and discussed their initiative, while on other days, they were busy or immersed in the work, leaving limited space for questions.

Relational ethics implies "an ethical self-consciousness in which researchers are mindful of their character, actions, and consequences on others" (p. 847); it involves an appreciation of *mutual respect*, *dignity*, and *connectedness between researcher and researched.* It includes the participants helping to define research rules and mutual dependence between participants and researcher, which, as a human instrument, with the help of the participants, must learn about the culture and how life is lived. From the beginning, I was aware that studying life and social life fuse and that looking into project work would provide a glimpse into the students' private sphere. This was why I found the participants' codefining the rule and frame for their participation to be a crucial factor. At the introductory meetings, I talked to each group about how participation in the project best fit into their way of working and concerns about participation. In ongoing field studies, I entered into a dialogue about how they experienced our presence and sought a presence that suited the individual group. The balance between observation and interaction and the access to Facebook Messenger are examples. I sought to answer openly and in the best way about the project and the application of data.

Exiting ethics concerns "*how researchers leave the scene and share the results*". The researcher may consider the best way to present the results, including how the work can be read/misread and used/misused. In the presentation, I endeavoured to treat students' trust with respect and create descriptions in which they could recognise themselves.

3.4.3. MAKING DATA

An important epistemic observation of ethnography is that the insights are broadly unique for the researcher, and ethnography do not claim to make an objective account independent of researcher's engagement with the setting (Hine, 2015, p. 20). The ethnographical approach involves reflexivity, an awareness of the researcher's subjectivity in knowledge production and representation (Pink, 2011). Data does not pre-exist the researcher's interpretive engagement; thus, data is always something we make, and data collection is often thermology rather than an ontological claim (Ellingson & Sotirin, 2020; Markham, 2018b).

Markham (2018b) identifies four ways in which data can be described as *things*. Initially, data acts as background information for, among others, shaping the questions for qualitative inquiry. Secondly, data are emergent, not preformed but made and apparating due to the focus we choose. With the choice of focus and questions for inquiry, we highlight some material and obscure the rest. Thirdly, Markham highlights digital data as fragments; *"Data are always partial representations of specific aspects of things, not the entirety"* (p. 7). Fourthly and finally, data become evidence for analysis and interpretation.

When visiting the groups, we made data combinations of field notes, pictures, video recordings, screenshots, and recordings. In addition, before each visit, I went through the groups' activity on the digital platforms, took screenshots, and wrote memos.

For the visits, I brought a paper tablet or a pad of paper for writing fieldnotes, as well as my computer, on which I simultaneously followed the group's digital activities. The field notes were my first-hand record of what was happening, what I observed, how it felt, and the first interpretive thoughts. Inspired by Emerson, Fretz, and Shaw (2011), I jotted keywords and short sentences in the field. Shortly after the visits, these jottings jogged my memory regarding experiences in the field when I transformed them into a coherent description. I combined the fieldnotes with photos, screenshots, and recordings depending on the given situation.

Writing field notes is an interpretive and constructive process that involves selection, emphasising some action and elements of the situation while marginalising and ignoring others. It is not an accurate description or 'passively copying' of 'what happened' (Emerson et al., 2011). It follows that fieldnotes are personal and different descriptions of the same situation and may differ markedly from each other;

> Fieldnote descriptions of even the "same event", "let alone the same kind of event" will differ, depending upon the choices, positionings, personal sensitivities and interactional concerns of the observer (Emerson et al., 2011, p. 9)

I presented video recording to the students as a premise for the study. Most of the time, the video camera stood in a corner or a place that captured all members without being in the way. The recording served the purpose of ethnographical memory and visual note-taking and enabled me to revisit and call to mind some of the situations in the analysis phase (Pink, 2011). The recordings also brought a feeling of security that I would not miss too much of the situation (i.e., too much might escape the fieldnotes). I was aware that the recordings did not capture the entire social situation, as not all ethnographical knowledge is recordable (Markham, 2018b; Pink, 2011). When Line visited a group without me, her fieldnotes, video recordings, and conversations gave me insights into the visits, though this was purely a supplement to my being there.

3.4.4. STUDENT 3E DIGITAL PRACTICE

Hine's description of the 3E internet resonated in different ways with my experiences in the field; I found the students' digital practice embedded, embodied, and everyday. In the following sections, I take the three concepts as my starting point in describing some of the methodological challenges I experienced in the field.

3.4.4.1 Embedded: What to follow?

According to Maeder (2018), "What should I look for in the field?" is "the big challenging practical question". He illustrates how difficult it is to explain what an ethnographer does by pointing to the various metaphors; 'go to where the action is', 'dirty fieldwork', 'doing social life', 'professional stranger', and 'fighting familiarity'. The primary metaphor for a multi-sited approach is 'following the actors', and I followed the project groups.

When the project groups met, the students were present on several sites simultaneously. Each member brought laptops and mobile phones, and perhaps other digital devices such as tablets or smartwatches. Activities on the platforms to which I had access were only a fractional part of the student digital activity. For other activities such as article reading, looking up words in digital dictionaries, watching videos on YouTube, programming, playing mobile games, and writing chat messages, I gained insights by asking questions or looking over the students' shoulders. I found that the 'digital' reinforced a fragmentation of the situation, which made it more or less challenging to comprehend it as a whole. I recognised a *perpetual feeling of uncertainty of wondering what has been missed* (Hine, 2017, p. 4).

Following five groups in parallel necessitated a high degree of planning and logistics. Weekly visits to each group set a frame and, in many ways, defined a path for where to go when; it created a shade of continuity, and if there was something I had to pursue, I could deviate. The 'where-to-go-when' challenge stood forth as a practical issue for planning the project group visits. On the one hand, much was given by the design of the study. On the other hand, it did not answer the question of what I was looking for.

Thus, when I visited the groups, the two passing questions were what I looked for and what I missed.

Initially, I found it easier to define what I was not looking for. As the choice of the connective method indicates, I was not interested in the isolated use of technology but, rather, in connections and relationships between online and onsite and between technology and group collaboration. Nor I did want to delimit the studies related to specific technologies or specific purposes or project phases. Instead, I was interested in the collaborative situation and the situated use of technology. The dynamic and ad-hoc student practice I experienced and, at times, found challenging to describe and capture in my fieldnotes aroused curiosity. Later, the diversity between groups' ways of approaching the project work and managing the high degree of student autonomy gave rise to questions about how we can understand, capture, and conceptualise the diversity and the dynamics between and within the groups' orchestration of group work.

3.4.4.2 Embodied: Shared extension of space and individual work caves

In my observation, I noticed two kinds of digital appearances: *extension of space* and *work cave*.

When the students had shared attention on the digital, e.g., a shared document, the digital appeared as an *extension of the physical space*. This became evident in situations in which my presence was confined to physical. I heard the group conversation on the text and heard the students verbalising *where* they were in the document, but I had to *be* in the document to have any chance of following and understanding. When I opened the document, it was like *fully arriving* – like the document was an additional part of the room, to which I had no access without a laptop.

When the students worked individually with distributed attention to their laptops, the digital appeared quite different. The student laptops formed separate workspaces – private *work caves*, which each student could crawl into for individual absorption. In the cave, the individual student usually moved dynamically between various digital sites: websites, documents, and programmes to which I – and other group members – had no admittance without an invitation.

The two appearances reflect different experiences of access and participation; an additional space, which students had invited me into, and separate caves, into which I had to invite myself. By the embeddedness, my observations were fragments. The degree of fragmentation and the uncertainty of what had been missed differ in the two types of situations.

3.4.4.3 Everyday: How could it look different?

In general, the use of technology and project work is, to a large extent, everyday for the students – something they take for granted and are not used to putting into words. Before the PhD studies, I was already very familiar with the PBL collaboration. I had to be aware of the danger of accepting normative assumptions both on the virtue of my personal experiences and previous research and the strong normative, which prevails in education (Maeder, 2018). Concerning technology and project work as everyday life for the students and my familiarity with the field, an essential question becomes: How could it look different?

For the student, the choice of technology and digital practice seems like a matter of course – not requiring discussion or a high degree of articulation – like everyday. I perceived that the students were unaccustomed to articulate how and why they use technology. Like technology, project work and group collaboration are everyday for the students. Most of the participating students have written a five PBL project collaborating with co-students on the previous semesters. However, the project group cannot simply be considered well-established teams relying on established project practices, organisational routines, and articulation work (Gerson & Star, 1986). The project groups are self-organised teams with high autonomy and negotiable collaboration practice. While a part of student practice may be considered ordinary (e.g., school practices like going to lectures, reading articles, and writing reports), another part is less established. When forming a new group, the members discuss how to collaborate. The students bring and build on experiences from previous semesters. In the project group, collaborative practice is renegotiated and adjusted on an ongoing basis. Therefore, I could not describe the student hybrid collaboration practice as an established practice and define evasion.

I am quite familiar with PBL collaboration. I have two bachelor degrees- and a master degree from AAU. In these eight years, I have written 16 semester projects together with co-students. The three latest semester projects, including the master thesis, concerned students' use of technology for PBL collaboration. During my PhD studies, I have lectured and supervised PBL project groups. Thus, I had to find ways to distance myself and make the familiar strange. During and after field studies, situational mapping (see also Section 4.6) helped me go systematically to the situation, formulate analytical questions, and clarify the taken-for-granted. Experiences with several groups' different ways of orchestrating their collaboration also helped me avoid accepting the normative and taking it for granted. Each time I asked myself the question 'How could it look different?', I found part of the answer by looking at one of the other groups.

In the field, my experience of recognisability and strangeness varied between situations. The recognition was related mainly to emotions and attitudes; the feelings of frustration, bustle, flow, cosiness, the collegial, friendly relationship, and, in the

final project sprint, almost roommate-like relationship to group members. I experienced strangeness, among other times, when visiting a student in the laboratory or when I had difficulty following a professional conversation. Online group meetings and the platforms Discord and Overleaf were less familiar to me. The ethnographical method and observing PBL collaboration from the outside, not being a full member, and putting into words what was going on, were new to me. This new position itself gave rise to a new perspective.

3.5. DIALOGUE BETWEEN DATA AND IDEAS

The logic of ethnography is abductive, and the associated reasoning is pragmatic. Atkinson (2014) describes an analysis process of ethnography as a "cyclic dialogue between data and ideas" (p. 67). Section 3.2 described the ethnographical logic as iterative, recursive abduction based on Agar (2006) – a logic that *leads us away* from what we already know to find explanations of the unexpected.

Abduction has its roots in American pragmatism; C.S. Peirce described abduction as pragmatic guessing, a back and forth process, which he saw as the first stage of all inquiries forming an explanatory hypothesis (Clarke et al., 2018, pp. 28–29). This guessing process is not random; instead, it is likened to conjectural thinking, searching to go beyond the known. Geertz (1973) describes it thusly: "Guessing at meanings, assessing the better guesses, and drawing explanatory conclusions from the better guessing" (cited in Clarke et al. (2018, p. 29)).

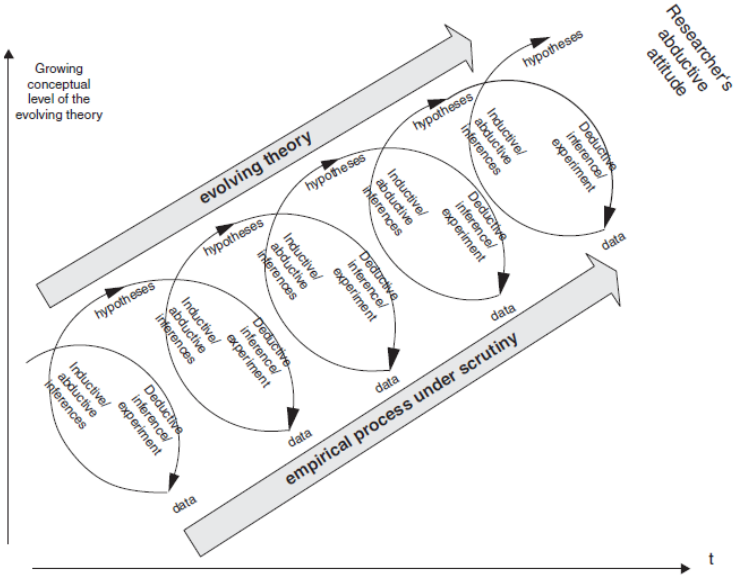


Figure 3-1 The process of abduction illustrated by Strübing (2007)

In line with Atkinson (2014), Clarke et al. (2018) describe abduction as an iterative looping between *the nitty-gritty specifics of empirical data* and *more abstract conceptual ways of thinking about them* (p. 28). The back-and-forth movement between empirical data and conceptualisations generates conceptual possibilities for handling the data, pragmatic guessing, and hopeful suggestions for what is at stake in the data. Clarke et al. (2018) borrow a diagram from Strübing (2007) (Figure 3-1). According to them, the diagram is helpful for illustrating the looping process between empirical data and an evolving theory or conceptualisation, though it is *too neat* and *linear* to illustrate the *actual* analytic process:

> The actual analytic process would likely be on more varied topographical terrain with many zigs and zags and going back to square one – a terrain where "getting lost" (Lather, 2007) is assuredly possible (p. 28)

In the following two sections, I describe how I engage with data and use situational mapping.

3.5.1. ENGAGING WITH DATA

Organising, ordering, and indexing are essential for preparing the data for analysis (Atkinson, 2014; Hammersley & Atkinson, 2007). I listed group visits and the recordings and data made. After ending the field studies, I brought together field notes, photos, screenshots, and memos in NVivo and labelled them with group and date. NVivo is a CAQDAS (Computer-Aided Qualitative Data Analysis Software) made for the qualitative analysis and coding of data – several carry direct references to Grounded Theory (GT) coding. Much qualitative analysis, including ethnographical

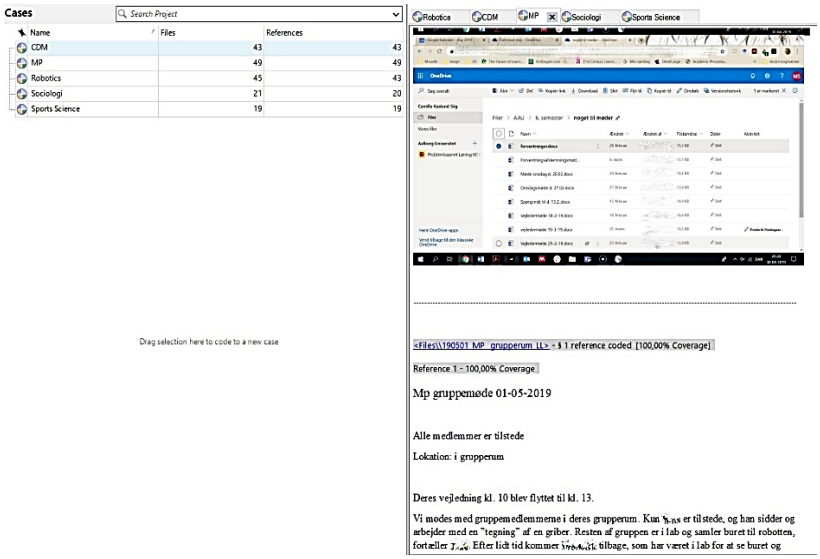


Figure 3-2 Screenshot of Nvivo project

analysis, includes sorting and categorising data into analytical categories (Atkinson, 2014; Hammersley & Atkinson, 2007). I went into the analysis expecting the initial analysis to take on an open coding process of field notes and memos (Charmaz, 2014). However, I found that this approach was not straightforward; I quickly recognised that the kind of categories, following from an open coding, would not help me understand the dynamics in the student hybrid collaboration practice, about which I was curious. Additionally, in the situations described in the field notes, I found many factors at play that I could not capture in analytic labels.

Several researchers have criticised the fragmentation and contextualisation associated with a coding process, often focusing on CAQDAS and GT coding. Atkinson (2014) criticises GT for believing that analysis is the coding of data and that technology for coding may lead the researcher to a jejune form of thematic analysis (p. 59). According to Atkinson, current ethnographic research is often based on a culture of fragmentation in terms of "decontextualizing data from its original location" to "recontextualizing them into analytically driven categories" (Hammersley & Atkinson, 2007, pp. 155–156). In previous projects, I have found CAQDAS and open coding beneficial for coding interviews or student-written assignments, and I do not intend to set up myself or others as judges of either CAQDAS, GT, or different coding types. Instead, I intend to describe and justify the experience of the approach (which I had used before and expected to apply) falling too short; I experienced it as impossible in a meaningful way to divide the situations into fragments and label them with analytical categories.

I had to find another way to access the data and figure out which analytical stories to pursue and, in the end, tell in this thesis. Initially, it was about getting to know the data (again) and creating an overview. Although I did not use NVivo for coding, the software helped me organise the data, contributed to an overview by group and chronology, and made it easy to move between the data fragments (Figure 3-2). I explored the field notes to identify situations in which I had found the dynamics of the collaboration most exciting and often, at the same time, most challenging to capture with words. I reviewed activity logs, version histories of documents, and conversations in Facebook Messenger. I revisited selected recordings and rewrote the description of situations. Simultaneously, I wrote memos and sought to link fragments into a mental chronological sequence. The process seemed structured and random – I alternated between a systematic review of data and letting what seemed worth pursuing define the path.

3.5.2. SITUATIONAL MAPS

Situational maps are analytic exercises for the researcher to 'open' up the data and think systematically about the project material. The maps are not analytic products, but thinking tools for the "materialisation" of questions that interfere with or rupture our usual way of working and provoke us to see things differently.

The situational mapping exercise is a main method in the theoretical and methodological framework of Situational Analysis (SA). Three books, primarily authored by A. Clarke, provide a theoretical and practical orientation of SA use (Clarke, 2005; Clarke et al., 2015, 2018). The key unit of SA analysis is the situation 'broadly conceived', and the focus is on the relationships between the entities and how they connect in the situation. The framework takes its point of departure and is considered an extension of, and supplemental approach to, GT. SA builds on the Straussians' string of GT with roots in symbolic interactionism and American pragmatism and finds inspiration in recent post-structural theory (including Foucault and STS). Clarke intends *to push GT around the interpretive turn*, a movement away from the 1960s positivist interpretation of GT towards a materialistic social constructivist understanding. The mapping exercises are compatible with methods other than GT, including analytic – rather than more narrative – ethnographical studies. Both Clarke et al. (2018) and others (e.g., Markham & Gammelby (2017)) emphasise that SA is especially useful for multi-sited ethnography, because the maps invite the researcher to combine and find connections across data sources and field sites.

Situational maps are divided into messy, ordered, and relational maps; in the following, I describe and show examples of the three maps.

Besides situational maps, the SA framework offers two other maps; arena/social world maps and positional maps. Arena/social world maps lay down collective mapping actors and key non-human elements in the situation and form a kind of organisational analysis involving mesolevel interpretations of the situation. Positional maps are a discourse analytic tool laying down the prominent positions on issues taken and not taken in the data. While the situation is elastic in the situational mapping, I found that the two other maps claim a broader view situation and an analysis level, deviating from the main focus on 'what the students 'actually' do'.

Clarke (2005) says that situational analysis helps free the researcher from 'analytic paralysis', uncertainty, and faltering regarding where and how to start the analysis. At times, I recognised analytic paralysis; simultaneously, I experienced the feelings of not knowing enough due to the many fragments in hand and *knowing too much* and being too muddy in the research context. It was challenging to 'be a stranger' and determine the analytic value of the possible analytic stories laying in the data. In these situations, mapping felt like taking a step backwards and looking at the situation from the outside.

3.5.2.1 Messy maps

The messy map simply laid down all elements that might matter in the situation, including human, nonhuman, temporal, spatial, socio-cultural, and discursive elements. Messy maps are descriptive maps; the elements on the map should be

Figure 3-3 Messy map made short after the end of field work

grounded in the data, reverse theoretical concepts, or analytic (not in-vivo) categories. The mapping assumes that the researcher knows this data. In a multi-sited connective study, data collection is fragmented; the messiness and lack of particular rules make the messy map a way to gain an overview of the different fragments and establish analytic junctions across field sites. The mapping is an association exercise with no perceptional rules for how the elements are placed in relation to each other. The messiness of the messy maps is intentional; it makes them accessible and easy for the researcher to manipulate. Maps allow unmapping and remapping. Clarke et al. (2018) point out that too much order may give rise to premature closure contrasting with the intention of the mapping to 'open' up the data. The delimitations of the situation depend on the project; the situation is elastic and arises through the mapping process.

Memo-writing, initially developed in GT, is an integral part of SA. The researcher must write analytic and processual notes continuously. When the maps and memos are dated, they constitute an analytic archive and become evidence of the analytic process that the researcher is going through.

Figure 3-3 shows a messy situational map made short after the end of fieldwork. Initially, the map was written by hand and in Danish, making it easier to manipulate. On the map, I have taken various elements, including human actors (group members, project group, supervisor), non-human actors, including technologies that the students use (e.g., Facebook and Google Docs), meeting places (group room, library, lab, home), school or academic activities (writing, reading), disciplinary elements (concepts, theories, and methods), work constellations (working together, working individually), coordination elements ('where to meet?', 'when to meet?', 'who works on which tasks'), moods or attitude (motivation, frustration, productive, cosiness), social elements (small-talk, social event, social activities), and organisational elements (PBL, study regulation). Further, I have included myself (PhD student), a research assistant, and a camera in the map. SA is a reflective method in which the researcher is an instrument as subject and as knowledge producer. Thus, the researcher might always be present on the situational map, making him or her a part of the situation.

The messy map creates a basis for the two other types of situational maps: the ordered and relational maps.

3.5.2.2 Ordered maps

The second type of map is an *ordered* situational map. The ordered map brings order to the messy map by categorising its different elements. The definition of categories depends on the empirical data and the situation of inquiry. Figure 3-4 shows an ordered map based on the messy map (Figure 3-3). The categories are inspired by Clarke et al.'s (2018) abstract version of an ordered map and modified the project. The categories help obtain a more systematic approach and broader perspective on the situation and clarify things that one would otherwise take for granted.

Figure 3-4 An ordered situational map

<table>
<tr><th>Human Elements/Actors</th><th>Nonhuman Elements/Actants</th></tr>
<tr><td>Project group
Individual group member
Co-students
Lecturers
Supervisors
Extern collaboration partner
PhD student
Research assistant</td><td rowspan="4">Technologies
Technologies for communication
Technologies for file sharing
Technologies for writing
Technologies for planning and organisation
Technologies for data processing and analysis
Other discipline-specific software

Documents and resources
Created by the project group:
Report documents
Documents for structuring and planning the process (e.g., to-do lists, calender-docs, group contract)
Documents for social purposes (e.g., film-list, who-owes-cake-doc)

Other documents, including articles, books, guides, and reports

Hardware
Computer, mobile phone, white board, paper and pen, discipline-specific hardware (robots, cameras, etc.)</td></tr>
<tr><td>Organisation</td></tr>
<tr><td>University
Faculties
Departments
Study programmes
PBL future project</td></tr>
<tr><td>Political/Economic Elements</td></tr>
<tr><td>Study regulations
PBL principles
Digital strategy
Economies
GDPR
21st century skills</td><td></td></tr>
<tr><td>Academic Elements</td><td>Feelings and Attitudes</td></tr>
<tr><td>Theories, methods, concepts, procedures</td><td>Productivity, flow, frustration, cosiness</td></tr>
<tr><td>Activities</td><td>Key Events</td></tr>
<tr><td>School/academic activities (writing, reading, searching literature, etc.)
Coordinating activities (‘who’, ‘when’, ‘where’, ‘how’)
Social activities (small-talk, eating cake, computer gaming)</td><td>Group formation, course lectures, supervisor meetings, deadlines, exams, social events, data collection</td></tr>
</table>

Related Discourses	Spatial Elements
Students as digital natives Students as incompetent digital learners 21st century skills PBL as group work PBL as a culture	Physical meeting places; group room, library, home, laboratory Working from home The digital infrastructures constructed by each project group

3.5.2.3 Relational map

A sufficient messy map also creates a basis for *relational mapping*. Relational mapping is a systematic and coherent way to go through and memo the data by ensuring the researcher visits all possible connections. In the mapping section, the researcher goes through each element on the messy map to characterise the relation between the elements; how are they connected? By drawing lines between the elements and memo on the nature of the drawn lines, the relational maps intend to help articulate the relations aloud and more clearly and formulate questions that the researcher has not asked in the situation.

Figure 3-5 shows an example of a relational map with the starting point in 'where to meet?' The map shows that the negotiation of 'where to meet' relates to specific meeting spaces (library, group room, lab), atmosphere and experiences (cosiness, flow, productivity), activities (data collection, social activities, writing), resources (blackboard, books), digital platforms (both as resources and as platforms for communication and documentation), and work organisation (working individual, working together, 'who works on which tasks'). Further, 'where to meet' relates to PBL, which involves the high degree of student autonomy, giving the project group the freedom to manage where, when, and how to collaborate.

Figure 3-5 is an example of one element; similar maps are created for the other elements in the map. In practice, I used many copies of the messy map for the relational mapping, ideally one per element, and by hand drawing lines between the elements and writing notes and memos on the relations. In Figure 3-5, I have used boxes instead of lines to make the map more readable.

RELATIONAL SITUATIONAL MAP

Figure 3-5 Relational map with 'where to meet?' as the starting point

3.6. INTRODUCTION TO THE ANALYSIS CHAPTERS

The following four chapters constitute the analysis of this dissertation; before we get there, I briefly introduce them.

Chapter 4 deals with diversity in the student collaboration practice. The basis for the chapter is the three participating groups studying Sociology. The three groups immediately have a lot in common, including study programme and regulation, study environment, and choice of digital platforms. However, despite these similarities, there is great diversity in how the groups manage the project work. This concerns, in particular, meeting frequency, choice of work constellation, and planning approach. The chapter describes the three groups' approach to meeting, writing, and planning,

including everyday reasonings behind their different approaches, and concludes by discussing diversity among the three groups.

Chapter 5 is entitled "Fluidity and structure" and describes two different types of collaborative situations. The chapter explains and analyses collaboration situations in the groups studying Sports Science and CDM. The distinction between the two situation types is based on two different experiences of project collaboration. The structured situation is characterised by the experience of predictability and a well-defined collaborative practice and stands in opposition to the experience of fluidity. Fluid situations often raised doubts about where the group 'flows' and whether they have a good grasp on the project. The chapter also drives into the two groups' use of technology and approach to planning and argues that technology can act as a place, tool, structure, and fluidity.

In *Chapter 6*, "Hybrid workspaces", I have selected three collaborative situations that each, in their way, reveal the students' hybrid collaborative practices and the construction of physical and digital workplaces. In the three situations, I identify various meetings between seemly distinctive elements. These meetings come together in two categories: between contexts and roles inside and outside the university and between digital and physical spaces and tools.

Chapter 4, Chapter 5, and Chapter 6 consist of sections that describe collaborative situations, followed by sections conceptualising and summarising. In the descriptions of the situations, I have not aimed for simple representation or renditions. Writing and rewriting the situation descriptions have been a way to process my experiences and understand what is at stake in the given situations. Thus, the descriptions are at once representations and interpretations of my observation and experience.

To understand the diversity and dynamics of the project group hybrid PBL collaboration, I propose six dimensions of group work in *Chapter 7*. The project groups orchestrate and balance the six dimensions differently, leading to multiple ways to successfully conduct PBL group work.

CHAPTER 4. DIVERSITY

This chapter presents the three groups from Sociology; the three groups share educational programs, semesters, and courses. They work in the same PBL environment with similar socio-materialistic conditions (e.g., they have no permanent group rooms) and under the same regulation. Further, the groups consist of female students and use the three digital platforms of Facebook, Google Drive, and Docs to support their project work. At first sight, the groups seem very similar, but a closer look shows striking differences in organising and orchestrating collaboration and project work. The diversity between the groups, which cannot be attributed to disciplinary or structural differences, illustrates the broadness of PBL collaboration and indicates how much of the collaboration practice between group members is negotiable. It reflects the high degree of student autonomy, which the AAU model implies.

The first three subsections describe each of the three groups and their approach and everyday reasoning for meeting, writing, and planning. The descriptions are based on different types and amounts of data; I have observed S1 across digital and physical sites throughout the semester, while my knowledge of S2 and S3 is based on two interviews, cf. Section 3.4.1. The last subsection discusses the everyday reasoning of the project work and the diversity between the three project groups regarding meeting frequency, work constellations, meeting spaces, writing, planning, sociability, and technology.

4.1. S1: WEEKLY MEETINGS AND HOMEWORK

Anna, Emily, Frieda, and Phillipa form a group for their bachelor project of the Sociology programme. They have not worked together on previous semester projects.

Meeting

The group meets about once a week. Most meetings proceed in similar ways. The group jointly reviews the text written since the last meeting, with each member sitting with her laptop, accessing the same Google Docs document. Hereafter, they agree on what they should each work on until the next meeting. Some days, the group notes the tasks on an ongoing basis. Some days, they write an agenda or a to-do list at the beginning of the meeting; other days, they do not.

At the beginning of the project period, the group meets before or after lectures in a meeting room on the university campus booked through the digital booking system. When the lecture frequency decreases, they meet at home and go to campus only once in a while for supervisor meetings or lectures. They find that it is ‘cosier’ to meet at home rather than in a campus meeting room. Anna lives 75 minutes by car from the

university, and Frieda uses a mobile hotspot and has no Wi-Fi connection at home; thus, the meeting space usually rotates between Phillipa and Emily.

Writing

The members prefer to work from home; they appreciate the personal freedom to decide when to work on the project. It is also more productive to write individually than to write all text together. They are aware that their way of working may affect the coherence between text sections, so they expect to spend much time in the last part of the project period aligning the text and making the report stand forth as a whole. On the other hand, they have, in a short time, written a relatively large amount of text. In the delegation of writing tasks, the amount of discussion on disposition and content depends on the given section; sometimes, they write an outline, other times they do not, and, as they say, it must show to what extent they agree. Nevertheless, they highly agree and approach the tasks similarly, to which they attach importance to courses and joint lectures.

The students write individually in MS Word and copy-paste the text into a shared Google Docs document for the entire report, often the evening before a meeting. When copying-pasting the text, they mark the new text with colour. Before most meetings, members read and comment on each other's work using Google Docs' comment feature. Based on written commentary and spoken discussions, they review and adjust new text from end to end at the meetings (further description Section 6.1.1). Once the group has reviewed the text, they remove the colour marking.

In the initial part of the project, the students have matched expectations and written a short group agreement;

Group meetings

15 min delay triggers cake/snacks

Assignment

Comments in docs may not be closed unless there is consent

Punctuation may be changed

Clear communication about whether it is possible to finish (before attending a group meeting)

Corrections are done together

Supervision

We talk about the content of the supervision and share out tasks after the supervisor meeting

A significant part of the agreement concerns co-writing in various ways. “Comments in docs may not be closed unless there is consent” and “Corrections are done together” indicate the writing process is a shared process. On the other hand, “punctuation may be changed” implies an agreement to not make significant revisions in sections written by other members and shows a weighting of individual ownership of the text.

The explication of the importance of clear communication shows that it is not a matter of cause, and awareness in the group of plans and time estimates for a writing process does not always hold.

Planning

The weekday for group meetings is not fixed, but instead agreed upon on an ongoing basis; the group either decides when to meet next at the end of a meeting or agrees later in the group’s Facebook Messenger conversation.

They write down, in a shared Docs document, the tasks they have agreed to work on until the next meeting. In the first part of the project period, they note it in the document at hand. Halfway into the project period, they create a document, ‘homework’, dedicated to tasks and plans. At about the same time, approximately halfway through the project period, the group makes a list of deadlines for the overall report sections.

Besides meeting time, the group uses the Facebook Messenger conversation to coordinate communication for the group (mail to the supervisor, external partners, and interview participants) and book meeting rooms. Mails and text messages are often shared, either as screenshots or as copied text, to make a shared decision on how to respond. The group does teen interviews; the coordination and labour division of carrying out and transcribing interviews is arranged continuously in the online conversation.

There may be days between the messages in the online group conversation.

4.2. S2: PAIR-WRITING AT DAILY MEETINGS

This is the third time that Kaya, Charlotte, Olivia, and Amy have done a semester project together. They experience it as an advantage that they have collaborated before; they know each other's strengths and weaknesses and are not afraid to ask stupid questions or have a feeling of having to ‘perform’. Instead, they know just how to approach the project work and know in advance that they complement each other well.

Meeting

As a general rule, the group meets daily from 9 am to 4 pm in Kaya’s apartment. They describe it as *cosy* to meet in a member’s home. They explain that they do not need to

search for an available workplace and imply that this is the case if they meet at the university. For the second interview, we meet the group at Kaya's. There is a homely atmosphere. A spring bouquet, water, coffee, and bowls of chocolate and biscuits stand on the small dining table between the four computers. Sharing a workplace enables them to discuss issues together if necessary, and by meeting for seven hours a day, they can keep the evenings and weekends free. They start each day by writing a to-do list for the day. Then, most days, they split up and write together in pairs.

Writing

For all sections of the project report, the group writes in pairs. The group emphasises that all group members have a hand in every section, and everyone has to vouch for the project report. When a pair has almost finished a section, the four members jointly review the text. Line and I are attending a review session of the method section; Olivia begins to read aloud, and Charlotte continually corrects typos and grammar. Continuously, they pause the reading aloud to discuss both overall content and individual wordings. It all happens without much coordination. It seems as though they have done this kind of review session numerous times in the same way with the same roles and labour division.

Planning

The four students have study jobs. With their work schedules in hand, they usually plan one and a half to two months ahead. They write down, in individual calendars, the days they will meet from 9 am to 4 pm and when they must deviate from the rule. The latter may be due to elective lectures or working hours at study jobs. The group writes the daily to-do lists in a Google Docs document stored in a shared Drive folder together with documents for the report, supervisor questions, and meeting summaries. They have created overall deadlines for the report sections and set off three days for proofreading. Last semester, they spent two days in a cottage together and made the final corrections.

The group has a shared Facebook Messenger conversation, which they apply to a member to bring a book or similar.

4.3. S3: BEST FRIENDS WORKING TOGETHER

Thea, Sanna, and Eva know each other well and characterise their relationship as "very good friends". While Thea and Sanna have worked together on previous semester projects, Eva has previously avoided group collaboration with friends, assuming that it will not work out well.

Meeting

The group estimates the ratio between meeting and work-from-home days to be "fifty-fifty". Whether they meet or work at home, they decide daily. By way of example,

Monday, they meet from 8 am to 4 pm; before leaving, they delegate tasks and agree to work from home on Tuesday.

The group often meets at the university library filial in the city centre. Two of the group members live nearby. They often arrive at 8 pm, as at that time they are assured of finding an available table. They have access to tap water with boiling water for coffee making and the possibility of using a whiteboard at the library. They usually buy their lunch in a market nearby.

For the group, friendship is a motivating factor in the project work and builds trust. However, friendship and project work stand forth as a balance they must orchestrate. According to the members, not only may the project work be “laborious”, but from their description, it is a risk if the social dimension is set aside. On the other hand, the friendship relationship is different from the relationship of being collaborative group members, and the fear may be that the collaborative relationship will change the friendship. In addition, social conversation might take over and steal time away from the project. To avoid this, the group has dedicated the first 30 minutes of the day to non-project-related talk. Besides this half-hour and the conversation over lunch, the time is delegated to project work, and they may not fudge time. According to the three friends, they mostly enforce the rule. Some days, they arrange friend time after project work; they go out together for ice cream, beer, etc.

The group is active in the Facebook Messenger conversation – the members write to each other every day. They describe the conversation as "a mixture of everything". 'Everything' seems to indicate a combination of project-related topics and non-project-related conversations between friends, and 'mixture' indicates that the interrelation between the two types of conversations is interwoven and fussed. The distinction between project and not-project, which helps structure the onsite group meeting, does not seem meaningful in the online group conversation.

Writing

Depending on the task, they either delegate individual writing tasks or write collaboratively. For instance, they have delegated theory sections, while they plan to write the analysis chapter collaboratively. They emphasise that "you write on everyone's behalf". This means that everyone can edit all text without anyone getting "upset". When they work at home, they can write to each other in the Facebook Messenger conversation.

Planning

Project planning is a combination of long-term planning, week-by-week planning, and day-to-day planning. On Fridays, they compare calendars and note appointments in a calendar document and talk about "What will we do next week? Any requests for meeting time, location or others?" The group discusses whether they will “knuckle on” or take the weekend off. Some might work on the project, while others have other

plans. They alternately bear the brunt. They emphasise the freedom to manage their work themselves and go home to family on weekends (none of the group's members is from Aalborg); they describe this as a motivational factor contributing to shared work.

Thea characterises their day-to-day planning as a loose approach but emphasises that deadlines set at the beginning of the project period ensure that "it all does not get out of control". The group has made a calendar, a table in a Google Docs document, each row containing the weekdays from Monday to Sunday. The calendar notes their appointments with the supervisor, the company they cooperate with, deadlines for report sections, the work schedule for study jobs, individual private appointments, and reading and writing tasks. Hence, the calendar document also tells the location of each group member and whether she is available.

4.4. DIVERSITY ACROSS GROUPS

The stories above on meeting, writing, and planning show crucial diversity in the collaborative practice between the three project groups. Figure 5-1 summarises and collates the three Sociology groups on members, meeting frequency, meeting place, rule, and technology.

Points of departure

The relations between the members and the project point of departure differ in the three project groups. Before their collaboration regarding the bachelor project, S1 knew each other only to a small extent. In contrast, S2 and S3 knew each other well as either previous collaboration partners or best friends. Thus, for example, S2 builds on previous semesters' shared experiences and established practices; in comparison, S1 starts from scratch and must, to a greater extent, negotiate a shared practice based on individual experiences for the project collaboration.

Figure 4-1 Collation of the three Sociology groups; members, meeting frequency, meeting place, rule, and technology

Meeting frequency and work constellations

A significant difference between the three groups relates to meeting frequency, labour division, and work constellations. Colocated S2 pair-writing, S1's weekly meeting with the joint collaborative reading of newly written report sections, and S3's constant assessing of joint or individual writing assignments and meeting or work-from-home days, based on situational needs, represent different orchestrations of collaborative or cooperative work modes (Dillenbourg, 1999; Ryberg, Davidsen, et al., 2018).

The three groups operate with different constellations of activity, work modes, time, and space. The reasoning involves text coherence, synergy, mutual engagement, productivity, individual preferences, and personal flexibility. For instance, S1 brings productivity and text coherence opposite when explaining the considerations of work constellation and meeting frequency. S2 emphasising that colocation enables alternating between pair-writing and all-member discussions is another example. The different forms of organisation or orchestration of the collaboration in the three groups

leave various amounts of room for individual choices and personal flexibility concerning where, when, and how to work and balance work-life or study-leisure. The different choices of meeting frequencies reflect the fact that the groups have found different productive rhythms in balancing togetherness and separation (Wenger et al., 2009). Likewise, the different work constellations and ways of being together reflect different orchestrations of togetherness (Ryberg, Davidsen, et al., 2018). The three groups' different approaches stand forth as various ways to balance group synergy, productivity, and flexibility.

The choice of meeting place

The Sociology groups have no group room, which is why they must choose and create their workspace for the group. The stories present considerations and criteria for the choice of meeting space. All three groups have chosen a more or less permanent workplace. Considerations of the atmosphere (cosy and homely), access to resources (e.g., whiteboards and internet access), and comfort (e.g., access to boiling water for coffee) stand forth as criteria for the choice of workplace. Two of the three groups also emphasise not having to spend time finding available space.

de Carvalho (2013) deals with motivational forces in the choice of place for nomadic work and distinguishes between freedom of choice, which involves criteria such as comfort and enhanced productivity, opportunity, and obligation, where the place offers resources that allow or are necessary for a given activity. All three types of criteria are in play in students' choice of workplace. S3's choosing to meet at the library is an example; hot water for coffee and the market nearby are about the freedom of choice, while access to a whiteboard can be both a matter of opportunity and an obligation. Access to a whiteboard can be a criterion for choosing a workplace because a planned activity requires a board or because the group wants to have the opportunity to improvise the use of the board.

Writing

In the PBL project work, writing is simultaneously a shared and individual process, as both the groups' organisation of writing and their articulation of the writing process show. S1's group agreement illustrates writing a project as a balance between individual and collective elements. The various rules in the three groups show that they relate differently to ownership of text and tasks. Boiled down, S1's guideline from the group agreement "Punctuation may be changed" and the group's individual "homework" stands in contrast to S2, whose members edit all text without anyone getting "upset" and alternately "bear the brunt". S1's description of productivity and text coherence implies that the text must move from individual to shared. The groups represent different ways of approaching this process.

Planning

Group planning is a combination of longer-term, shorter-term, and more situational decisions, and it varies between the three groups as to which elements concern which

of these everyday planning categories. The differences are seen, among other things, in the decisions about when and whether the groups meet. Similarly, the stories indicate differences between which practices stand forth as routines and which, in contrast, stand forth as more ad-hoc. The use of to-do lists is a concrete example; while to-do lists appear to be almost a ritual for starting S2's workday, they are a tool that S1 uses ad-hoc in given situations, where the group finds it useful.

Sociability

The stories about the three groups indicate that sociability and social coherence are a dimension that the project groups orchestrate in various ways. Especially for S3, the social dimension of the project work stands out; when they meet, the group distinguishes between time for social conversation and time for project work. Thus, even though the two other groups do not have such explicit strategies for balancing friendship and project, both seem to add importance to the sociability in the group. For example, both S1 and S2 choose a cosy and homely work atmosphere with cake or snacks, indicating an awareness of this balance. Another example is S2's days in a cottage to make the last corrections before the report is handed in.

Same digital platforms – various practices

Common to the three groups is that they all use Facebook Messenger, Google Docs, and Google Drive to support their project work. However, the above stories on meeting, writing, and planning indicate that these platforms imply different practices. An example is the degree and type of communication between meetings in the groups' Messenger conversations; to what extent do the group members communicate between the meetings or how do they work together separately? The amount of communication between S1's weekly meetings varies and depends on the need for coordination. The fact that S2 meets every day decreases communication between meetings, which often takes the form of messages asking for or offering reminders to bring something to the meeting, such as a specific book. S3 is always connected through its online group conversation, where the members write about 'everything'.

Another example relates to planning and calendars; S1 turns a document into a class book with homework, while S3 has made its own calendar design in a document. Instead of a shared calendar, S2 has a document for to-do lists. This also illustrates how the groups use technology to build up dedicated systems and responding practices. Further, it is worth noting that students use Google Docs for scheduling and planning rather than a dedicated software solution. Google Docs is designed as a text editor and not for planning but is highly manipulable and open in its possibilities, allowing students to build and adjust their own systems. The stories also show that students use some of the programs' functions and opt out of others. For example, S1 uses the comment function in Docs diligently while inventing a colour marking system to distinguish between 'new' and 'old' written text instead of using the Docs function of tracking changes.

4.5. SUMMARY OF CHAPTER

- *Diversity and richness in PBL collaborative practice:* The stories of the three Sociology groups show diversity and broadness in collaboration practice, which does not relate to disciplinary or structural differences. Instead, it reflects the high degree of student autonomy, which the AAU model implies.
- *Diversity in the project groups' orchestration of work modes*: A significant difference between the three Sociology groups relates to the constellation of coordinative, cooperative, and collaborative work modes. The orchestration of work modes involves reflections on the balance of group synergy, productivity, and flexibility.
- *Diversity in the project groups' orchestration of time and space*: The variety in meeting frequency is another significant difference between the three Sociology groups; How often does the group meet? When and where is the group together? The answers relate to work mode, activity, and how the group chooses to be together (togetherness), both located and distributed.
- *Choice of meeting place involves considerations of atmosphere*, *obligations*, *and possibilities:* The stories of the three groups also talk about the criteria of the choice of meeting place. The choice of meeting place includes considerations of atmosphere, comfort, and access to resources.
- *Project writing is both a shared and individual process*: Project writing involves both shared and individual elements. The stories of the Sociology groups show three different roads from individual to shared text.
- *Varieties in the planning practice among the project groups:* The planning practice among the three Sociology groups varies and involves aspects ranging from long-term to ad-hoc planning.
- *Varieties in routine and ad-hoc structure among the project groups*: Some structures and practices, which are routine in certain groups, are more ad-hoc and applied as needed in other groups.
- *The social dimension of PBL project work is essential and something the project group must orchestrate:* The stories of the three Sociology groups indicate that the social dimension is critical and a motivating factor of the project work. The project groups must orchestrate and balance the social dimension, such that the project work does not become too "laborious" on the one hand, and that the social conversation does not steal too much time from the project on the other hand.
- *The project groups use commercial and familiar technologies to create structures and responding practice:* The stories of the three Sociology groups applying Facebook and Google services confirm the student choice of familiar commercial tools. Further, it shows that using the same tool involves various practices; students use technology to build up systems and structures responding to their collaboration practices.

CHAPTER 5. FLUIDITY AND STRUCTURE

This chapter presents a distinction between fluid and structured collaboration situations; the two types differ among predictability and conversation dynamics. Fluidity implies that the experience of conversation, activity, and work constellation may easily change shape. The dynamic makes the conversation stand forth as fragmental but tethered, while the shifts still seem smooth and fluid. Fluidity also implies the capability to flow, sometimes into social non-project-related issues and others into crucial project issues. For the structured situations, the object and the way seem given, and the practice is well-defined. The activity and work constellations are settled – the movement of conversation and which kind of decisions to make are predefined due to the activity.

The chapter is based on experiences and data from the project groups studying Sports Science and CDM. It presents fluid and structured collaboration situations and dives into the project groups' use of technology and approach to planning. I argue for four non-mutually exclusive meanings of technology; technology acts as space, tool, structure, and fluidity. The last part of the chapter sums up the distinction between fluidity and structure.

5.1. FLUIDITY

This section presents two situations that I experienced as fluid. First, I describe the Sports Science group, whose members sit reclining on the library's sofa and read articles while having an ongoing conversation about project-related and non-project-related issues. Second, I describe the CDM group sitting in a study area working on individual assignments. In the group are ongoing joint, sometimes parallel, conversation(s) with varying numbers of participants and issues, leaving me with the impression that the group members simultaneously help, motivate, and disturb each other. Common to the two situations is a fluid conversational dynamic, which I look into in this section's third and last part.

5.1.1. SPORTS SCIENCE: ARTICLE READING ON THE COUCH

I meet the four group members, Emma, Peter, William, and Sara, at the filial of the university library in the western part of the city. The group sits in a sofa corner, and all four students look pretty laidback. Emma has her feet on the coffee table, and William lies prone on one of the two sofas. Their eyes are on separate screens – mainly on their laptops, though smartphones attract attention from time to time. There are empty coffee cups and drinking jars on the coffee table. Today, no paper plates with

crumbs indicate that they have eaten cake. I have not met students who talk so much about cake – especially the "small ball-shaped cake" from the canteen located next to the library whose price recently has gone up by two Danish kroner. Visiting this group always leaves me with an incredible craving for cake.

Sara: We are reading articles.

I have just arrived, and this stands forth as an explanation for their sprawled position.

William: I cannot deny that I had almost fallen asleep.

Sara: From now on, I will keep an eye on you, whether you are scrolling or not.

They say this with a smile. The atmosphere is relaxed.

They have divided readings between them. Sara focuses on the design of the project experiment, while the others read in preparation for their respective parts of the theory section.

Concurrent with the individual reading and note-writing, a group conversation is ongoing with alternating topics and participants. Fluidly, each member drops in and out of the joint conversation by moving their attention back and forth between their laptop screen and the conversation. Each member can bring up an issue for discussion; the smoothly ongoing conversion can change immediately and markedly, and if no one is saying anything, the conversion just resumes. It shifts between different subjects: the difficulty of understanding the theory, the construction of an argument for the project problem and hypothesis, the understanding of specific terms and decisions regarding the experiment design. They often refer to particular studies by last name and year. The conversion also turns to movies; William has made a must-watch movie list for Sara, and she had watched one of the movies over the weekend.

William hands his laptop to Sara and asks her to read a short section of the article on the screen; “Do you understand it in the same way?”

I sit next to Peter and can follow his activities on his screen. He regularly goes on YouTube and watches videos of skiing while otherwise orienting himself in articles. I cannot see the screens of the others.

Figure 5-1 The Sports Science group reading articles

Before they leave, they coordinate the next day. William books a room at the main campus in the eastern town. Upon short notice, they have set up a meeting with their supervisor and co-supervisor tomorrow. Their supervisor has not yet replied as to whether or not he can participate.

5.1.2. CDM: HEADPHONES, CANDY WRAPPERS, AND SQUIRRELS

By the first table on the left in the open study area, the six members sit with their laptops. It is about lunchtime, and more are having their lunch. Carl's cardboard cup shows that his lunch is from Burger King. Kenny has brought a packed lunch from home: rye bread and a banana. Christina sits with a bag of wrapped chocolates. She pushes the bag to the middle of the table; the chocolates are for sharing.

The group works on individual tasks; Sam and Lisa make corrections according to the forenoon's supervisor meeting feedback. Kenny works on a preliminary analysis of an interview, and Carl, Tanja, and Christina write on separate sections for the project report. Regularly, they exchange comments, for instance coordination of sub-tasks or questions on in which documents they find specific text-section or how to use a specific term. Sometimes short text sections are reading aloud followed by a question. The number of participants in the joint conversation shifts dynamically between two and six. Sometimes, parallel conversations occur between pairs. Group members alternately leave and shortly after return to the room. Some leave without a word, while others are more informative about their intended destination.

They struggle with concentration – they comment on a lack of concentration several times. Christina describes them as squirrels, referring to the fact that they easily get distracted and have a short attention span. In the forenoon and yesterday, they were much more focused, the group says. It seems crucial for them to explain that today is

not representative. Much of the conversion is not about the project. Kenny and Sam make jokes. Others chuckle and participate partly. After a while, Kenny finds and puts on his headphones. "These seem to be necessary", he says. The headphones mark a shift from the non-project-relevant joking to concentrated project-work mode. Sam is the only one who has not bought headphones. The five other members alternately have the headphones in/on two, one, and no ear(s). Short parallel conversations between two members occur; in a low voice, one member asks a clarifying question of another member. They often refer to a text section in a document; members who sit next to each other lean a bit to the side to look at the neighbouring screen. A third member may contribute, either with a single comment or as a full participant in the conversation. All members are free to join the conversation(s) at any time. An individual member can choose between participating in a joint conversation, listening with half an ear, or staying in their work cave (with headphones in no, one, or two ear(s)). The group members seem to both support and disturb each other.

Carl brings his laptop to one of the cafe tables in the hallway. He edits some video material before returning to the group.

After a while, Lisa leaves to work from home; she is going to transcribe an interview. Transcribing appears to be a task that, inherently, is done at home. Perhaps this is because the task does not require ongoing discussions but instead has a more operational character. Shortly after, Tanja also leaves the group.

"Shall we walk together?" Tanja asks a co-student, who walks by their table and leaves to go to her study job. "I just work from home – we have a hard time concentrating anyway," Tanja replies to the question of whether she should not stay with her group. She packs her bag without coordinating with the other members.

As time passes, the pile of candy wrappers grows at the table. Both group members and candy-starving co-students passing by the table contribute to the pile. When the first bag is empty, Christina opens a second one. The two candy bags are empty when we leave the group after one and a half hours of observation.

5.1.3. FLUID CONVERSATIONAL DYNAMICS

In both situations described above, the conversation subject and number of participants change dynamically. Discussions of disciplinary concepts or how the group should approach, for instance, report structure or experimental design, social small-talk, clarifying questions, and communication about logistics and planning almost flow in between each other more or less on equal footing. The individual group members sign in and out of the joint conversation by shifting attention between their laptop screens and a joint conversation. When they join, sometimes it is as if they have taken part in the conversation from the beginning; other times, they turn the conversation in another direction. Sometimes, a comment or question is turned to one

or more specific members; other times, it is addressed more to the room, and the matter of who responds and contributes to the conversation stays open for a short moment.

In both of the situations described, the atmosphere is relaxed. The students' attitude shows, in particular, the relaxed sitting and lying positions of the Sports Science students and the CDM students joking. The conversation dynamic, the individual freedom to join and leave the conversation and shift between project and non-project issues, also substantiates the relaxed atmosphere. Leaving the conversation can involve a retreat into an individual work cave or 'a project break' in the form of a mobile phone or YouTube video. In CDM, this individual freedom also involves physically moving, either for a brief remark or to work elsewhere nearby or leaving to work at home.

At the beginning of the field studies, I found this conversational dynamic interesting and somewhat challenging to describe. The conversation was not random but, rather than planned, it arose or emerged out of the situation. Instead of being structured, it appeared fluid. The experience of this fluidity made me reflect on questions like; Does the project group have a good grasp on the project? Do they know where they are 'floating'? What did they decide, or did the discussion stop because they cannot make the decision right now? The questions arose from doubts on how to grasp and describe 'what is going on' rather than a normative consideration of project work and management.

Often, my jottings describing the conversation were lists of subjects with notes about conversation participants on the given subject. Based on the subject's list and due to the subject's different nature – for instance, in between disciplinary discussions and social talk on movies – the shift in the conversation happened abruptly. In contrast, I experience the shift of subject as unproblematic, smooth, and fluid.

The shifts in themselves were abrupt. Metacommunication on the shift in conversation, e.g., comments like, 'Sorry I interrupted, but…', 'I'm checking out of this conversation – I have to read this article', or similar, belong to the rarities. In other contexts, it might be considered rude, interrupting, or interfering to join the conversation in this way, or ignoring or showing a lack of interest in leaving a conversation without a word. However, this is not the case. There is complete acceptance from all members of the sometimes frequent and otherwise immediate abrupt change of subject.

Sometimes, the shifts in the conversation reflect what the individual students are working on, where fellow students can help one in the process or answer a clarifying question. Other times it is of a more 'small-talk' nature. Sometimes, the conversation shifts appear as an implicit negotiation of how the group should collaborate, where they stand in the project, and where they are going. Thus, the conversational dynamic

involves a high degree of flexibility in how to work and collaborate. It is like a conversational space that the member could join and leave as they wanted, with space for motivating as well as disturbing each other, expressing frustration as well as enthusiasm, and for dynamic shifts in activities and work constellations. Just as the conversation sometimes moves primarily between social topics, the conversation can lead to crucial discussions and decisions. However, the shifts and pauses in the conversation sometimes leave doubt as to whether the group has reached any decision or conclusion on the subject it just discussed. This brings to mind Engeström's (2008) description of knotworking, a *movement of tying, untying, and retying together seemingly separate threads of activity* (p. 194) (see also Section 3.3.4). In the fluidity, threads are brought together, which potentially leads to crucial nodes or knots.

5.2. STRUCTURE

The experience of fluidity in some collaboration situations contrasts with other collaboration situations, where the project group's activity appeared planned and well-defined, and the group's members worked towards a defined object. The following sections describe two structured situations; the Sports Science group's text review and a CDM group meeting.

5.2.1. SPORTS SCIENCE: TEXT REVIEW IN THE QUIET ROOM

The project group is often the first set of students to arrive at the library in the morning. This allows them to work in the open study area (with café tables and a sofa corner) or in the quiet room, a small and narrow meeting room that students can use according to a first-come, first-served policy. Today, they have chosen the quiet room because they plan to collaboratively review the method chapter.

The browsers are open to the same Google Docs document at the four laptops occupying the small table. Different coloured cursors represent the students; the pictures in the top right corner indicate which belongs to whom. All cursors are in the text passage, which William is reading aloud. Continuously, they correct the text due to both the ongoing suggestions and written comments. They have all made comments in the document in preparation for today's review session. They alternately take the lead in making the corrections. At times, three of the students make changes simultaneously. They do it without any spoken coordination regarding who is doing what. Sometimes they replace a few words; other times, they add or rewrite longer text segments. Significant changes often involve longer pauses in the reading-aloud, where the students discuss and orient themselves to articles or books. They have just stopped reading and are discussing how to present the experimental design. William turns around his laptop to show a flow diagram to the others. Emma picks up a book from her bag and starts browsing it.

The group plans to finalise the corrections of the method chapter today and then email it to their supervisor. It has been a long time since they talked to the supervisor, and they have recently made various changes to the experimental design. The group explained earlier that the supervisor 'approving' their decisions provides a sense of security.

5.2.2. CDM: AGENDA ON WHITEBOARD AND IN DOCS

The four members have met in a meeting room for a group meeting. They sit around a table with each of their laptops in front of them. An agenda for the day's meeting is written on the whiteboard. Two group members are missing; Lisa is ill, and Tanja is at a family event (the latter appears in the group's shared Google Calendar).

All four have shared attention, through each screen, on a joint Docs document named with today's date. At the top of the document is the meeting agenda, almost identical to the one written on the whiteboard. The only difference is that the group has elaborated one item with three sub-items in Docs (Figure 5-2).

When I arrive, the group members are working on the first item; they write on the content form in the document underneath the agenda. When they have finished the consent form, Christina takes on the task of creating the form's layout. She copy-pastes the form into MS Word while the group moves on to the next item. The members discuss the research design including criteria for participants, finding

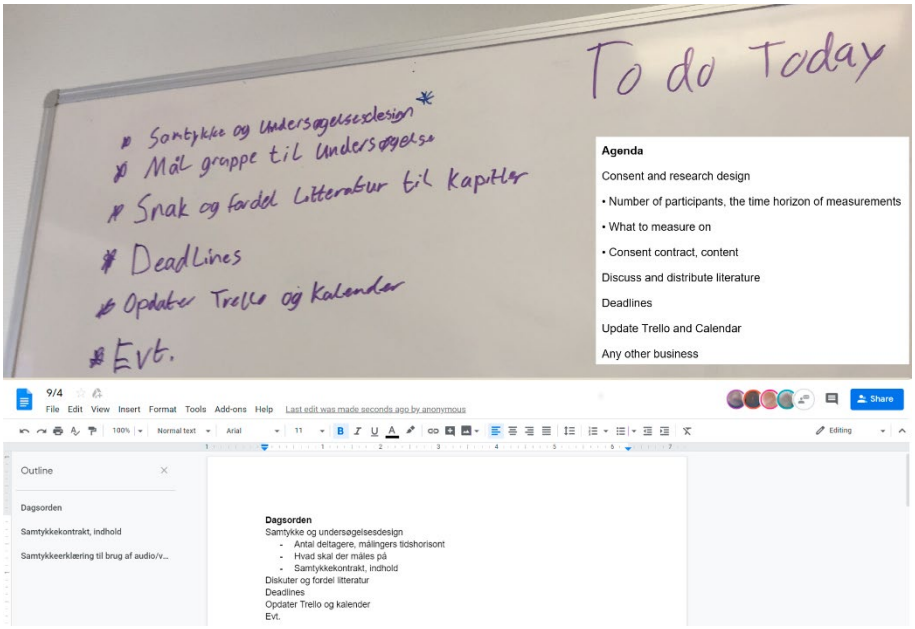


Figure 5-2 CDM group's meeting agenda on the whiteboard and in Google Docs

participants, and roles and responsibilities during the experiment (observers, interviewer, and others). During the conversation, they continuously write down their decisions in the document. They take alternate initiatives to take the meeting notes. Christina turns around her computer to show the layout of the consent form. The other members approve with a nod.

The group goes through the items on the agenda. They all have their attention on the document. A couple of times, Carl quickly glances at the agenda on the whiteboard. It does not seem to have any function during the meeting. Instead, it appears to be a start-up ritual.

The distribution of tasks goes smoothly; each student steps forward to write parts of the theory or method section. They have to ask Tanja and Lisa which sections they want to work on. The conversation quickly turns to when they expect to have written the sections. They each make an estimate. They agree to set all the tasks to Tuesday the following week. They talk about who has to coordinate regarding the interrelation between report sections. They create the task as cards on the board in Trello, a digital task management tool. The due dates are set. One responsible member is added to most of the cards, while two members are added to a few cards.

5.2.3. WELL-DEFINED PRACTICE AND STRUCTURED CONVERSATION

Compared to the fluid situations described in Section 5.1, the two situations – the Sports Science group reviewing the method chapter and the group meeting in the CDM group – are more structured and planned; the activity and aim of the day's work are defined in advance. The conversation subjects and structure are given by activity, either by a meeting agenda or in the review process, where the top of a document is the logistical starting point. In the two situations, all present members of the group participate in the same activity; the work constellation is well defined.

While the changeableness in the fluid situation implies ongoing implicit negotiations of how to work together in the current situation, the collaboration practice stands forth as predefined routines in structured situations. The negotiations appear primarily as an explicit discussion about concrete decisions, such as experiment design, deadlines, or content or wording in a report section. The difference between the two types of situations reflects different degrees and balances between participation and reification (Wenger, 2019; Wenger et al., 2009). In fluid situations, discussions may raise doubt as to whether the group made an agreement or decision; meanwhile, in the structured situation, the decisions and participation are made plain and reified, e.g., by technology in meeting notes, Trello updates, or text additions and edits.

The object of the review session is clearly defined; the members must make the text ready for supervisor feedback. The reviewing practice in the Sports Science group seems well-defined; they have prepared written comments, read aloud, collaboratively

edited the text with shared attention in the same Docs document, and, finally, emailed the text for supervisor feedback. The situation shows shared understanding and engagement in both the section's content and collaborative editing; they have done it several times before. The review session stands forth as a routine, a structuring element for the project work. In writing the report sections, the group works towards the review session, where they, with shared engagement, take joint ownership of the text. The supervisor meeting and supervisor feedback stand forth as another structuring element. The supervisor vouches for or ‘approves’ the text and, with the feedback, more or less implicitly tells the students whether or not the group is on the right track.

At the CDM group meeting, the meeting agenda, in Docs and on the whiteboard, and the meeting notes are parts of routine meeting practice. The agenda predefines the subjects and decisions that the group will make, and the decisions stand forth clearly in the meeting notes. Likewise, the delegation of writing tasks and the estimation of effort and time for setting a deadline, which goes quickly and smoothly, are accustomed practices. The task division and deadlines stand forth as structuring elements, guiding project work for the coming days.

5.3. TECHNOLOGY AND PLANNING

This section describes the Sports Science group and the CDM groups' use of technology and approach to planning concerning balancing structure and fluidity.

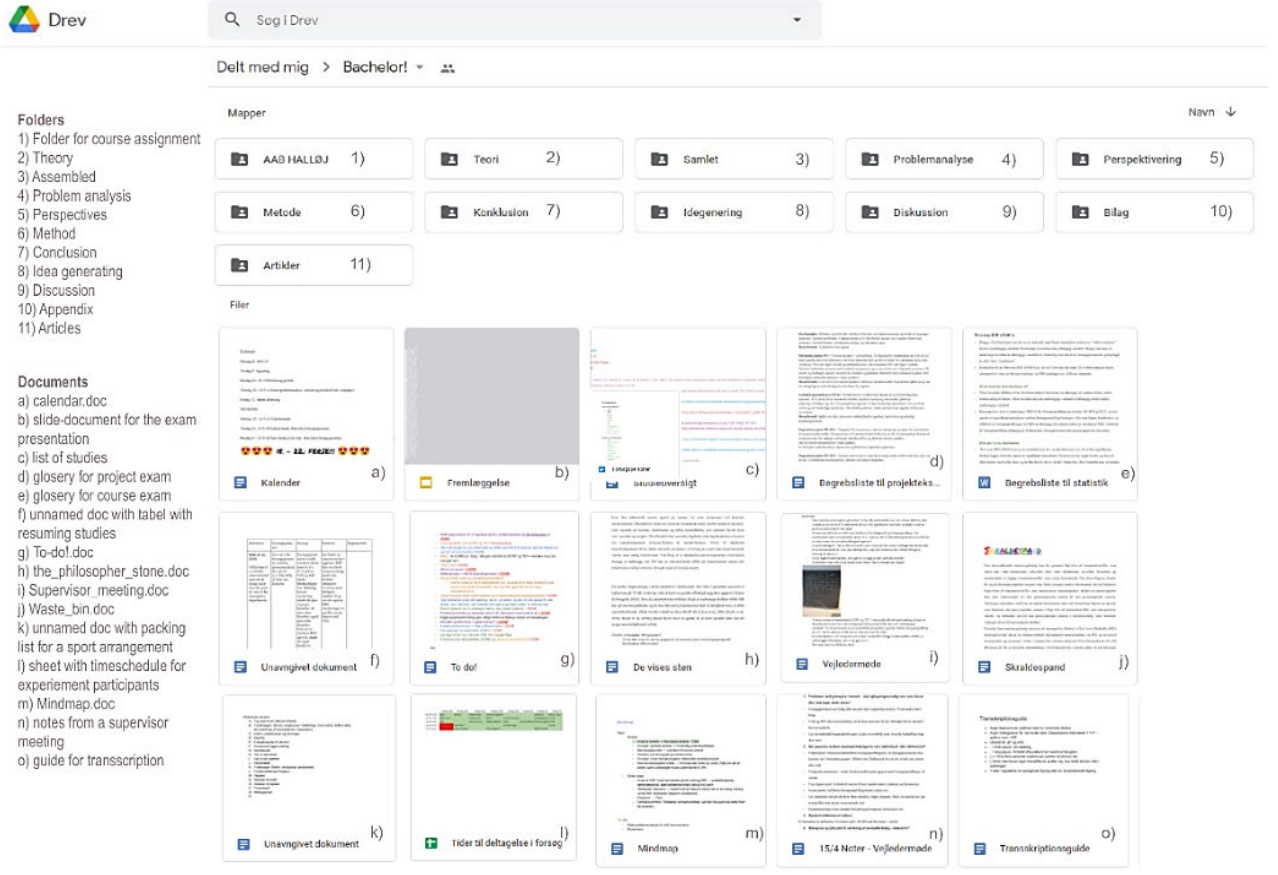
5.3.1. SPORTS SCIENCE: AD-HOC STRUCTURES AND CHANGED PLANS

The Science group uses Google Docs for text editing, Google Drive for filesharing, and Facebook for communication. A look at the group's documents and Drive activity log shows traces of the group creating its own systems and structures as the occasion demands. More systems are quickly degraded, and new ones are established when needed. The Facebook Messenger conversation shows that the group has a casual approach to plans; in the conversation, much ongoing coordination of meeting time and venue occurs almost on the go, and agreements are made and changed at short notice. As the group itself indicates, time management tools do not suit their way of working.

Google Drive and Docs

Figure 5-3 shows screenshots from the Sports Science group’s Drive folder. In Google Drive, the group shares proceeding report documents organised in folders and documents by report sections, including problem analysis, theory, method, discussion, conclusion, perspectives, and appendix. The students create Google Docs documents

Figure 5-3 The Sports Science group's Google Drive folder



continuously based on the sections they are going to write. Besides report documents, the Drive folder includes documents for planning and organising the project work (including to-do lists and a calendar document), documents for the experiment (including a list of participants, the planning and result schedule, and the protocol), and documents with course assignments. A few files have a social purpose; for instance, a packing list for a social event with sports activities and a party, which the group members join together.

In the following, I zoom into selected documents used primarily for planning and organising the project work;

- *Articles.doc* is a numbered list of references created early in the project period to structure the preliminary reading. The group shared out the reading, and each member resumes relevant articles from the list.
- In *Calendar.doc*, the group writes its plans for the coming day, between one day and two weeks ahead. The members have listed the dates and noted the meeting time or if it is a work-from-home day. They write tasks, which they agree to do from home, as "homework". Some days, the students add the number of hours they expect to spend on the homework. The number of hours noted does not reflect the scope of the given task but is a common understanding of how many hours they expect to spend on the project. The group uses the documents throughout most of the project period, but the use is not systematic and not continuously updated according to changing meeting times.
- *To-do!.doc* created in March, *Mindmap.doc* created in April, and *Plan-for-the-coming-week.doc* created in May are three documents containing a to-do list and a few notes. For all three documents, the editing is done over one or two days, whereafter the group does not seem to open the documents. The documents reflect a situated demand for overview and current status on the project, rather than a systematic and continuous practice. In late May, the group resumed using To-do!.doc; they write a long list of tasks and use colour codes to divide them. They edit the document for five successive days, reflecting the fact that the submission date is approaching and the need for an overview increases.
- In the *supervisor-meeting.doc*, the students write questions and summaries for the supervisor meetings. The project group uses the document continuously in the project period. However, similar to the other documents, it does not seem to be systematic.
- After the group has handed in its project report, it also uses Google Docs and Slides to structure its project exam preparation. The group has made *glossaries* and a document with *summaries* of relevant studies and a slide *presentation* for the exam.

The documents reflect both systematic practices and ad-hoc and situational needs. The documents, articles.doc, and documents for exam preparation serve to structure and

systematise defined and time-specific tasks. The documents, Calendar.doc, To-do!.doc, Mindmap.doc, Plan-for-the-coming-week.doc, and supervisor-meeting.doc, reflect well-known process and planning tools, namely, calendar, summaries, agendas, to-do lists, and dispositions. The frequent updates that usually characterise and add value to these tools to provide an ongoing status and overview of the project are wholly or partly absent. It seems like the students build up structures and systems that soon crumble, whereafter they build up new systems if needed. On the one hand, the crumbling of systems can be (maybe normatively) considered a lack of maintenance. On the other hand, building short-lived systems configured for the task at hand offers flexibility and is associated with Spinuzzi's idea of adhocracies (Spinuzzi, 2015).

Facebook

The Facebook Messenger conversation, "Bachelor (It'cool)", makes the group members always connected. The group members use the conversation thread to communicate when they are not together and share files and links, whether or not they are together. Most of the communication is about logistics. They coordinate meeting times and locations and communicate about room booking and working hours (three of the four members have a study job). If one is ill or delayed, he or she lets the others know by writing in the conversation. On work-from-home days, the Messenger conversation is used for clarifying questions and the coordination and division of work. The tone is informal; smileys and memes are an integral part of communication.

Figure 5-4 shows selected segments from the group Messenger conversation (pseudonyms used, pictures blurred, and messages translated from Danish to English).

The first conversation segment shows an example of how the group changes plans at short notice. Plans initially noted in calendar.doc are changed both in the conversation thread and verbally – and as an outsider, it is difficult to assess whether agreements in the planning document are valid or changed. Messages on when they agreed to meet next indicate that the students feel similarly (segment 2). However, the quick response in the Messenger thread makes it easy and unproblematic to clarify. The third conversation segment is an example of the group coordinating tasks on a work-from-home day. The fourth conversation segment shows the group's constant cake craving and use of memes.

I coordinate the visits with the group in the Messenger conversation. Conversation segments 5 and 6 show parts of the conversation related to the coordination of visits. In segment 5, I ask the group if they are meeting the next day and get a quick response that they do not know yet; they will let me know.

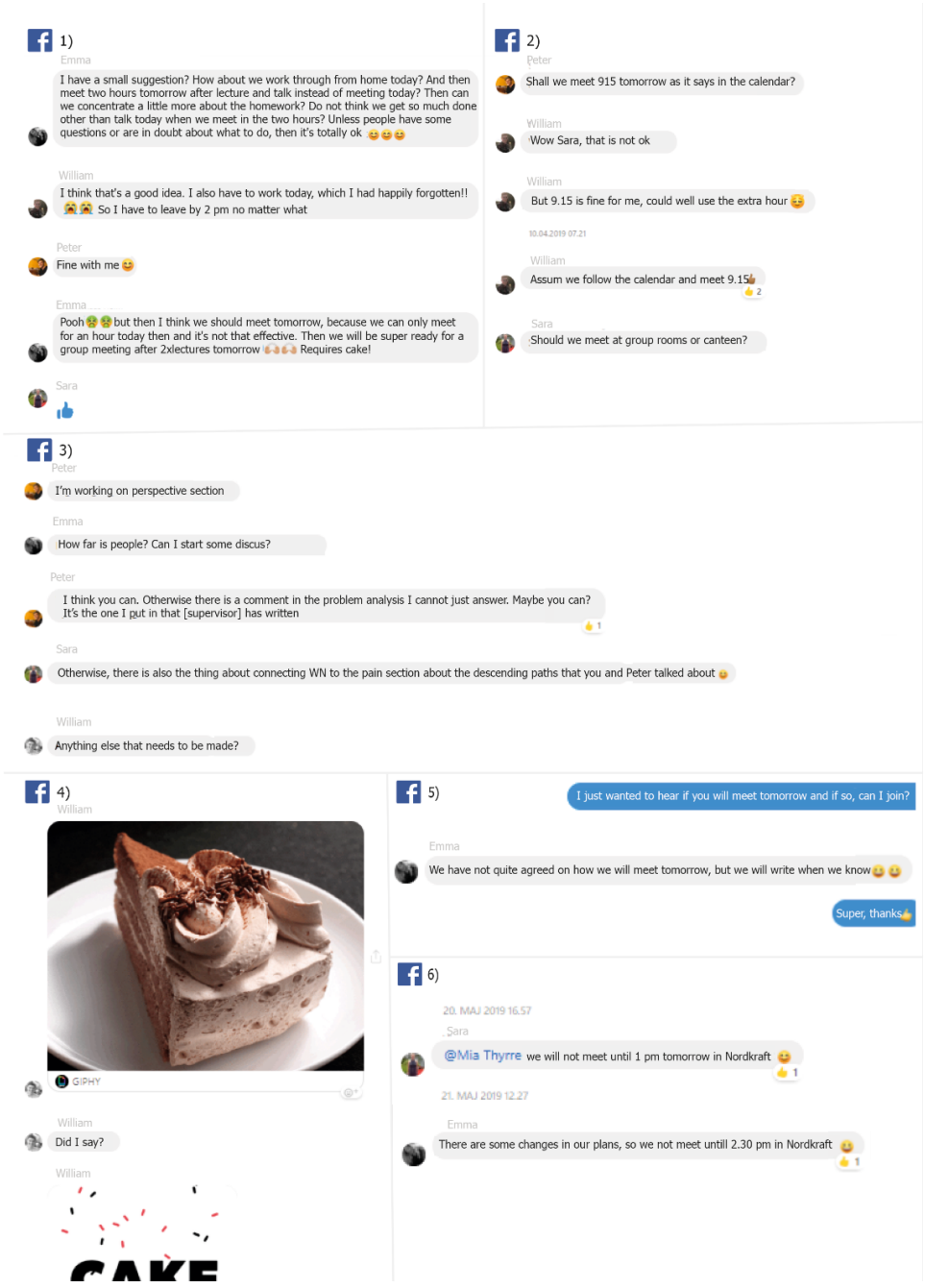


Figure 5-4 Segments of the Sports Science group's Facebook Messenger conversation

The group postpones a meeting for one and a half hours, just a half-hour before the agreed-upon meeting time (segment 6). When I meet with the group, they describe the day before as a 'cosy Monday' with much non-project social talk. The main reason for working from home in the forenoon was to avoid social talk and ensure concentration and productivity. When the meeting time approached, they agreed to use a bit more time for working at home before the meeting. The message in the group conversation regarding the changed meeting time was aimed at me. Before writing to me in the group conversation, they coordinated it in individual private messages.

Planning tools do not suit

The group from Sports Sciences plans things in stride. If they need a status on the project, they create a document with a to-do list and dispositions and identify the next steps in the process. Hereafter, the document has performed its function, and the students seldom reaccess it. If they have spent too much time on social talk, they plan a work-from-home day to ensure concentrated work. When a text section is nearly done, the group decides on dates and times for deadline and review. Deadlines are ongoing decisions and verbal agreements, not written down in any document. The writing process determines when deadlines are set, rather than the other way around, where deadlines are decisive or guide the writing process.

The day after cosy Monday, Sara and Peter talk about the group's approach to planning, responding to my question on their plans for the coming days. They explain their approach to planning based on the experience that plans do not hold;

Sara: We're not planning that long in this group.

Peter: It is because it often ends up not being so anyway.

Sara: There are a lot of unforeseen things.

Peter: Now it is the discussion, then we have to see what the next is. We plan to hand in something at some point, and then we have to make it happen.

The Sports Science group's approach to planning is far from project planning models and normative conceptions of organising or managing good project work. This is especially the case if it includes long-term plans, milestones, and deadlines. The students explain that planning tools, like back-casting and milestones, to which they have been introduced in a first-semester PBL course, do not suit their way of working. The project work seems less about following a plan and more about navigating the present.

5.3.2. CDM: PLANNING TOOLS AND INDIVIDUAL WORK PREFERENCES

The CDM project group uses Google Docs for text editing, Google Drive for file sharing, Google Calendar for scheduling, Trello (trello.com) for task management, Facebook for communication, and disciplinary software for, among others video editing. The CDM group is the only group among the eight participating groups to use a definite task management tool. This section takes a closer look at the group's use of Google Calendar and Trello.

While the two digital tools clarify and illustrate the group's plans and tasks, each member has a high degree of personal flexibility to choose where and when to work. Initially, the group had agreed on daily meetings, but this did not happen in practice. In return, through their organisation, they seek to meet the group's individual work preferences.

Digital planning tools

The CDM group makes use of a shared Google Calendar for “long-term planning”. The group has divided the project period into writing periods for the different report sections in the calendar, for instance, analysis, discussion, and conclusion. In addition, supervisor meetings, course exams, and private appointments, such as family-event and doctoral appointments, are written in the shared calendar.

Besides the shared calendar, the CDM group uses Trello to coordinate tasks. Trello is a virtual board for managing tasks inspired by a scrum board. Scrum is the agile project management method often used in software development; a scrum board clarifies and illustrates the project’s tasks, traditionally divided into a backlog (a complete to-do list for the current sprint), doing, and done. The CDM group has created four boards: to-do, doing, review, and done (Figure 5-5). Tasks are created in the form of cards and are placed and moved continuously between boards. They add responsible members, due dates, descriptions, files, checklists, and others to the cards. In the first and second semesters of the study programme, the project groups had dedicated tables and whiteboards functioning as dividing walls in an open study area. This semester, fourth- and sixth-semester students share an open study area and three adjacent meeting rooms. Following a first-served policy, the project groups can use the meeting rooms, tables, and whiteboard in the open area. There is no room for all groups to have a dedicated workspace, but finding an available table is rarely a problem. The CDM group explains that it uses Trello mainly because the group does not have a dedicated whiteboard this semester. With this, the Trello board stands forth as a digital and mobile replacement of the physical board on a permanent workspace.

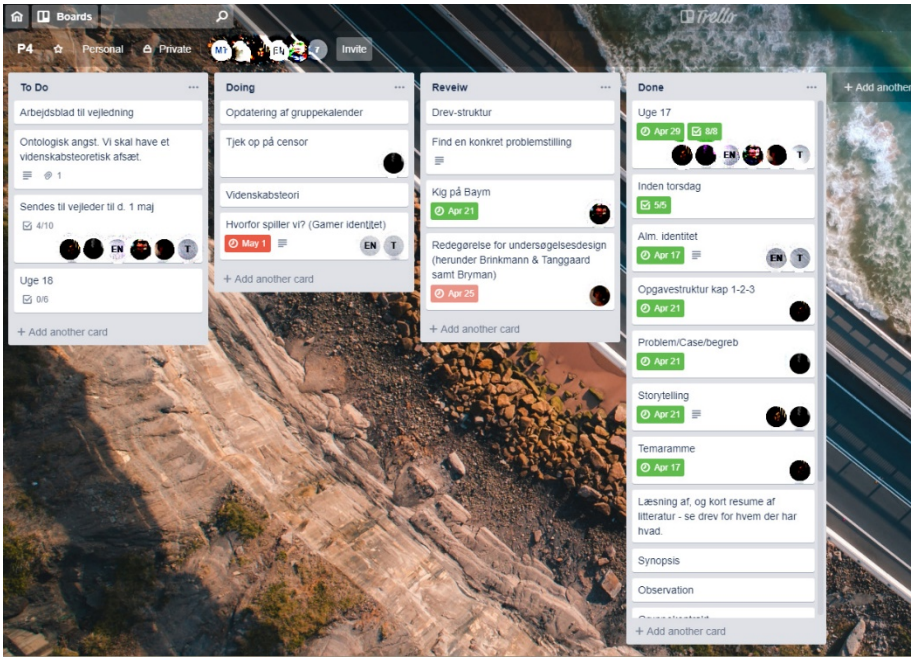


Figure 5-5 Screenshot of the CDM group's Trello board

The group members have differing levels of experience with Trello. Half of the group has no experience using it or similar tools; others have used dedicated task management platforms in previous semesters or have had the intention to do so. More of the members say that they have attached low priority to – or just forgot to update – the boards, which is why they dropped the tool after a short while in their previous project groups. These narratives confirm previous studies showing that students continuously incorporate new tools and drop other tools (Rongbutsri, 2017). Thus, from the beginning, the group has been aware that Trello requires continuous updating to not lose its value. During the semester, the group updates the board continuously – approximately weekly. According to the group, members take a look at the boards almost daily. They make significant revisions when they "need an overview". For instance, the group often updates the boards after a supervisor meeting. The CDM group creates tasks on an ongoing basis concurrently with the delegation of the tasks. In the beginning, it does this in the form of one task per card. Later, several cards contain a checklist of tasks, for example, tasks to achieve in a given week. The group members do not work with sprints or otherwise work with scrum, meeting types, or roles. The CDM group's use of Trello is an example of how a group is inspired by and selects from established systems, in this case, a project management method and a design of software, from which they build up their own systems and practices, adjusting continuously during the project period.

Individual work preferences

At the beginning of the project period, the CDM group aligns expectations and writes a group agreement contract for its collaboration. The group agreement in the group's shared Google Drive states, among other things, daily meetings as a general rule. Practice, however, has become another matter.

The members have various experiences from earlier semesters and different individual preferences for workspaces. Some are used to working from home and are more productive when they do so, while others are used to meeting daily at the university. For them, working at home is connected to displacement activity. In the organisation of the project work, the group tries to comply with the different preferences. When the group has no joint activities, it is up to the individual to choose their preferred workplace. The meeting frequency varies during the project period.

5.4. MEANINGS OF TECHNOLOGY

The situations described in the chapter corroborate that technology is a ubiquitous and entangled part of the students' collaborative practice. The situations and digital activities described in this section show how technology is applied and may afford both fluidity and structure in the project work.

I propose four categories of non-mutually exclusive meanings of the technology in project work:

- *Technology as place*: In Section 3.4.4.3, I described two kinds of digital appearances related to my experience of participation and access to the field. I characterise these appearances as a shared extension of space and individual work caves, which describe two ways in which the digital becomes or acts as a place or spherical element. In the two situations described in Section 5.1, the digital acts primarily as individual work caves. The students often move into their cave when they leave the joint conversation and invite other members into the cave for feedback or clarifying questions. Access to the cave can be through either separate computers (for example, by opening the same Docs document) or the same computer. In the situations described in Section 5.2, the technology functions primarily as a shared space expansion. For the Sports Science group, the document is a space for the correction process; members move among each other in the document represented by coloured censors; they almost dance without music when three members correct in the same text section without oral coordination. Likewise, in the CDM group, the document with meeting notes and the digital agenda act as an extension of the meeting room.
- *Technology as tools:* This category relates to the purpose and function of the technology; simply, for what purpose do the students apply technology? For example, Google Docs is a tool that students use to write. The Sports Science

group uses the university's digital booking system to book meeting rooms and a mail client to email the supervisor.

- *Technology as structure:* The students create structure through, among other things, technology. The students build up systems to support their practice (calendar document, to-do lists, table for summaries) and reify participation and decisions through technology (e.g., the CDM group's meeting notes). The students continuously adjust structures and practices through the project period. Sometimes, the adjustments are minor; other times, they are significant. Some technologies enable or afford certain types of structures. The manoeuvring space depends on the given technology; the manoeuvring space in Google Docs is relatively large, while it is smaller for Trello and Google Calendar. Some structures and practices are more permanent and appear as routines, while others are relatively ad-hoc. The CDM group's meeting structure with agenda and use of Trello are examples of routines and minor adjustments. The Sports Science group's to-do lists are examples of an ad-hoc structure built to meet situational needs, which has quickly served its purpose and can be dropped or broken down, after which new systems and structures are built for other occasions.
- *Technology as fluidity*; Technology enables a significant degree of flexibility and fluidity, among others, by enlarging the connectedness among group members. The almost continuous connectedness through Facebook Messenger enables the Sports Science group to reschedule appointments, make plans, change plans, and make decisions at the last minute. Technology is also increasing flexibility and the possibility of fluidity through the possibility of different types of spaces or presence in the project collaboration, between which it is easy to switch. I will return to this in the next chapter. The technology makes it easy 'to take a break' from the project, whether with deliberation or distraction, by directing attention to mobile or YouTube.

5.5. FLUIDITY AND STRUCTURE – SUMMARY

The distinction between fluidity and structure emerged from the different experiences of collaborative situations, where the group has an object of the activity and practice, which I found relatively straightforward to describe, and other situations, in which I found it challenging to describe or capture what was at stake or what was going on. As described in Section 5.2.3, I found that I could best describe it as fluid. The experience of fluidity sometimes made me reflect on whether the group had a good grasp on the project. Furthermore, it made me ask which elements were structuring the project work or deciding where the group flowed and how they approached it –in

Table 5-1 Fluid and structured collaboration situations

	Fluidity	Structure
Conversation *subjects and participants*	Conversation emerges out of the situation – subjects and participants change dynamically – flowing between social subjects and crucial project discussions.	The subjects and purposes of the conversation are planned and well-defined, for example, in a written meeting agenda.
	The group members join and leave the conversation with just a shift in attention between their laptops and the conversation.	The number of members participating in the conversation is given and often constant.
Activity and work constellation	Space and flexibility for alternating between tasks and work constellations. Implicit negotiation of 'where are we?' and 'where are we going?'	Activity and work constellation are well-defined. Explicit negotiation concerning project decisions. The decisions and participation are made plain and reified through i.e., technology
Atmosphere	Relaxed atmosphere. Members both distract and motivate each other.	Focused and object-oriented

Table 5-2 Fluid and structuring elements of project work in the Sport Science and CDM groups

	Fluid elements	Structuring elements
Sports Science group	Meeting space and time; changing plans with short notice	Review practice; comments, reading aloud, editing collaboratively
	Fluid boundaries between social talk and project-related discussions	Litterature.doc; readings and summary writing
	Verbal ongoing setting of deadlines	Calendar.doc; 'homework', working hours
		Supervisor meetings and feedback
CDM group	Fluid boundaries between social talk and project-related discussions	Group meetings; agenda, meeting notes
		Supervisor meetings
	Meeting space; when no joint activity, the individual can choose her/his preferred workspace	Calendar with deadlines and meetings
		Trello taskboard; task division, due dates, checklists

both structured and fluid situations. For instance, the distribution of tasks among the members stands forth as a structuring element in both fluid situations described in Section 5.1.

Tables 5-1 and 5-2 summarise the previous sections. Table 5-1 clarifies the difference between a fluid situation and a structured situation according to conversation subjects and participants, activity and work constellations, and atmosphere. Table 5-2 shows some of the elements identified as fluid and structuring in the Sports Science and CDM groups. Which elements appeared fluid and created structure varied between the participating project groups. In particular, whether groups had a fluid approach or structured approach to meeting frequency, meeting times, and work constellations varied. Examples include which types of practices were emerging as routines and which were of a more ad-hoc nature. Some structures recurred between the groups, including joint text review sessions, supervisor meetings and feedback, and the report structure. Also, every group had disciplinary methods and procedures guiding its project work. These immediate similarities between the groups involve differences in practice. For example, the report structure can help structure the process by a shared general understanding of which sections the project report includes, the order and interrelations between sections, or a detailed outline.

5.6. SUMMARY OF CHAPTER

- *Fluid and structured collaboration situations*: In the field, I experience fluid and structured collaboration situations. The two types of situations differ in, among other things, predictability and dynamics in conversation and work mode.
- *Fluid dynamics in conversation and work mode*: The conversation shifts in subjects and participants in fluid situations. The members join and leave the joint conversation(s) whose subjects are dynamically changing and most likely emerging at the moment. The conversation can flow into primary social and non-project-relevant conversations and essential discussions of crucial project issues.
- *Structured and outcome-focused collaboration situations*: In the structured situations, the conversation dynamic and work mode are (in advance) given by the activity. The practice appears well-defined – known by the group, often standing forth as routines.
- *Varieties in structured and fluid elements among groups:* I experience varieties among which elements stand as structuring and fluid in the participating group. Structural and fluid element relates to different types and degrees of reification and participation and different approaches to planning – which elements are planned and determined and which arise or are negotiated (explicitly or implicitly) in the situation.
- *Digital technology acting as place, tool, structure, and fluidity:* Technology acts as a *place*; the digital appearance seems like a shared space extension or

an individual work cave depending on the work mode. Technology acts as a *tool* for a specific purpose. The project groups use technology to build up *structures* and systems for project collaboration. Further, technology enables a significant degree of flexibility and *fluidity* by enlarging group members' connectedness and making it easy to change plans and break down and build up new structures.

- *Adjustment and development of practice and systems over time*: The project groups build systems and structures – possibly by adjusting known systems to their own practice – that are continuously developing and adjusting. Structures can have both permanent and temporary functions. What works for some groups may not suit others.
- *Project work builds on combinations of individual and shared experience and involves combinations of individual and shared practices:* In building collaborative practice, the students combine individual experiences from previous semesters. In this process, potential opposing individual preferences regarding workspace, work mode, and technology may be considered.

CHAPTER 6. HYBRID WORKSPACES

This chapter describes three selected collaborative situations, which, each in their way, tell about the students' hybrid collaborative practices and the construction of workplaces. The situations show different meetings between digital/physical and inside-/outside-university elements, and the importance of the construction of onsite and online workplaces for creating and maintaining social coherence

Initially, in a matrix, I introduce a model of four types of presence. These four types of presence help describe the various orchestrations of work modes, presence, and locations in and among project groups. Then follow descriptions and analysis of the three collaboration situations. First, the review session in Sociology group 1 shows the online and onsite become interwoven, and the Docs document becomes an extension of place. Next, the MP group, whose group room acts as a second home, uses a combination of analogue and digital tools in the design and elaboration of robot hardware. Finally, the virtual meeting in the Robotics group shows how the students move dynamically and smoothly between different digital platforms and work constellations. Two sections sum up the use of the matrix model and the hybrid meetings, identified in the analysis of the three collaborative situations, respectively.

6.1. FOUR FORMS OF PRESENCE

In this chapter, I distinguish between four forms of presence; 1) The group members are *co-located* and work *collaboratively*, 2) the group members are *co-located* and work *cooperatively*, 3) the group members are *distributed* and work *collaboratively*, and 4) the group members are *distributed* and work *cooperatively.* Figure 6-1 illustrates, in a matrix, the four presence types. Each type of presence provides different possibilities for relations between the digital and the physical. In Sections 3.4.4.2. and 5.4., I have argued that the work mode of the group affects the experience

The four types of presence are overarching categories; many other constellations are possible, overlapping and switching between these four presence types. Both previous and later descriptions of collaboration situations show that the students move more or less dynamically between the different types of presence due to the changes in work modes. The students can switch dynamically and smoothly between 1) and 2) and between 3) and 4), respectively (illustrated in Figure 6-1 by the vertical dotted line). Movement between 3) and 4) presupposes synchrony and a shared platform. Horizontal movement between 1) and 3) or 2) and 4) requires a location change (illustrated by a solid horizontal line). When the group works collaboratively, the members may create parallel individual workspaces by working parallelly in another document and catching a glimpse in an article or website. A member can invite other members into her or his cave, whereby the individual cave transforms into an expansion of space. Another constellation is yet that a part of the group is co-located

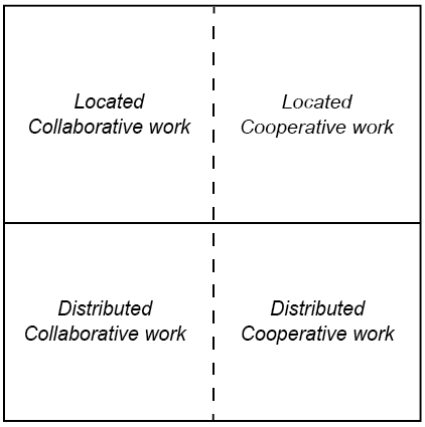


Figure 6-1 Four types of presence

while individual members participate online. Thereby, the matrix model both categorises and reduces potential constellations of space, time, and work modes. In the chapter, the model works as a tool helping denote the differences between various orchestrations.

6.2. S1: GOOGLE DOCS

The following section describes a weekly text reviewing session in the S1 group. The situation shows a digital appearance acting as an extension of space.

6.2.1. ANIMAL ICONS, COMMENTS, AND COLOUR CODES

Turning on laptops and opening the Google Docs document with the report text is the first thing that Anna, Phillipa, Frieda, and Emily do when they meet. It is the first step in preparing to review the text they have written since their last meeting. Review of text is an essential part of every meeting. For that reason, they are most of the time – if not all of the time – present and have shared attention in the same document.

The second step of the preparation is to ensure that no group members are represented as anonymous animals in the document. In the upper-right corner, user icons show who is present in the document. The user icon is either a picture, user-initials, or – if the user is not signed in, has the same document open in more than one tab, or other situations – an anonymous animal (e.g., an anonymous alligator, bat, fox, or hyena). A click on a user icon takes one to the location of the user cursor. It is an essential feature to ensure that they are talking about the same piece of text. Anonymous animals make the distinction of the representations of the group members, and thereby the navigation in the document, less immediate.

Today, the group meets at Phillipa's home; they sit around her dining table with their laptops. They are in the same document and are all represented by user initials. Now they are ready to start the meeting. Anna suggests that they write an agenda, and the others join in on the idea. Inside the document "homework", they quickly write an agenda containing three points; 1) review the method section, 2) how to code, and 3) calendar. It is my sixth visit, and it is the first time I have observed the group create a written agenda.

For observation, Line and I are sitting on Phillipa's sofa. We cannot see any of their screens, but we have followed the group into the Google Documents, the report document, and the homework document.

They start to review the method section. The previous evening, on Facebook Messenger, they agreed to read and comment on each other's newly written text sections before today's meeting. Different text colours make it easy to locate text sections written since the last meeting. Black means "old" text, while blue and red both mark "new" text. While the others use blue, Philippa marks new text with red; she thinks blue is too indistinct.

The group goes through the blue and red text sections from one end. Emily has not been able to read and comment before the meeting; therefore, they include reading time intervals between the review of the text section. The written comments make up the main structure of the review process. When they have found a solution to a comment-prompted issue, they quickly turn their attention to the following comment. The conversation changes quickly. Moving on without any protests seems to be an expression of acceptance. Sometimes, one brings up suggestions to changes not mentioned in the comment. After reviewing a text section, they change the text colour from blue/red to black. In this way, black becomes equivalent to "approved by the group".

The four group members move back and forth in the document. They follow each other using the user icons. Comments such as "Click on me" refer to the user icons. The question "Where are you" refers to the cursor's position and is responded to by a "Here I am" and a markering of a text paraph. The written comments are an integrated part of the group conversation, almost equal to verbal comments. The text writer's spoken response to a written comment often marks the movement from one comment to another. Though the comment has just been read, the response formulation gives the perception that it might as well have been spoken.

Concurrently with text corrections, the group members continuously talk about potential additions and other tasks they must do. Some of the tasks are noted in comments in the document, while others remain oral. After a while, Frieda suggests that they write the tasks in the homework document. The group follows Frieda's

request. Again, some of the previously discussed tasks – presumably, the most important ones – are noted, while others are not.

During the otherwise focused review session, the group takes short small talk breaks chatting about the wall-decoration, travelling and the oat milk on the table (for the coffee). The layout of the apartment, especially the wall decorations, indicates that Phillipa travelled a lot before she started her university studies.

6.2.2. SPOKEN MEETS WRITTEN, PROJECT WORK MEETS VISITING WITH FRIENDS

The group talks about their presence in the document as if it were a place. The cursor appears as a bodily extension or a simple form of an avatar. The icons in the right corner become a kind of teleport, and marking a text and waving arms can draw attention to one's presence and position, either digitally or physically. Comments, written in preparation for the meeting the day before, and comments spoken at the present meeting, constitute a 'hybrid' conversation. Inside-university meets outside-university in the choice of meeting space. Visiting with a friend (drinking coffee with oat milk while chatting about travelling) interferes with university project work and creates a 'cosy' working atmosphere. In the review session, online meets onsite, spoken meets written, the meeting context meets the preparation context, and inside-university meets outside-university.

Outside- and inside-university relate to the distinction often made on analytic and system levels between school and everyday life. Whether the distinction between school (university) and everyday life is meaningful can be questioned from a student's perspective. The meeting between outside- and inside-university, friend visiting and project work, and related meetings, identified in the two following sections, indicate that these elements cannot be considered dichotomies, but rather that the boundaries in between often become blurred.

When the S1 group meets weekly, they are physically located and work collaboratively; they are in the first quadrant in Figure 6-1. The rest of the time, they are in the fourth quadrant, working individually and asynchronously from home. In the group's orchestration of time, space, and work modes, the collaborative and cooperative work modes are divided; they do individual 'homework' at home (cooperative work) and work closely together at the weekly meetings (collaborative mode). This contrasts with other types of orchestration of togetherness, such as the MP meeting every day in the group room.

6.3. MP: THE GROUP ROOM

The group room is not a static container within the individual student makes the project work, but instead is a dynamic entity produced by social and material

interactions (Fenwick et al., 2012, p. 129). The following story about the MP group's room layout concerns how a project group redesigns and reconstructs the university's learning environment and how this placemaking process and the project collaboration generally involve combination and transition between analogue and digital technologies.

6.3.1. A SECOND HOME

During my fieldwork, the MP group's room changed slightly in arrangement for every visit, either through the acquisition of new items or furnishings. The group shares the room with another project group. The room is divided into two group rooms by a blackboard and a whiteboard, both on wheels. The room is lockable such that only the members of the two groups and relevant staff (e.g., cleaners) have access. A student lunchroom with a kitchen, several refrigerators, tables for eating lunch, and a pool table are down the hall. The two project groups seem to use this area to a limited extent. Each group has invested in a second-hand refrigerator, and the members often have lunch in the group room.

The MP group's workplace consists of four tables assembled into a shared table. Felix and Jack have both brought desktop displays; they work consistently with extended desktops. Benjamin often brings his laptop and tablet to work with extended desktops as well. Kate works on one screen on her laptop, a 'gamer' model with good processing power and graphics. The study requires them to work with various computation and 3D modelling software. Most of the software they acquire by themselves – perhaps with help from fellow students. They do not receive any specific instructions but are expected to apply the software for problem-solving in both courses and projects.

On our second visit, the MP group offers us coffee brewed in its new second-hand industrial coffee maker, a shared investment with the neighbouring group. We politely refuse the coffee. Some of the members make themselves a cup; the maker is quite noisy when brewing. On the third visit, the groups have added a stereo to the facilities of the group room. On the fourth visit, the groups have conducted what could be called a makeover of the group room – they have rearranged the tables. Before, all the group members sat sideways to the door; now, Kate and Benjamin sit with their backs to the door, while Felix and Jack sit facing the door, hidden behind their desktop displays. The four tables stand two by two in the neighbouring group room; with stationary screens back to back, the rearrangement reflects associations with an open office environment. The two refrigerators stand on top of each other, and next to them, on a low shelf, the coffee maker stands next to two bottles of liquor and a small bottle of coffee syrup. It almost constitutes a minibar. The room is cluttered; there is a plastic bag overflowing with deposit bottles in the corner. The students say that the cleaning lady has called it a messy teenage room.

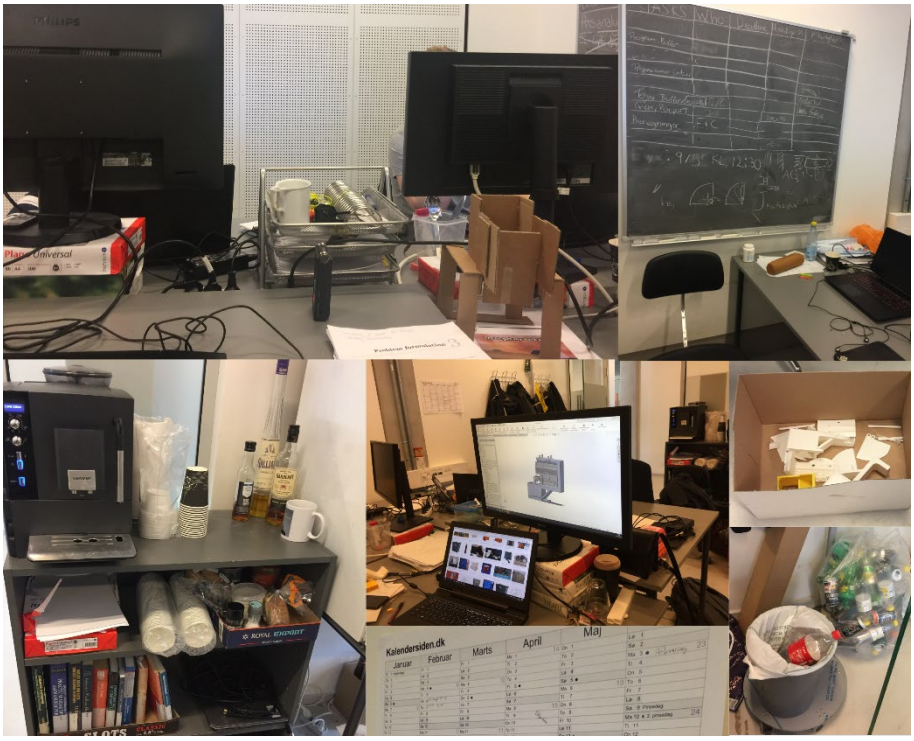


Figure 6-2 The group room of the MP group

When some of the students are in the room, the door is open. Only when one of the groups has a supervisor meeting is the door closed, to avoid unnecessary disturbances. As a general rule, the students meet every day from 9 am to 4 pm, with this schedule changing only due to lectures. Some days, the group or individual members stay longer. On other days, individual members meet later or leave earlier due to personal appointments. Then, they work at other times, in the evenings or on weekends. According to the project group, they almost live in the group room – at least they spend more hours in the room than they do at home.

On a wall-hanging blackboard, the group has made a task table with the columns; 'Task', 'Who', 'Finish %', and 'Missing'. The group writes its report in English, which rubs off into the list of tasks, written in a mixture of English and Danish. The board is more or less full of tasks; however, the table is rarely filled out with deadlines or responsible members. While the board changes from week to week, the conversation with the students indicates that the board is outdated and rarely updated. It changes in the last part of the project period, when the group updates the board daily. Most tasks – whether writing, design, or lab tasks – are distributed individually. The group members regularly read each other's text and write comments, while the final joint correction process occurs at the end of the project period. Being together in

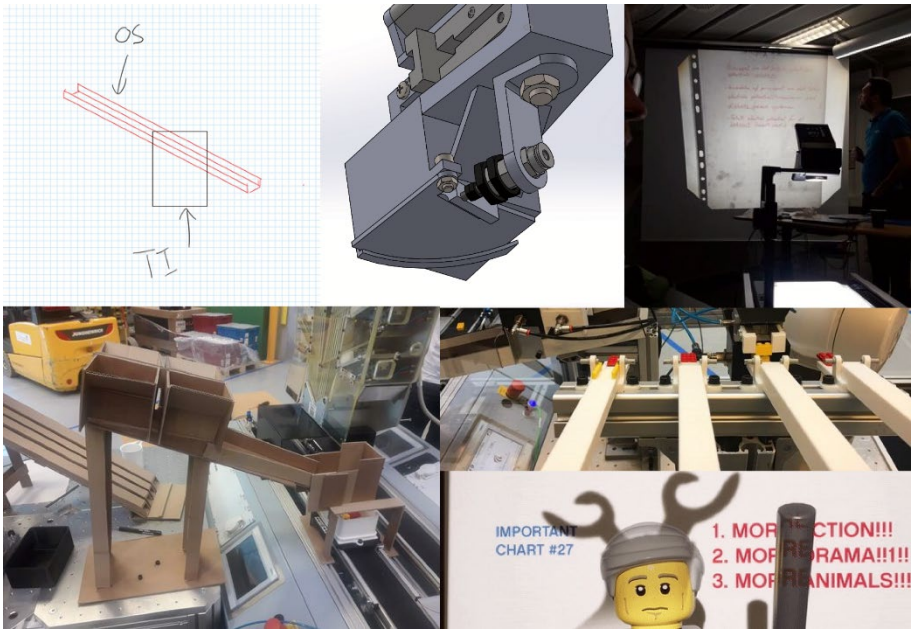


Figure 6-3 Shared in the MP group's Facebook Messenger conversation: (from top-left) photo of a drawing, 3D model, photo from lecture, photos from the lab, and a Lego meme

the group room means that they can quickly seek advice from each other. The boards constituting a wall stand forth as a crucial tool for drawing and illustration during discussions of different designs. The students say that they could not do without or imagine not having the boards available – for example, if they worked together online.

On a wall-hanging paper calendar, the group has noted dates for course exams. Early in the project period, they wrote deadlines for report sections in a document in OneNote. However, they do not adjust dates or seem to look in this document; the deadlines appear to be at the back of their minds.

The project group is designing hardware for the robot, which the project group from Robotics is programming. The robot should move and pack Lego bricks. The group makes digital 3D models, physical models in cardboard, and 3D printed models. In the room are models both in cardboard and printed in white plastic. The models result in actual robot hardware. This is not the case for all projects; some semester projects result 'only' in digital models. The prospect of designing hardware becoming physical or 'reality' was decisive in the group's choice of project.

Most models stand in the laboratory located in another building, a five-minute walk from the group room. Communication between the laboratory and group room occurs in the joint Facebook conversation, where the members also share photos, videos of models, and 3D models, among others (Figure 6-3).

On the group room table are Lego bricks. Jack says that Lego bricks are lying on his kitchen table at home. All members have taken home a few Lego bricks. Although they have measured the dimensions of the bricks to many decimal places, having the physical bricks at hand makes it easier for them to visualize and assess whether or not the calculations will fit.

6.3.2. STUDY MEETS LIVING, NEW MEETS OLD, DIGITAL MEETS ANALOGUE

Much literature concerns descriptive models for designing learning spaces, compared to the smaller amount on how teachers and students co-construct learning spaces (Ellis & Goodyear, 2016; Goodyear, 2020). Ellis and Goodyear (2016) point out the importance of a student perspective on learning space and demand an observation of:

> […]how they [students] move in, inhabit and reconfigure space, how they create congenial learning places, how they assemble tools and other artefacts in their work as students (p. 181)

The above description of the MP group's room is an example of how students *move in, inhabit, and reconfigure* space that the university provides. The group room is more than just a space with a table, chairs, and Wi-Fi connection where the MP group can bring their laptops to work. Together with the neighbouring group, the MP group gradually moves into the group room by bringing various items and rearranging tables. Reverse Sociology group 1 brings its study and project work into a domestic setting, while the MP group brings 'home' into the university learning setting. In the group room, a meeting room/office meets a teenage room/dorm room. The stereo, coffee liqueur, empty soda bottles, clutter, and open door, ensuring connection and interaction with fellow students/friends, are all associated with a dorm and socialising. The MP students' description of almost living in the group room captures the sense of student life and social life merging in the group room

The above story about the MP group's construction of a group workspace is also an example of *how students assemble tools and other artefacts in their work* (Ellis & Goodyear, 2016). Laptops (with various 3D modelling and calculation software), desktop monitors, boards, paper calendars, Lego bricks, and models in cardboard and plastic all constitute assemblages of tools and entanglements of digital and analogue elements. Sharing on Facebook, among other things, digital 3D drawings, photos of hand drawings, pictures, and videos of physical models confirms this. In doing their project planning, the MP group uses a combination of digital documents, a paper calendar, and a blackboard, as an example of PBL project work involving orchestrating multiple technologies (Ryberg, Davidsen, et al., 2018). The constellations of technologies combine analogue and digital technologies and so-called old/low-tech and new/high-tech. For example, the MP group first builds a cardboard model ('old') and then prints a similar model in plastic using a 3D printer ('new'). Furthermore, students use relatively advanced calculation software and

afterwards use an old-school Lego brick to assess the accuracy of the calculations. Another example is the overhead projector used for a lecture shared in the group's Facebook Messenger conversation (Figure 6-3).

In an analysis of students' collaborative design work, Bernhard et al. (2020) show that students use a combination of low-tech and high-tech. Opting out of high-tech for low-tech is not a matter of lack of technical skills; the students apply the technologies in interaction according to what they find most beneficial. Bernhard et al. (2020) point out that "by hand" and "by computer" cannot be understood as dichotomies;

> Engineering students are trained to work "by hand" *and* "by computer" and that it is not a question of "by hand" *or* "by computer" (p. 568)

They warn against a too one-sided focus on digital education and digital technology and call for a post-digital perspective on education; "the digital makes up part of an integrated totality"(Fawns (2019) cited in Bernhard et al. (2020)).

The MP group living in the group room represents another constellation of togetherness and presence; they work mainly cooperatively (second quadrant – Figure 6-1) but make collaborative discussions when needed (first quadrant). The collaboration often involves coordinating tasks or disciplinary discussion of calculations or hardware design in which both digital and physical models and boards are crucial tools.

6.4. ROBOTICS: DISCORD

The following section describes one of the last days before the Robotics group hands in its report. The members work from home, talk, and chat through Discord and co-write by applying Overleaf and Google Docs. The Discord platform consists of text and voice channels; which and how many voice channels they use depends on the current work constellation. If they work individually, they are all muted. When the group works in pairs, the group members are divided between two voice channels, while they can gather in the same voice channel when all four members have to work together.

The group writes the project report in Overleaf (overleaf.com), a web-based LaTeX editor for collaborative writing. LaTeX is a document preparation system in which the user uses plain text and codes to format the text. Additionally, the group shares files in a Google Drive folder, including documents, pictures, videos, models, PDF files with software and hardware manuals, and programming files.

The Robotics group manages its project work inspired by scrum with a short daily meeting at 9 pm to provide a status update on yesterday's work ("Does anything cause problems?") and plan for the day’s work (“What do we work on?”). They have defined

sprints and subgoals for the design process. This is the first time they have used scrum. According to the group, scrum has several similarities with their usual way of of doing project work, including contentious status and frequent coordination.

6.4.1. ONLINE MEETING, A FEW DAYS BEFORE HANDING IN THE REPORT

Coordinating the day's work

I log in to Discord around 9 am to listen to the daily scrum meeting in the Robotics group. The four members are online, talking together on the main voice channel. They briefly pick up on a video. In the text channel "#general", I notice that the last message is about a video of the robot. It was written about midnight. Afterwards, the members talk about the plan for the day. Concurrently, they orient themselves in the Google sheet document "Trello-log". The name is inspired by the task management tool, which they have applied for a previous project. "Trello-log" works as a scrum board with the following categories: task, who is working on it, expected finish, progress, and priority (Figure 6-4). They have divided the progress into three levels – working, review, and done – to which they have each assigned their colour. They plan to split up in pairs; Oliver and Jasper review sections while Adam and Stephen write the abstract.

The Robotics group has worked from home the last eight days – almost continuously connected through Discord. The deadline for handing in the project report is four days away. They plan to finish the project today and participate in Saturday's carnival.

"Why does oatmeal get so damn smashed after 20 minutes." Adam's comment and the sound of a spoon on a plate indicate that he is getting oatmeal for breakfast. The conversation continues without any further comments on Adam's breakfast. Then, I hear a bus; I look out the window, though I know it is outside one of the students' windows, not mine.

After 10 minutes of summarising and coordination, Oliver and Jasper switch from the voice channel "Elven Kingdom" to "Elven Village". "The Lord of the Rings" inspires both server and voice channel names and the aliases of the group members. The group has named its Discord server "Elven Bachelor War" and the four voice channels are "Elven Kingdom", "Elven Village", "Elven Prison", and "Elven Dungeon". My alias, 'Human Mia', given by the group, also matches the fantasy universe.

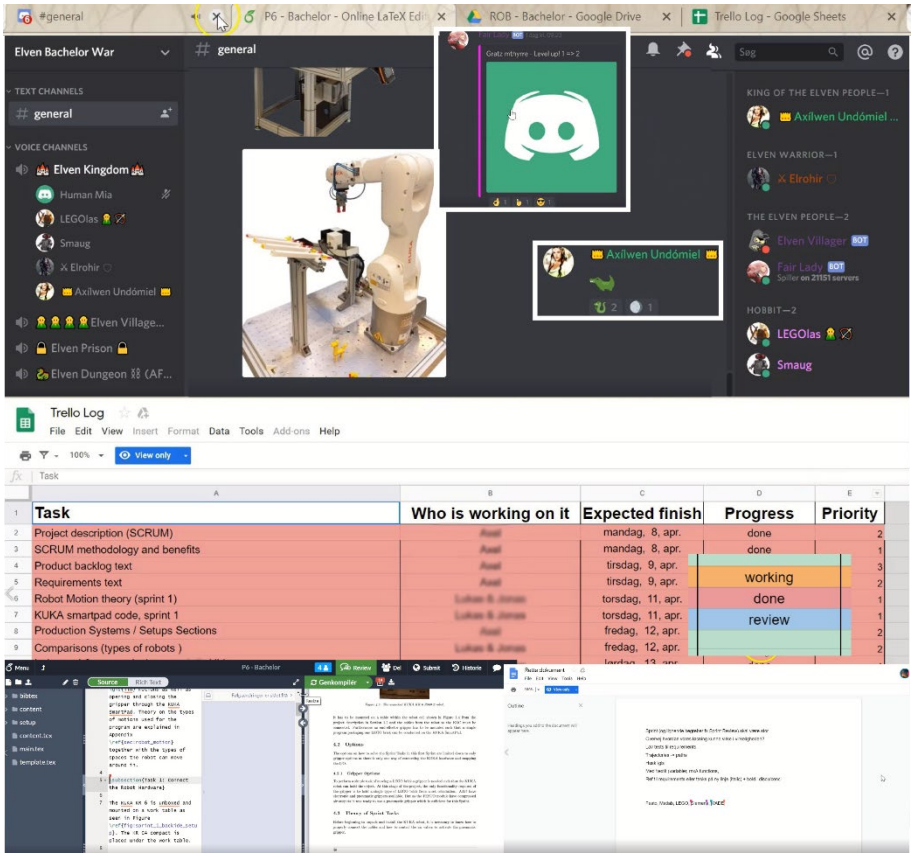


Figure 6-4 Discord meeting in the Robotics group. We shift between the tabs; Discord, Google Sheet, Overleaf, and Google Docs.

Human Mia reaches level 2

"Now, we are going to be quiet," Adam says. I interpret the comment as indicating that he and Stephen initially will work on separate tasks and mute their microphones. Adam suggests that I follow Oliver and Jasper. I answer, but I am muted; instead, I write in the text channel. After sending the message, the bot 'Fair Lady' writes me; I have reached level 2. Adam congratulates me, and later, I see that the other members have responded with emojis.

In the Elven Village

In the Elven Village, Oliver and Jasper talk about a text section, and I go to the Overleaf tab. By clicking on the user icon, I find Oliver and Jasper's cursors in the conclusion chapter.

After a few corrections in the conclusion chapter, they move on to another section. The section consists of many subsections with subheadings. Abbreviations of

disciplinary terms and names of companies make the text appear to have many words in block letters. Jasper thinks it looks strange and disturbs the reading. They agree to make some rules for using abbreviations. They move into a Docs document, "correct.doc", containing a few rules written down for alignment of report text; they write some general rules for abbreviations and agree to discuss the rules with the two other group members. I accompany them to the Elven Kingdom.

In the Elven Kingdom
Stephen and Adam talk when we 'arrive'. Jasper and Oliver explain the problem: The abbreviations interfere with readability, and they must agree on guiding rules for abbreviations. Jasper and Oliver invite the others into the "correct.doc". The four members go to the document, where they jointly make a few additions

Back in the Elven Village
After a short while, there is quiet in the Kingdom. This indicates that Jasper and Oliver have moved back to the village, while Adam and Stephen have muted their sound. I switch the voice channel and click on the Overleaf tab. Oliver speaks the most, while Jasper has the primary lead on adding and editing the text. The keypad sound from Jasper's writing is loud. He asks: "Is my keypad noisy?" Jasper has no microphone for his desktop computer and uses his laptop for sound. "Yes, but I am used to it," Oliver replies. Jasper tries to lengthen the distance between the laptop and the keyboard a bit. I doubt whether it makes any difference.

Crocodile, Adam arrives
After a while, I hear a beep and Adam's voice; he has switched the voice channel to the Village to ask a question: "Do you write the missing introductions?"

"You said we shouldn't," Oliver replies, and Adam leaves the Village.

I click over in the Discord tab; Adam has shared a crocodile emoji in the text channel. It was probably the reason for the beep sound. I interpret it as a 'here I come' emoji. The others respond, two with crocodile-like seahorses and one moon. Discord seems foreign to me.

6.4.2. PROFESSIONAL MEETS PRIVATE, PROJECT GROUP MEETS GAMING COMMUNITY

Whether the Robotics group works located or distributed, separately from home, depends on the day's activities. Often, they decide the day before. If they will be programming the robot, they go to the laboratory. They meet in the group room in the event of lectures or meetings with the supervisor or others, or on days when laboratory and writing activities are combined. When a whole day is devoted to writing, like the situation described above, the group prefers to work from home through Discord. They describe a comfortable workplace and increased effectiveness as two primary reasons for working from home through Discord. All four group members have desktop computers with a wired internet connection, desktop displays, and a gaming chair at home. In addition, the group finds that the amount of social conversations decreases when they are distributed compared to when they are co-located.

Like the choice of meeting space, the work constellation and modes depend on the day and the activity. This is the case both when they are co-located and when they are connected through Discord. In the orchestration of time, space, and work modes, the Robotics group makes use of all four quadrants in Figure 6.1; they move smoothly between the first and the second and between the third and the fourth, respectively, due to shifts in work constellation between working as individuals, as pairs, and with all four members together. The day in Discord, described above, shows how the group dynamically shifts between the work constellation (third and fourth quadrants) by changing voice channels and microphone settings. Other days, they work mostly individually on different report sections, and the microphones are primarily disabled.

Besides dynamically shifting between work constellations and work modes, the Robotics group moves dynamically and smoothly between various platforms. The group applies various technologies to support its studies and PBL collaboration. This includes the technologies in play: Discord, Google Docs, Google Sheets, Google Drive, and Overleaf. In addition, the group uses disciplinary software for calculation and robot programming, Facebook Messenger (internally in the group and with the MP group), MS Teams (communication platform for the large cooperation project with several external partners, of which their semester project is a part), the student mail, and Moodle (LMS used primarily for course materials and schedules). The technologies are a combination provided by the university, third parties, and students (Ellis & Goodyear, 2016). The situation described above shows that these technologies are not seen and understood as a collection of separate tools; they function in a media ecology (Ito et al., 2010) and the technologies are in a dynamic relationship constituting an arena for the use of media. The orchestration of technology cannot be reduced to ‘what to choose from the toolbox’; instead, it is part of a complex interplay between different technologies, times, places, activities, and work constellations. It includes combinations of digital/analogue and new/old

technologies, conferring the description of the MP group room described in Section 6.3.1.

The orchestration of multiple technologies implies negotiations of which, for what, when, and how the technologies are used and the interplay between the technologies. As described in Chapter 5, the negotiations and practices on experiences acquired together and separately, in, among other places, previous and current semester projects and orchestration of the multiple – digital and analogue – technologies are continuously negotiated and adjusted. The Robotics group tells me about some considerations and everyday reasonings related to these negotiations. This includes the relation and interaction between the two text editors, Overleaf and Google Docs; the situation varies regarding whether the group members write report sections directly in Overleaf or write the first draft in Google Docs. They experience Google Docs as being especially useful when they are working in pairs for a writing task; for instance, sharing pictures is quicker in Google Docs than in Overleaf. Also, parts of the text are marked with different colours in a Docs document; two members invented colour codes for a specific writing session. The group writes an extended version in Docs with more explanatory text than the final report text for some report sections. These are for group members who have not been involved in the writing. The relation and interaction between the communication platforms also imply considerations about recipients and professionalism. The group describes Discord and Facebook as 'more private' platforms than mail and MS Teams, which are 'more professional'; in student mail and MS Teams, you do not write 'stupid things', the students explain.

When the Robotics group is distributed at each workplace at home, working on the project while connected through Discord, they move smoothly and with a high degree of shared understanding across platforms and work constellations. Following the group by clicking around among the different browser tabs and voice channels gives me the impression of the digital as a place. The group's naming of voice channels as places in The Lord of the Rings universe only enhances this experience. In the situation, the different contexts meet in which the four group members and I are located. However, unlike Sociology group 1, which is co-located and for which digital becomes almost an extension of physical spaces, the digital appears more like a place (or world) of its own. Background sounds of buses, the amplified sound of fingers on a keyboard, and the sounds of a spoon against a plate provide fragments of the context in which the group members are located.

In addition to the different situated contexts which meet in the online meeting, the situation can further be interpreted as meetings between other elements. Using the adjectives by which the group categorises communication platforms, professional and private meet in the situation – both in the combination of platforms and in the roles and relations of friends and professional partners. Choosing Discord and constructing the server as a Lord of the Rings universe also creates a meeting between the project group and the gamer community. The four members first knew and applied the

platform for gaming but have found it useful for project work. They have brought the platform from a personal and informal arena to a more formal educational context and, with this, ways of being together and communicating. Participation in the community, which the project group constitutes, is defined by interests and a sense of belonging beyond the individual semester project and the study programme.

6.5. THE FOUR TYPES OF PRESENCE – SUMMARY

The matrix in Figure 6-1 distinguishes between different orchestrations of the PBL project work concerning time, place, and work modes. The four quadrants represent different possibilities for interaction between digital/online and analogue/onsite elements. The three collaborative situations in this chapter are examples of the different constellations of time, place, and work. In the first situation, Sociology group 1 is co-located and works collaboratively (first quadrant). The MP group's room is where members are most often co-located and work primarily cooperatively (second quadrant). In the last situation described, the Robotics group connected through the Discord platform works primarily collaboratively and distributed (third quadrant). The orchestration concerns choice of meeting space, meeting time, and division of labour, work modes, and movement between and orchestration of different constellations. This is revealed in the differences between Sociology group 1 and the Robotics group. Sociology group 1 divides collaborative and cooperative work modes in time and place (Section 6.3.2). In contrast, the Robotics group moves dynamically and smoothly between cooperative and collaborative work modes due to the given activity (Section 6.5.2).

The fourth quadrant, indicating the group members distributed and working cooperatively, is not represented in the chapter. In these studies, the focus has been on following the groups and not directly on how the group members work individually on the project when they are not with the group. However, the studies indicate diversity in the degree and type of communication – how the students orchestrate to "work together apart". Some groups' mediated communication is primarily coordinating and logistical; other groups communicate about “everything”. In the fourth quadrant, personal freedom and flexibility often follow the individual member to choose where and when to work. How the students are together apart reflects a perception of the connection between study life and leisure. In some groups, it merges; MP 'lives' in the group room, and S3 communicates about the project (and other issues) from the gym and the couch in the evening, on workdays, and on weekends. In other groups, leisure and study life seem more separate – for example, the S1 group emphasises the individual freedom to decide work hours, and the S2 group likes to keep weekends free. Across these differences, the social platforms, notably Facebook Messenger, assume a crucial role in the groups' orchestration of working together individually, as a space for both informal – project-related and social – communication and almost constant connectedness.

6.6. CONSTRUCTING HYBRID WORKSPACES – SUMMARY

In the three collaborative situations described in this chapter, I have identified different meetings between different elements. These meetings come together primarily into two categories: the meeting between digital/online and analogue/onsite (spoken/written, new/old, digital/analogue) and the meeting between inside- and outside-university (project work/friend visiting, study/living, meeting room/dorm room, formal/informal, friendship/professional partnership, project group/gamer community).

In addition to these two categories, the meetings identified in the three situations relate primarily to three aspects:

- *Orchestration of multiple tools:* Project work involving both digital and analogue tools in interplay is shown in particular in the description of the MP group's interplay between boards, documents, cardboard models, and digital 3D models, which they later print and transform into plastic.

- *Meeting between physical and digital spaces:* In Section 5.4, I argued that technology changes our experience of place. The three situations show how different digital and physical locations meet in the student project work. This is particularly evident in the Robotics group's online meeting, which moves across members' physical locations and several different digital platforms. Also, the review session in Sociology group 1 shows a change in the experience of place: here, the physical presence appears entangled with members' presence in Google Docs.

- *Meetings between roles and contexts:* In the students' project work, roles and contexts meet. This is shown in Sociology group 1's review session, where project work meets friend visiting, and in the Robotics group's online meeting, where project group meets gaming community. The meeting between contexts is not only something arising; it is part of the construction of workspace in the project groups. This is apparent, among other times, when Sociology group 1 brings project work into a domestic setting and when the MP group brings 'home' into an institutional university learning setting. The meeting between roles and contexts gives rise to ongoing negotiations of relationships and ways of being together. The relationship can be considered a balance between friendship and professional partnership. Concerning this balance, the construction of the workplace appears as a central aspect to create and maintain group sociability.

In the project work, the students have the autonomy to define and redefine the boundaries between digital/online and analogue/onsite and between inside- and outside-university. Negotiating and defining the digital/analogue and inside-/outside-

university boundaries are essential in constructing workspace and in orchestrating time, place, technology, and work modes.

6.7. SUMMARY OF CHAPTER

- *Construction of workspace is a crucial part of working together*: The chapter shows different workplace constructions and argues that the construction of workspaces is a central part of working together. The choice and construction of workplaces enable different constellations of practice and stand forth as a central element in defining the relationship between members and creating and maintaining sociability in the group.
- *A matrix presents four types of presence:* The four types of presence – co-located-collaborative, co-located-cooperative, distributed-collaborative, and distributed-cooperative (synchronous or asynchronous) – provide different possibilities for various time, place, technology, and work constellations and interrelations between the digital/online and the analogue/onsite. The matrix of the four types of presence classifies the numerous possible constellations and works to denote differences between orchestrations.
- *Meetings between onsite/analogue and online/digital elements and between inside- and outside-university elements:* Through the chapter, I identify various meetings in the student project collaboration. These meetings fall into two categories: meetings between digital/online and analogue/onsite elements and between inside- and outside-university elements.
- *The project groups orchestrate multiple technologies:* Students combine and orchestrate digital and analogue technologies in their project work. The choice of low-tech and high-tech is rarely a matter of technical skills, but most of all what students find most beneficial. Digital and analogue tools work interactively and cannot be considered a dichotomy.
- *Physical and digital spaces meet and interact in student project collaboration:* The students work across different digital and physical spaces. The chapter shows situations in which multiple physical and digital spaces meet in an online meeting and how physical presence intertwines with digital presence for a colocated group meeting.
- *Roles and contexts meet in the student project collaboration*: The meeting between roles and contexts gives rise to ongoing negotiations of relationships and ways of being together. The relationship can be considered a balance between friendship and professional partnership.

CHAPTER 7. SIX DIMENSIONS OF GROUP WORK

This chapter proposes six dimensions of group work. By the dimensions, I intend to conceptually describe the orchestration of student PBL collaboration, including the diversity and dynamic in and among project groups. The six dimensions are grounded in the data. In the following, I argue for the dimension based primarily on examples from the previous chapters.

7.1. SOCIAL – ACADEMIC

During the studies, the social and academic stand forth as a balance, which the students are aware of and orchestrate in various ways. Sociology group 3 balances the dimension by clearly distinguishing between project time and friend time (Section 4.3). The Sports Science group chooses to work from home to ensure productivity, after a day with much social talk and less productivity (Section 5.3.1). The Robotics group finds it more productive to write at home connected via Discord, as they engage in less social talk this way compared to onsite meetings (Section 6.4.2). These strategies emphasise social talk as being something to reduce because it disturbs or steals time from productive and focused academic project work.

From a reverse perspective, the students prioritise and take time for social conversation, social activities, and events. More students state that the social elements and interpersonal relationships between group members are essential and motivating factors. Sociology group 3 expresses that project work without the social dimension will become demotivating and laborious (Section 4.3). Also, in group formation, the interpersonal relationship stands forth as critical. Most of the participating groups have collaborated in previous semesters. The Sports Science group forms before deciding the problem or topic for the project; the interpersonal relationship and the collaboration running smoothly seem to be of a higher priority than academic interests. Sociology group 2 finds that previous collaboration and knowing each other well are advantageous because they know each other's academic strengths, and just as important, they have a safe collaborative relationship (Section 4.2). Several groups describe cosiness as being a factor in the choice of meeting place, which is supported by the importance of access to coffee and sweets

The students' PBL collaboration involves balancing social and academic elements, which also shows in the distinction of fluidity and structure, described in Chapter 5, and the project groups' construction of workspaces, described in Chapter 6.

The distinction between fluidity and structure reflects various orchestrations of the social – academic balance. A significant difference between the structured and fluid collaboration situation is the transitions and dividing lines between social and academic conversation. In the conversation, the difference is whether social and professional subjects flow or are markedly divided, for instance, by timeslots for meeting and breaks.

In the students' construction of the workplace, the balance and interplay between social and academic elements show in the meeting between contexts and roles and in the meetings between outside- and inside-university. The relationship between members is a field of tension and an interweaving between friendship and partnership, consolidating in the meetings between project work and friend visiting, between the project group and gamer community, and in the construction of workplace, where students bring project work to a domestic context and “home” to an institutional learning context.

7.2. PBL COLLABORATION – PBL COOPERATION

The PBL collaboration – PBL cooperation dimension implies the project group’s orchestration of work constellations and modes. It is inspired by the distinction between collaboration and cooperation, described by Dillenbourg (1999), involving different task divisions and interdependencies, group negotiations, and synchronicity (see Section 2.3.2). The field study shows a marked variation in the project groups’ work division and orchestration of work constellations. The diversity in labour division in the three Sociology groups markedly shows (Section 4.4): Members of the S1 group write all report sections individually, members of the S2 group write in pairs, and in the S3 group, the specific writing task determines whether writing is done individually or as a group. The considerations of work constellations include types of activities and working preferences. Additionally, it is a weighting or balancing of effectiveness and productivity on the one hand and text coherence and group synchronicity on the other. While it is more efficient to divide tasks between individuals, the project report is a shared product that everyone must vouch for and that must stand forth as a whole.

The project groups orchestrate coordination, cooperation, and collaboration in different ways. Sometimes, groups separate the cooperative and collaborative modes; for example, S1’s members write at home (cooperative mode) and hold coordination and review sessions for the weekly meetings (collaborative mode) before and after the writing process (Section 4.1). Other groups switch more dynamically between the different work modes; for example, the Robotics group, alternates dynamically between work constellations by switching Discord voice channels (Section 6.4). These differences in the orchestration of work modes are also evident in the distinction between fluidity and structure, presented in Chapter 5. The type of engagements and work constellations is, in structured situations, well-defined and often unchanged.

This contrasts with the fluid situations, in which both engagement and work constellations are dynamic, and the boundary between collaborative and cooperative modes becomes blurred. The work constellations and how to divide tasks between members often go smoothly without much discussion (for example, the CDM group (Section 5.2.2)). The form and scope of the discussion of content and outline for specific sections before the writing vary from everything between detailed written outlines to a few oral comments. The review process is central to creating textual coherence in project reporting; all groups participating in the main study have a well-defined practice for a collaborative review process. In the previous chapters, I have described review sessions of Sociology group 2 (Section 4.2), the Sports Science group (Section 5.2.1), and Sociology group 1 (Section 6.2.1). How the groups approach the review process varies, as do whether and to what extent it is an ongoing process or occurs primarily in the last part of the project period.

The groups' orchestration of work constellations and modes is reflected in the students' choice and construction of workplace, just as the choice of workplace and organisation of work provides different possibilities for the orchestration of work constellation and change in work modes. For example, is the group co-located or distributed? Are the members present on the same digital platform? Do they work synchronously or asynchronously? The presence matrix in Figure 6-1 illustrates four ways of being together and indicates the different possibilities for alternating between work constellations. Several groups emphasise opportunities to switch between work constellations and coordinate collaborative and cooperative modes.

7.3. INDIVIDUAL – SHARED

The project work involves a combination of shared and individual activities and practices. Planning, coordinating, the division of labour, and group discussions are some of several shared activities involved in the project work, while course preparation, reading, and annotation are often individual practices. The writing of a project report is both an individual and a shared process. As described in Section 4.4, the report text moves from being individual to being shared – and the project organisations in the three Sociology groups show three different paths to the goal. The different orchestrations leave various room for individual flexibility on the one hand and shared engagement on the other.

The individual and shared as a balance is reflected in practices and articulations of working together, e.g., individual homework (Sociology group 1, Sports Science group), everyone bears the brunt (Sociology group 3), equal distribution of work as ideal (Sports Science group), and everyone must vouch for the report (Sociology group 2).

When a project group forms, the group members usually match expectations regarding the project work, e.g., work effort, meeting frequency, meeting places, technology

constellations, and possible guidelines for specific practice rules for writing. Each member brings experience to the group, which constitutes a basis for building up shared practices. The practices are continuously negotiated and adjusted over time. In the CDM group, contrasting individual workplace preferences leads to a change in shared practice, which deviates from the group's initial balance of expectation (Section 5.3.2).

7.4. PLANNING – IMPROVISATION

The planning – improvisation dimension concerns different approaches to and orchestrations of project planning. Planning down in detail what to do when, ensuring a high degree of predictability on the one hand, and, on the other, navigating the present with a short planning horizon, taking things in their stride, and contrarily entailing a low degree of predictability, constitute the dimension ends. The project work involves a combination of long-term and short-term planning, though in different ways. Most groups operate with long-term planning in the form of deadlines. The setting of deadlines is often part of the initial project planning early in the project period. However, I have experienced deadlines set halfway through the period (Sociology group 1, Section 4.1) and on the go (Sports Science group, Section 5.3.1). Meeting times and places are agreed upon both long in advance and on short notice. Both Sociology group 3 (Section 4.3) and the Robotics group (Section 6.5) often agree daily. Sociology group 2 arranges meeting times from one month to one and a half months in advance (Section 4.2). The Sports Science group again plans between one and fourteen days ahead and adjusts the plans to a half-hour notice (Section 5.3.1). Often, the groups change strategies for planning over the project period, depending on situational needs. Likewise, the self-perceived need for planning intensifies as the project submission deadline approaches and the groups must ensure that they finish the report before the final deadline. The Sports Science group's use of the same to-do list several days in a row (Section 5.3.1) and MP updated planning schedule on the blackboard (Section 6.4.1) express an intensified need for planning and overview at the end of the project period.

The activities in the groups are more or less planned or scheduled. This becomes apparent by, among other things, the distinction between fluidity and structure, described in Chapter 5. An essential difference between structure and fluidity is the degree of predictability; in the structured situation, the activity is planned, and the conversation structure is given by either the activity itself or a predefined agenda. In a fluid situation, the activity and conversation more or less emerge in the situation.

In particular, the fluid situations (Section 5.1) and the Sports Science group's "plans do not hold anyway" (Section 5.3.1) show that the planning in the project groups can stray far from conventional models of project planning or normative conceptions of good project organisation. Sometimes, students focus very little on following a plan and entirely on navigating the present. Then, the group work becomes about

improvisation. Improvisation is the contrast to rational and structured decisions driven by plans and predictions. Instead, it implies uncertainty and unpredictability – what managerial models may often miss (Ciborra, 1999). Improvisation is neither irrational nor random – it is situational, intuitive, and spontaneous in its manifestation. Improvisation is organically a term from music. To engage in excellent improvisation, the musician needs knowledge and a sense of the rules and conventions of the given style or genre. PBL improvisation requires knowledge, sense, and experience with rules and conventions related to general academics, disciplinary traditions and chains of reasoning, and collaboration in a project group. We could ask: What knowledge, sense of rules, and conventions do students require to successfully improvise in a PBL context?

7.5. ROUTINE – AD-HOC

The project work involves different practices; some are routine and others are more ad-hoc and emerge in a given situation. Routines often involve processes such as reading, writing, taking notes, searching literature, and proofreading text, but also include regular practices related to group collaboration. Examples from the previous chapters of routine practices related to group collaboration and the daily to-do list and reviewing practice with established roles and labour division in Sociology group 2 (Section 4.2), Sociology group 3's daily thirty minutes of social talk (Section 4.3), the CDM group's agenda on the whiteboard and in the docs-document (Section 5.2.2), the S1 group's weekly text reviewing (Section 6.2), and the Robotics group's daily scrum meetings at 9 am (Section 6.4). Conversely, ad-hoc practices refer to unplanned processes, where structures are built up and put to use according to situational needs. Examples from the previous chapters stand forth as structures of an ad-hoc nature: the Sports Science group's to-do lists (Section 5.3.1), the CDM group's updating of the Trello board (Section 5.3.2), Sociology group 1's use of an agenda and to-do lists (Section 6.3.1), the MP group's updating of the schedule on the blackboard (Section 6.4.1) and the Robotics group's colour codes (Section 6.5). Some tools and structures, such as weekly or daily group meetings, agendas, and to-do lists, are permanent and appear as routines in certain groups. In other groups, the same tools are temporary, and the use is ad-hoc, involving an evaluation of whether the same tools make sense and have value in the given situation.

The routine – ad-hoc dimension relates to the previous dimension, planning – improvisation. However, while planning and improvisation focus on strategies for planning, the routine – ad-hoc dimension describes the pattern of processes. Just as routines evolve and adjust over time, the immediately temporary structures that emerge for a specific situation may become more regular routines.

The dimension relates to the distinction between fluidity and structure and the idea of elements structuring or directing/guiding the collaboration situations (Chapter 5). The students build up various structures, temporary or permanent, which match and adjust

their collaboration practice. For this, they use both digital technologies, e.g., groups' calendar documents in Sociology group 3 (Section 4.3) and the Sports Science group (Section 5.3.1), the Robotics group's 'Trello' sheet (Section 6.3), and analogue tools, e.g., the MP group's blackboard (Section 6.2.1). They also use oral agreement for reification (e.g., the Sports Science group's deadlines – Section 5.3.1).

7.6. TOGETHER – APART

The together – apart dimension implies the project groups' orchestration of time and place, i.e., when, where, and how the group is together. The studies show great diversity in the groups' orchestration of time and place. For example, the meeting frequency varies from daily to weekly, and meeting places include group rooms, booked meeting rooms, open study areas, the library, at home, online platforms, and others (cf. Table 3-1).

When, where, and how the group gets together affects the balancing of the other five dimensions. Choice of meeting frequency reflects and is associated with the choice of work constellation (the PBL collaboration – PBL cooperation dimension) and individual preferences, including the balance between shared engagement and individual flexibility (the individual – shared dimension). The choice of meeting place includes considerations about logistics (e.g., where the members live), resources (e.g., internet, available table and board), and comfort (e.g., cosiness and access to coffee). Specific activities may require specific resources, and the choice of a workspace can be based on a planned activity or simply the possibility of specific activities, e.g., the use of a whiteboard (Sociology group 3, Section 4.4) or dynamically shift between work constellations (Robotics group, Section 6.3). As touched on in the dimension description, the academic-social dimension relates to the choice and construction of workspace. I find that students take home-work days to reduce the social conversation and increase productivity and individual concentration. At the same time, I also see that study and friendship meet and interweave in the students' construction of workplaces, indicating that the placemaking process is essential for creating and maintaining social coherence.

7.7. SUMMARY OF CHAPTER

Six dimensions of group work: Grounded in data from the fieldwork and with references to examples from previous chapters, this chapter presents six dimensions of group work:

- *Social – Academic*: The project work includes a combination of academic and social elements, which the project group must balance. The social conversation may not 'steal' too much time from the academic work on the project. On the other hand, social elements and interpersonal relations

between members are also essential; they provide motivation and make the project work more than simply labourious.

- *PBL collaboration – PBL cooperation:* The project groups work in varying work constellations – sometimes all members together, sometimes in subgroups or individually. Coordination, the interrelation between tasks, and how the groups orchestrate work constellations vary depending on the group and situation. In some situations, the collaborative and cooperative modes appear well-defined and separated. In other situations, the students switch dynamically between collaborative and cooperative modes, and the divide between the two modes becomes blurred.
- *Individual – Shared*: Project work involves both joint and individual processes. Different individual experiences and individual work preferences play together and are considered in constructing a shared practice.
- *Planning – Improvisation*: Project work involves both longer-term and shorter-term planning. Sometimes, plans are made well in advance; other times, the project work is unpredictable, and the plans more closely arise as improvisation in the situation.
- *Routine – Ad-hoc*: Some activities are routines that occur repeatedly, associated with specific practices. Other activities arise ad-hoc according to situational needs.
- *Together – Apart:* This dimension concerns how to be together and the project group's orchestration of time and space. Orchestrating time and space affects the orchestration of the other dimensions.

CHAPTER 8. DISCUSSION

Most of the existing literature on educational technology focuses on teacher-designed technology-enhanced learning rather than students' self-organised use of technology for learning. Further the literature on students' use of technology tends to focus on which technologies they use rather than why and how they use these specific technologies, and on individual rather than collaborative use of technology. At the risk of overstating, the literature on students and technology tends to divide into two; general discussions of technology in education that often end in technology determinism and simple causalities, on the one hand, and discussions arguing for a high degree of complexity and messiness describable almost only through empirical examples and narratives and hard to operationalise, on the other hand.

This dissertation provides insights into the students' self-organised PBL collaboration and technology use. Throughout the analysis, I have developed concepts to increase our understanding and move towards operationalising the complexity of the students' orchestration of their PBL collaboration, be it through the distinction between fluidity and structure (Chapter 5), the four non-mutually exclusive meanings of technology (Section 5.4), the hybrid meetings in the student construction of workplaces (Chapter 6), or the six dimensions of group work (Chapter 7).

In this chapter, I discuss the conceptualisations; firstly, hybridity and how to understand and interpret the hybrid meetings, and secondly, the six dimensions of group work and how to understand the relation between the elements that make up each dimension. In conclusion, I argue that ecotones' concept can help form the six dimensions of group work and the hybrid meetings into a framework for analysis and reflection.

8.1. HYBRIDITY AND PBL

Chapter 6 provides examples of how students, in different ways, construct hybrid workspaces and identify meetings between seemly opposing elements. Briefly summarised, the meetings fall under the two categories, digital/analogue or onsite/online and outside-/inside-university, and relate in different ways to 1) orchestration of multiple tools, 2) experience and construction of space, and 3) meetings between roles and contexts.

My analysis of the construction of hybrid workspaces raised reflections on how to interpret hybridity and the relationships between new and established and between teacher design and student autonomic flow in the analysis of the students' collaborative practice.

8.1.1. THE RELATION BETWEEN NEW AND ESTABLISHED

The notion of hybridity and hybrid learning in education is applied with different interpretations, and how to understand the concepts is not entirely clear (Eyal & Gil, 2021; Nørgård, 2021).

In education, hybrid most often refers to the combination and interaction between onsite and online learning and the dissolving of the online-offline dichotomy and distance to digital dualism (cf. Section 2.1.5). As previously described, the term hybrid is originally used in biology and refers to cross-breeding between species (Hilli et al., 2019). A well-known example is a mule, which is a hybrid of a donkey and a horse. In education, cross-breeding relates to more than online and onsite; hybrid is a multidimensional term related to dissolving dichotomies dominating education.

Hybrid education is an under-researched and under-theorised area; the notion of hybrid is often confused with related terms like blended and flipped (Nørgård, 2021). To achieve conceptual clarity, Nørgård (2021) distinguishes between hybrid, hybridisation, and hybridity:

- A hybrid refers to a new species, form or culture that is a cross, fusion or dissolution of already existing species, forms or cultures […] it reminds us of two distinct forms which we recognise while at the same time there is something new and previously unknown.

- Hybridization describes the process of cross-breeding, fusing or dissolving species, forms or cultures to create new hybrids […] the form we call hybrid is in a state where it is not yet established as a 'mature species', but is something on its way to becoming

- Hybridity is a term for the relation between a hybrid and its source material. Hybridity highlights what makes a hybrid a hybrid—that is, its 'otherness', distinctiveness or signature […] (pp. 5-6)

Briefly summed up, hybridisation refers to the cross-breeding process and hybrid to the result of this process. Hybridity is the relationship between the new and the old, "its otherness".

Hybrid learning and hybrid learning environments bring together elements of existing learning environments, aiming for the emergence of new opportunities, experiences, and interactions. According to the above citation, hybridisation is a stage on its way to becoming and not yet established. The hybrid being not fully formed implies possibilities but also unpredictability and uncertainty. Hybrid learning thereby involves experimentation and risks and places new demands on students to take a risk and tolerate frustrations in situations in which the goal and the final destination are not completely clear (Köppe et al., 2018; Nørgård, 2021). It challenges traditional

formats and instils reflection on the value and purpose of existing categories, dividing lines, and ongoing dialogue and negotiation of concepts, formats, and roles

Hybrid learning opens up new relationships and interactions between learning and working and between learner, professional, and citizen roles. It also follows that the personal and professional learning life arenas merge and become entangled to a greater extent. Hybrid learning offers flexibility, work, and learning across locations, time, and contexts (Nørgård, 2021, p. 9). It brings both opportunities and challenges; an example is the merging of life arenas providing opportunities to create a better work-life balance, on the one hand, and the entanglement of different roles requiring coping with the challenge of balancing the simultaneous roles, on the other

8.1.2. A NEVER-ENDING DANCE?

In analysing the student construction of hybrid workplaces (Chapter 6), I searched for distinctive elements and then tried to identify a kind of ‘otherness’. In this process, I had the experience of clarifying and reinforcing distinction lines rather than dissolving them. However, the distinctions become a tool to describe elements of the collaborative situations that seem difficult to describe and capture in other ways.

When the collaboration situations are observed, the elements appear neither unambiguously compatible nor unequivocally incompatible; they stand forth neither unambiguously contradictional nor complementary. The elements exist side by side; they can be unilaterally considered neither isolated species that do not fuss or interact nor full fusions. I experienced the relationship between the elements as dynamic, like the elements alternately moving in the foreground and the background. Sociology group 1's review session (Section 6.2) is both project work and friend visiting, but depending on which parts and times of the meeting we focus on, 'friend visiting' or 'project work’ characteristics will appear more or less dominant, in the foreground or in the background. As for the MP group, digital tools come to the fore in some situations (drawing 3D CAD model), while analogue tools are more crucial in other situations (building a cardboard model). At the same time, these models and tools are part of the same process and interplay. This interplay sometimes appears as sharply separated processes and other times as more interwoven. In the same way, relationships and roles in the Robotics group can be described as a combination of friendship and professional partnership, where the two parts take turns coming to the fore.

Stommel (2012) describes hybridity as a *dance* and a *moment of play*:

> Hybridity is about the moment of play, in which the two sides of the binaries begin to dance around (and through) one another before landing in some new configuration (unpaginated)

Dance seems like a suitable metaphor for the movement between foreground and background. The relationship between the distinctive elements is dynamic, and the students continuously negotiate and orchestrate dividing lines and the degree of interwovenness. The continuous negotiation and the dynamic – movement or dance between foreground and background – make a dynamic and diffuse form of "the otherness". Likewise, it appears vague as to when or whether the dance ends and new configurations land, as this is still under negotiation.

8.1.3. TEACHER DESIGN OR STUDENT AUTONOMIC FLOW

Recently, Eyal and Gil (2021) identify three perspectives on hybridity, illustrating how the concept is used with different interpretations inside education. The three perspectives – *hybrid as blended*, *hybrid as a space of merging interactions*, and *hybrid as fluid* – enlighten a difference between focusing on formats and learning design and focusing on students' choices and practices. The three perspectives summed up are:

- *Hybrid as blended*: In some research literature, hybrid learning and blended learning are used interchangeably and as synonyms concerning primarily the time and space dimension of learning and the ratio between face-to-face learning and online learning. Face-to-face and online learning are two distinct worlds that constitute a heterogeneous mixture and whose learning properties are immiscible. Eyal and Gil (2021) refer to this perspective as "the first generation of hybrid". The hybrid as blended implies "a somewhat technical change in study methods, as a result of external technological developments that allow for altered learning environments, without any specific reference to the complexity that might be involved in teaching/learning" (p. 4).

- *Hybrid as a space of merging interactions:* The "always-on" has changed the perception of face-to-face and online learning; the distinction between physical and digital space has become "somewhat obscured". From hybrid being a heterogeneous mixture of two distinct environments, hybrid instead becomes a "compound" whose properties move beyond and are different from the initial properties of each of the two environments. From this follows a social and situated view on learning: "Learners are not passive when they interact with content, the teacher, and their peers, autonomously and in groups. Learning is characterised as active and collaborative, and the content has a flexible attribute to it. The role of technology here is to encourage learners to contribute to the learning environment" (p. 9). The design of open-ended learning environments and related activities involving located, mobile, and social components is key to creating meaningful learning experiences. In this process, Eyal and Gil (2021) argue that teachers must compromise between "the learning goals set by the academic institution" and

"the variety of options available for learning" for which the teachers need help and scaffolding.

- *Hybrid as fluid:* Unlike the two previous perspectives, which address learning in a formal educational framework, the third perspective, hybrid as fluid, represents "a greater flow in and between the dichotomies" (p. 14) rooted in the learners' autonomy and decisions about their learning. The learners continuously decide what and where to study, manage time and resources, and adapt learning strategies. These choices of learners are the ones crossing boundaries. The continual crossovers between dichotomies create "a network of possibilities in which every node is temporary for the specific need in real time" (p. 12). The crossovers are driven by curiosity and necessity rather than 'just-in-time rules': "hybrid learning is an ever-changing hybridity that is not bound by conformity and is characterized by breaking boundaries as necessary" (p. 14). The educational system attempts to adapt fluid hybridity components. Micro-courses, MOOCs, and the flipped classroom can be considered examples of creating flexibility and relevance, adapting to the learners' needs, and fluid hybridity. However, it stands forth as diffusely definable; "Yet a truly fluid hybrid resists fixed boundaries of teacher, time, place, curriculum, goals, and methods of teaching, learning, and assessment. In fact, the attempt to define the concept of hybridity as fluid would be a contradiction to its meaning" (p. 13).

Hybrid as blended and *hybrid as a space of merging interactions* concern, each in its way, the design of teaching and learning. The differences between the two perspectives are similar to what I earlier described as the conceptual differences between blended learning and hybrid learning (cf. Section 2.1.5). Hybrid as blended focuses primarily on combinations of teaching formats considering the onsite and online dichotomies without room for thirdness (Engeström, 2014) and otherness (Nørgård, 2021); the possibilities are related to the location of the learner, who is either in the classroom or online. *Hybrid as a space of merging interactions* implies room for otherness; cross-breeding of something existing creates the space for merging interactions, where something new may emerge. The focus is on designing new engaging learning environments and responding activities and, in this process, challenging existing categories and ways of thinking to create new categories, patterns, and configurations – and thereby new possibilities and types of interactions. *Hybrid as fluid* opens up numerous relations between dichotomies and focuses on the student choices and interactions across two or more categories or boundaries. Roughly set up, from hybrid as a space for merging interaction to hybrid as fluid, the focus shifts from the teachers' design practice to the student practice. As a category, *hybrid as fluid*, as just mentioned, moves the focus to the students' choice and autonomy, and first and foremost, enlightens the complexity followed by *the greater flow in and between the dichotomies*.

Figure 8-1 Eyal and Gil (2021) illustrate hybrid as fluid with colourful fluid mixing, made in a fluid simulation app

The three categories clarify a distinction between teacher design and student autonomy in the interpretation of hybridity. Hybridity in a PBL environment is rooted primarily in student autonomy rather than in design decisions made by lecturers or principles implied in the model. The PBL model implies a high degree of student autonomy, including co-decision, participation, and responsibility among the students in creating the learning environments. Hybrid as fluid contributes to describing a part of the dynamic, unpredictable and complex nature of the meetings and to turning the focus to the students' practice and autonomy. Hybrid as fluid is also convertible with the description of the meetings as a never-ending dance between foreground and background.

The difference between teacher design and student autonomy leads to the difference in purpose between design and analysis. When learning is designed, the definition of the seemingly opposite categories and dividing lines acts as a thinking tool or methodology for creating opportunities and new experiences through the design. During analysis, the categorisation of dividing lines, in contrast, is a concern of analytical value for contributing to increased understanding and new perspectives on the students' hybrid practice. The first two perspectives describe two different focuses on design. Hybrid as fluid describes a focus on student practice, highlighting unpredictability and complexity; rather than being operational, the category highlights conditions and challenges of analysing autonomous student practice in a hybrid learning environment. Hybrid as fluid is an interpretation that echoes my experiences of the students' hybrid collaboration practice. However, it leaves an open question of how we can further work with hybridity in analysing student practice.

8.2. THE SIX DIMENSIONS OF GROUP WORK

Each of the six dimensions of group work – social/academic, PBL collaboration/PBL cooperation, individual/shared, planning/improvisation, routine/ad-hoc, and together/apart – consists of two seemingly opposite parts. In the reflection on characterising the dimensions in general and the relationship between the two parts making up each dimension, dichotomies and dualities, therefore, emerged as possible models to which to resort.

Dichotomies and dualities constitute two frequently used, often considered reverse explanation models characterising the relationship between two diverse parts. *Dichotomy* describes the contrasting relationship between groups or entities identified by mutual exclusivity (either/or) and contradictional qualities. Dichotomy comes from the Greek 'dicha' meaning 'two-part', and 'tomos' meaning 'cut, cutting'. Dichotomies are central in logic and classification; they indicate two mutually exclusive subclasses exhaustive of the whole (in the case of three classes, it is called trichotomies). For example, the world can be divided into mammals and non-mammals. An animal, N, belongs to either the class of mammals or the class of non-mammals. Conversely, *duality* describes a mutual and complementary relationship between two entities or groups. Etymologically, the word is derived from Latin 'dual' meaning two. While dichotomy refers to a whole cut into two mutually exclusive parts, duality refers to a whole with a two-fold nature. The duality's two diverse parts are mutually inclusive (both/and) and cannot be understood in isolation.

The dialectic concept of contradictions (Engeström, 2014), found in CHAT, and the dualities of participation and reification (Wenger, 2019) are examples of the two types of relationships or ways of thinking. According to Engeström (2014), contradictions are an analytic tool pointing out tensions between activity systems. They should not be understood as problems or conflicts but as structural tensions that motivate change and development. Contradictions are propositions that appear incompatible and cannot be dealt with simply by combining or balancing priorities (Engeström, 2001; Engeström & Sannino, 2011). However, contradictions cannot be considered dichotomies in the true sense of the word. Engeström (2014) describes the problem of dichotomies:

> The problem with the dichotomies is that they depict movement as mechanical opposition, summation or oscillation between two fixed poles, thus effectively excluding the dimension of concrete historical development. 'Either-or' and 'both-and' are closed and timeless structures. Within them, there is no room for something qualitatively new emerging first as a subordinated mediator between the two poles and being transformed into a determining factor that will eventually change the character of the whole structural configuration. There is no room for thirdness (p. 177)

Contradictions differ just so from dichotomies by the room for 'thirdness', "a new concept for the new thing under transformation" (Engeström, 2011, p. 598) and "something qualitatively different from a more combination or compromise between two competing forces" (Engeström & Sannino, 2011, p. 371).

Participation and reification are an example of duality (see Section 2.3.1). Wenger (2019) depicts the distinct and complementary relationship as yin and yang. He describes duality as a "single conceptual unit formed by two inseparable and mutually constative elements whose inherent tension and complementarity give the concept *richness* and *dynamic*" (p. 66). Dualities are not classificatory categories, as opposed to dichotomies, such as tacit/explicit, formal/informal, individual/collective, private/public, conscious/unconscious, and people/thing. Instead, they describe interplays between two parts. The two parts can be interweaved to such a degree that it is hard to discern, and the in-between boundary seems blurred.

Wenger et al. (2009) characterise the relationship between participation and reification (together with separation/togetherness and individual/group) as *polarities*:

> We use the term polarities for a number of reasons. First the notion of polarity suggests that each pole depends on the other—that considering one pole calls for consideration of the other. Second, experiencing a polarity requires a constant process of balancing between the two poles. Finally, the concept of polarity is meant to include a range of relationships and interplay between the poles—from complementarity to incompatibility, from harmony to conflict, from mutual reinforcement to tension. These polarities affect each other, but each captures a distinct dimension of the challenge of learning together (Kindle Locations 1445-1449).

Both dichotomy and duality, as general explanatory models, are widespread in various research fields. Both explanatory models appear appealing; they are clear and confident in their distinction. A significant critique of the models is that they offer too-simple explanations and connections for something otherwise uncertain, unclear, fluffy, or blurred. An example of this is the perception and articulation, in education, of online and onsite as a dichotomy; Fawns (2019) directs criticism against digital education and related terms such as e-learning, technology-enhanced learning, blended learning, online learning, and face-to-face learning: "What all of these terms have in common is that they imply a simplistic distinction that is actually very complex" (p. 133). The explanatory models may simplify and do not encapsulate complexity. In addition, dichotomies can be criticised for focusing too much on conflict and contradiction; similarly, duality may be criticised for focusing too much on unity and complementarity. When considering the relation as dichotomic, there is a tendency to value one over the other (Ellingson, 2012) or understand one as a problem to which the other is the solution (Wenger, 2019). Although duality potentially permits several types of relationships and interactions between the two

sites, duality is defined (and limited) by being 'two' and by the assumption of mutuality and dependence between these two.

Returning to the six dimensions of group work, neither of the two explanatory models seems entirely adequate. The dimensions are not mutually exclusive; they can be considered both contractional and complementary. For example, the *social* conversation can steal time from and make the *academic* project work inefficient, though social conversation and relationships play a crucial and motivating role in academic collaboration. On the other hand, considering the academic and the social as a duality, a unit consisting of two units that enter into interdependence does not, in any case, seem plausible either. Thus, the duality as an explanatory model does not seem to be an option. Another example: Something cannot be planned in detail and improvised simultaneously; on the other hand, planning without improvisation can become too rigid, and improvisation without planning may become un-organised and involve uncertainty about whether the project will be finished in time. Another counter-argument for the two explanatory models is the relations and interplays between the six dimensions; each dimension cannot be understood in isolation – as either dichotomy or duality.

Following the above, the two explanatory models are too simplifying. The question emerges: How can we nuance this understanding of the relation between seemly distinctive elements and, in this case, the six dimensions of group work?

8.3. FRAMEWORK FOR ANALYSIS AND REFLECTION

Section 8.1. implied reflections on the interpretation of hybridity; I described the dynamic relation between the seemly distinctive elements and emphasised differences between teacher design and student autonomic flow and between learning design and analysis of practice. The section concluded with an interpretation of hybridity as being fluid and an open question regarding how to work with hybridity analytically. Section 8.2. commenced a search for an explanatory model for the six dimensions of group work but found dichotomies and dualities too simple, which is why it concluded with a question on how to nuance these explained models.

In my proposal to answer the two questions above, I turn to the concept of ecotones. Like hybridity, the ecotone is a concept originating from biology, specifying the transition area between two environments. Ecotones permit both contradiction and complementarity without presupposing mutuality, which is why the concept is interesting concerning the six dimensions of group work (Chapter 7) and the hybrid meetings (Chapter 6). Ecotones provide a thinking tool that helps to describe differences and dynamics in balancing the dimensions and defining and negotiating dividing lines, which is beneficial both analytically and in the students' reflection on their collaboration practice.

The six dimensions of group work and the hybrid meetings in the student construction of workspaces provide a new conceptual apparatus and have potential as a platform for reflection internally in project groups and in the conversation between project group and supervisor. With a focus on diversity and the question of 'when', a narrow and normative picture of good group work will hopefully be avoided and replaced with space for experimentation, dialogue, and reflection on what good group work means in a given situation for a particular project group.

8.3.1. THE NOTION OF ECOTONES

Ecotones specify the transition areas where environments meet and interact. Encyclopaedia Britannica (n.d.) and Wikipedia (n.d.) define ecotones in these ways:

> Ecotone, a transitional area of vegetation between two different plant communities, such as forest and grassland. It has some of the characteristics of each bordering biological community and often contains species not found in the overlapping communities (Encyclopaedia Britannica, n.d.)

> An ecotone is a transition area between two biological communities, where two communities meet and integrate. It may be narrow or wide, and it may be local (the zone between a field and forest) or regional (the transition between forest and grassland ecosystems). An ecotone may appear on the ground as a gradual blending of the two communities across a broad area, or it may manifest itself as a sharp boundary line (Wikipedia, n.d.)

The notion of the ecotone has been adopted by, among others, environmental humanities, educational research, and innovation studies. Ryberg et al. (2021) recently brought the ecotone into post-digital education to help address *problematic dichotomies* such as digital/analogue and onsite/online.

Ryberg et al. (2021) identify two dimensions of the concept of ecotones: conceptual and affective dimensions and spatial and material dimensions.

Ecotones' conceptual and affective dimension emphasises that particular ecotones contain the possibilities for both enrichment and tension, for contentiousness and peaceful co-existence. The meeting between environments can increase (bio-) diversity; an ecotone area often contains more and new species than the two ecological communities that meet. Conversely, ecotones also contain tensions; the word ecotone combines ecology and tonos or tension. Applied to the debate on the boundaries between digital and analogue, in some situations, the boundary between digital and

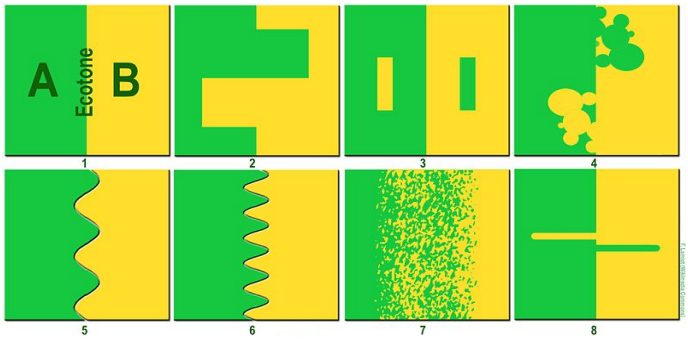


Figure 8-2 Schematic representation of different types of ecotones (Lamiot, n.d.)

analogue is a contentious issue; other times, the boundaries almost evaporate, and the digital and analogue co-exist unproblematically (Ryberg et al., 2021).

Ecotones' spatial and material dimension concerns the physical and spatial encounter between the two environments and describes the form. Figure 8-1 shows a schematic representation of different types of ecotones and illustrates how the boundaries can take the form of sharp and marked dividing lines and fluid, gradual transitions. Concerning the digital/analogue or online/onsite boundaries, ecotones accommodate different degrees of interwovenness. Sometimes, the digital and analogue appear inseparable and difficult to distinguish from each other; in other situations, they appear separated and easy to distinguish.

Ryberg et al. (2021) suggest using ecotones' perspective to explore how seemingly contradictory entities live together in practice. They argue that the discussion of technology and the boundaries of digital and analogue often ends in questions of dichotomy or dualities because it happens in general and abstract terms, rather than a concrete case of "specific instances of use as part of particular activities" (p. 12). By including tension and peaceful co-existence, and sharp divides and fluid, gradually overlapping transitions, ecotones inspire moving beyond the either-or or both-and discussion of dichotomies and dualities. Ryberg et al. (2021) turn the either-or or both-and questions to questions of *when*:

> When is the co-existence peaceful and calm among the wider (metaphorical) species and fauna, and when do tensions arise? […] When are the ecotones experienced as sharply divided environments, and when do they unproblematically blend together? (p. 12)

8.3.2. THE SIX DIMENSIONS IN THE LENS OF ECOTONES

By considering the six dimensions in the lens of ecotones, the questions of mutuality and complementarity or contradictions posed in the previous section turn to *when* and

how ... in particular situations. The distinction between conceptual and affective dimensions and spatial and material dimensions offers a way to view and describe various orchestrations of group work. Previous chapters offer descriptions of particular situations, and thinking back, that descriptions and analyses of students' group work relate to conceptual, affective, and spatial and material dimensions. For instance, descriptions of the social – academic dimension and how social conversation and relations can take attention and time from academic project work, but at the same time support and motivate that academic work, relate to the conceptual and affective dimension. It is also true for the individual – shared dimension; in some situations, the individual and the shared complement each other in building shared collaborative practices. The individual and the shared collide in other situations, and the best solution is not necessarily a compromise.

The distinction between fluid and structure, introduced in Chapter 5, relates primarily to the spherical and material dimensions. Differences between the fluid and structured collaboration situation relate to the transition between academic and social and between collaboration and cooperation. In fluid situations, the conversation flows between social subjects and crucial project discussions. The members alternate between work constellations and tasks; thus, the boundaries between collaboration and cooperation may become blurred. In structured situations, the purpose and subject of the conversation are planned, and the work constellations are well-defined and often fixed. The social and academic are divided, for instance, by defining timeslots for meeting and breaks. Thinking back to the schematic representation of ecotones, in Figure 8-2, the transitions between social and academic and between PBL collaboration and PBL cooperation, respectively, are fluid and gradual (as shown in scheme 7) in fluid situations. In structured situations, the same transitions may best be illustrated in various ways by sharp lines (as shown in schemes 2, 3, or 7). Similarly, the differences in the orchestration of the dimensions can be reflected in the schematic representations. The differences in the orchestration of the PBL collaborative-PBL cooperative dimension and the together – apart dimension between Sociology group 1 and the Robotics group, as described in Chapter 6, are examples. Sociology group 1 working either co-located and collaborative or distributed-cooperative reflects sharp transitions between collaboration and cooperation and between together – apart. For comparison, the Robotics group meeting in Discord and dynamically changing its work constellation reflects fluid and gradual transition lines for the dimensions.

This perspective admits that it is not unequivocal whether the six dimensions are contrasting or complementary, sharply separated or entangled. The particular situation determines whether the dimensions are contrasting or complementary, separated or entangled. In some situations, the condition changes dynamically and therefore is not so unambiguous. In contrast, in others, it is more permanent. By this, it becomes difficult to define what good project work is. The dimensions can be described as a balancing act, where immediately opposite tendencies interact and exist side by side.

Nevertheless, it is not in the sense that they can be described as a spectrum, where a step towards one is necessarily a step away from the other – just as there is no ideal balance point for which project groups should strive.

8.3.3. ECOTONES AND HYBRIDITY

Hybridity and ecotones have a lot in common; both concepts originate from biology and have interests in the study of binaries and the creation of richer and more diverse environments. Ryberg et al. (2021) state that hybridity and ecotones, as concepts, "could be seen as merely two ways of accomplishing the same" (p. 15). Furthermore, they argue that ecotones have an additional analytical value by the two kinds of dimensions – conceptual and affective dimensions and spatial and material dimensions – offering a way to approach hybrid learning environments analytically.

Similar to the six dimensions in the previous section, we can consider, in the lens of ecotones, the meetings between the seemingly distinctive elements identified in connection with the students' construction of workplaces in Chapter 6. In particular, ecotones appear to be suitable for helping to describe the difference between distinctive meetings between similar elements, about whether elements exist in peace vs. tension or sharply separated vs. interwoven. As described in Section 8.1, the relationship between the elements is dynamic, and the two dimensions offer a way to approach this dynamic. An example of ecotones helping to describe differences is in the meetings between online and onsite in the Sociology group 1 review session (Section 6.2) and the virtual meeting in the Robotics group, respectively. While online and onsite interwoven in the meetings between spoken and written, between the Google Docs document and the dorm room, is experienced almost as an extension of the physical space, Discord chat, Overleaf, and Docs appear in the virtual meeting in the Robotics group, most of the time as separate spaces, separated from each other and the physical space. The rooms momentarily merge into a form of interwovenness, for example, when the sounds of buses and a spoon towards the breakfast plate tell of the onsite workplace. Most of the time, it exists online and onsite, immediately peaceful and without tension.

8.3.4. PLATFORM FOR REFLECTION

The diversity identified in and between the collaborative practice in the project groups shows that successful project collaboration can take many forms and challenges general and normative considerations about good project work. The six dimensions and the meetings between seemly distinctive elements related to the student construction of workspace propose and offer a conceptual framework to analyse this diversity. In addition to a tool for analysing and understanding project groups' collaborative practice, the six dimensions of group work and the hybrid meetings in the construction of workspaces are a potential starting point for the students' reflection on collaboration practice. Dimensions and the meetings can form a platform for

reflection questions to be discussed internally in the groups or with the supervisor. As the previous sections argue, diversity and hybridity emphasise and contemplate 'when' questions, ambiguous answers, and space for experimentation. Examples of questions formulated based on the six dimensions of group work follow:

> When does it work well that the social and the academic are sharply divided? Are there situations in which the social and the academic are advantageously intertwined? When do the academic and the social substantiate and enrich each other? In what situations do the academic and the social conflict?
>
> When do gradual and fluid transitions between coordination, cooperation, and collaboration work well? When does it work best that the different types of processes are sharply divided?
>
> In which situations do the shared and the individual support each other, and when do they conflict?
>
> When is tight planning rewarding/beneficial? Are there situations in which space for improvisation is essential? When do planning and improvisation have a constructive interplay? When do they conflict?
>
> When do routines work well? In what situations is an ad-hoc approach more beneficial? When do routines and ad-hoc approaches have a constructive interplay? When do routines conflict with an ad-hoc approach?
>
> When is it rewarding to be together? When is it rewarding to be alone? When is it rewarding to sit together? When is it rewarding to be connected virtually? When does it work best to meet in a domestic and cosy environment? When does it work best to meet in the group room or at the library?
>
> When does the high degree of interwovenness between online and onsite work well? And when is a sharp divide between online and onsite beneficial? Are there situations in which online and onsite conflict? When do online and onsite support each other constructively?
>
> In which situations does a sharp divide between inside- and outside-university work well? When does it work best that inside- and outside-university are interwoven? What does this mean for choosing a meeting place and creating a workplace? In what situations do they substantiate each other? In what situations do they conflict?

The above reflection questions form a framework for reflection, which is based on the students' own experiences and emphasizes diversity and situation dependency. By

emphasizing diversity and focusing on “when”, we can move from narrow and normative considerations about what good project work is to successful project work taking multiple forms.

CHAPTER 9. SUMMARY AND CONTRIBUTIONS

Technology plays a crucial role in student collaboration practices, and these practices imply a complexity that we do not yet fully understand. Previous research on educational technology has focused mainly on teacher design rather than student practice and on individual practice rather than collaborative practices. Additionally, the attention has tended to concentrate on "what we know *might* be achieved through technology-enabled learning", creating a gap between the state-of-art and the state-of-actual, "the realities of technology use within contemporary university contexts" (Henderson, Selwyn, Finger, et al., 2015, p. 308).

Through this dissertation, I have reported a multi-sited ethnographical study of the student orchestration of group work in a PBL environment. With an explorative and adaptive approach to the study, I have focused on the students' *actual* practice – beyond normative and deterministic perspectives on technology and education – with the primary purpose of developing new concepts and models that can help describe and explain this practice. I have approached the project with the open-ended research question:

How do students orchestrate project- and problem-based group work, and what is the role of technology?

This chapter concludes the dissertation; I answer this question by summarising the dissertation and its contribution.

Guiding directions for the study

The current study of student collaborative practice has been guided by principles, which I have drawn from movements within educational technology research, presented in Chapter 2. The chapter provides an overview of movements within the field: from a deterministic to multiple understanding of technology, from the learning process being a solely personal and social issue to a socio-material approach to learning, from digital dualism to hybrid pedagogy and postdigital education, and from competency checklists to situated practice. These movements describe the challenges of everyday reasoning, including a linear causality thinking about what technology *does* or how it *affects* learning and practice.

I have strived to follow the five guiding directions for the PhD studies: 1) technology is multiple, 2) agency and affordance are relational, 3) connections across onsite and online sites, 4) sensitivity of materiality and place, and 5) focus on the students' actual practice.

Multi-sited connective ethnography and methodological challenges

Chapter 3 presents the field studies and argues for the choice of the multi-sited connective ethnographical methodology. Through this methodology, the study provides a broad perspective and an explorative approach based on participant observations in natural settings and enables movements across temporal and spatial boundaries. Ethnography is an explorative method with adaptive logic. It demands moving beyond normative and deterministic assumptions. Rather than figuring out consequences and fitting new experiences to what we already know, it leads us away from what we already know to find possible explanations and develop new concepts. With this, the methodology is in line with the guiding directions

Based on Hine's (2015) characterisation of the 3E internet, Chapter 3 provides an overview of methodological challenges that mediated communication brings to the ethnography of the movement from exotic cyberspace to embedded everyday internet. The challenges relate to the fact that the field is not limited in time and place; thus, 'where' and 'what to follow' get no unambiguous answer, and the digital enhances the experience of fragmentation and the changing experience of place and access to the field.

I exemplify the fragmentation and how technology changes the experience of access and space by distinguishing between *digital as an extension of space* and *digital as individual work caves*. Respectively, they refer to members having shared attention on a digital platform working collaboratively and members working with individual tasks in separate digital spaces. When digital has been an extension of space, I was invited into the project group's shared digital space instead of working caves where I did not have immediate access. The distinction emphasises that the experience of access and space is situated and is not dependent on the individual technologies, but instead is a product of, among other things, the project group's orchestration of work modes and the interrelations between online and onsite.

Methodological challenges have been related to 'what to follow' and the fragmentation of the situation, enhanced by the digital, and not being sure what has been 'missed'. Other challenges were related to the internet as infrastructure and everyday, questioning the taken-for-granted and making the familiar 'strange'. I have proposed and used situational mapping (Clarke et al., 2018) to address these challenges.

Diversity, negotiability, and richness

Successful PBL group work can take multiple forms.

The study of student hybrid collaborative practices has shown great diversity and richness in practice. Throughout the dissertation, via descriptions, empirical examples, and the development of models and concepts, I have strived to illustrate and capture this diversity and richness that I have experienced in the field.

Illustrating the broadness of PBL collaboration and the diversity and negotiability in the project groups' practice has been the primary intention behind Chapter 4. The chapter describes and discusses collaboration practices in three sociology groups. The three groups share a study program, semester, and regulation and have large parts of the learning environment in common, whereby diversity in practice cannot be ascribed to disciplinary or structural differences. I have identified differences and similarities in meeting frequency, choice of meeting place, writing, planning, and various digital practices using similar tools. Based on conversations with the students, I draw out everyday reasoning related to practice. These include the orchestration of work modes – constellations of cooperative and collaborative work – involving reflections on the balance of group synergy, productivity, and flexibility, consideration of the choice of meeting place, and the social dimension being a critical and motivating part of the project work.

In Chapter 5, I have sought to describe and capture dynamics in various collaborative situations by distinguishing between fluid and structured collaborative situations. The structured situations are characterised by organised activities with a well-defined structure and procedure, e.g., agenda-driven group meetings and text-review routines. These situations were characterised by predictability and a well-defined object of activity. In these situations, the professional and social conversation was most often separated, and the division of labour and work constellation was well-defined and permanent. In fluid collaboration situations, I found that where the project group flowed was unpredictable; how the groups worked appeared to be the sum of several ad-hoc decisions, the conversation alternated dynamically between professional discussion and social talk, and the number of participants and work constellations was flexible and dynamic.

In addition to describing different dynamics and differences in and between groups, the distinction between the structure and fluid collaboration situations underpins the breadth, negotiability, and changeability of student collaboration practices. Normatively, we may tend to rank one as better than the other and distinguish between well-organised and effective collaboration and unorganised and ill-structured collaboration. In distinguishing between fluidity and structure, one is not better than the other; they have different functions, reflecting participation and reification (Wenger, 2019). The structuring elements help to reify practice, while fluidity can be considered part of a negotiation of collaborative practice, including balancing social and academic elements (cf. Chapter 7) and handling the unpredictable and unknown character

The role(s) of technology

The study shows that technology is a ubiquitous and entangled part of the students' collaborative practice and substantiates that the role of technology is multiple and situational. It underpins and illustrates that unambiguously defining what the technology *does* or *brings* to the students' collaboration is impossible.

Technology as a tool	**Technology as a place**
For which purposes do students use technology?	*How does technology change the experience of place? How do students create a collaboration space?*
Students use a combination of digital and analogue tools, e.g. for writing, searching information, sharing resources and communication	Technology is a critical part of students' construction of workplace implying negotiations of boundaries between online and onsite, and between contexts and roles in- and outside university
Technology as a structure	**Technology as fluidity**
How does technology structure, guide and reify practice?	*How does technology offer and demand flexibility, negotiability, and change-ability of practice?*
Students build different structures, e.g. calendar and to-do-list, to support their project work. They reify practice and decisions through technology, e.g. in meeting notes.	More technology offers students a large room for manoeuvre, making it easy to adjust, change and build up new structures and practices. Almost continuously connectedness brings flexibility and enables the students to make and change plans and decisions at the last minute.

Figure 9-1 Four meanings of technology in students' group work

In my endeavour to understand technology's role(s) in student collaboration, I have identified four categories of meanings of technology, summarised in Figure 9-1 (see also Section 5.4).

The first two categories are *technology as a place* and *technology as a tool*.

Technology as a tool refers to the purpose of using the technology; what do the students use the technology for? For instance, more of the project groups use Google Docs as a tool for writing. Technology as a place refers to the digital acting as space and changing the experience of place The distinction between digital as a shared extension of space and digital as individual work cave is an example of how technology can change the experience of place.

Chapter 6 also provides examples of technology acting as a tool and as a place. Technology acts primarily as a tool when the MP group uses a combination of digital and analogue tools (Section 6.3). The Sociology group's meeting (Section 6.2)

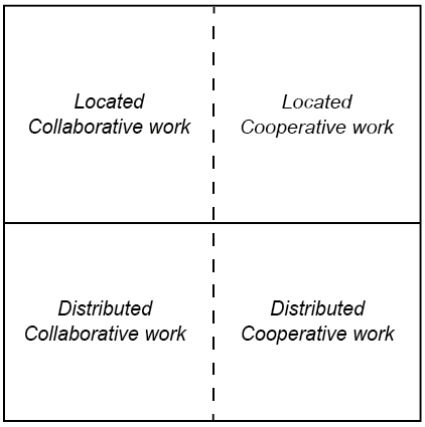


Figure 9-2 Four types of presence

exemplifies how technology acts as a shared extension of space. I propose a matrix of four types of presences; see Figure 9-2. The matrix stretches between presence (co-located/distributed) and work mode (collaborative/cooperative) and consists of the four types of presence: 1) The group members are co-located and work collaboratively, 2) the group members are co-located and work cooperatively, 3) the group members are distributed and work collaboratively, and 4) the group members are distributed and work cooperatively. These presences are four out of many possible forms; the matrix serves as a tool to distinguish between orchestrations and articulate differences and shifts in presence. Additionally, the matrix underlines technology acting as a place and having a crucial role when students construct their workplace(s).

Previous research tends to focus primarily on technology as a tool, *which* technology the students use for *which* purposes, and, to a lesser extent, the relationship between technology and practice. The distinction between technology as a tool and technology as a place shows that using technology for learning and collaboration is not just – put at the forefront – about choosing the right technology and applying it correctly. The use of technology for learning and collaboration is, to a large extent, also about constructing a workplace and creating a collaboration space. The matrix of presences presents possible constellations for students creating spaces for learning and collaboration.

The other two categories *are technology as structure* and *technology as fluidity*.

The two categories describe two opposing tendencies. The students build different structures to support the project collaboration, and several of them involve technology as a critical element. Calendar documents and to-do lists are examples of such structures guiding the student collaboration practice. Besides acting as a structuring element, technology contributes to flexibility and fluidity. By offering increased connectedness, technology enables decisions to be continuously negotiated and

changed. Several technologies also offer students a large room for manoeuvring, making it easy to adjust, change, and build new practices and associated structures. The two categories thereby describe a tension between the technology, which both helps to create a structure for the collaboration and opens up for continuous negotiation, adjustment of practice, and building new structures.

The study contributes to the understanding of student choice and motives for using technology. Previously, I have described the students' choice of well-known and commercial digital tools as pragmatic and outcome-focused based on the 'more time for project work' strategy and with a 'why change what works' attitude (Sørensen, 2018). Through the study, it has become apparent that the choice could not be reduced to a matter of 'more time for project work'. Most of the technology used in the project groups provides them with a large manoeuvring space and, thereby, flexibility to adapt and build new structures continuously in the orchestration of the project work. The choice of commercial social tools, like Facebook Messenger, in combination with disciplinary technologies, reflects the balancing of the academic and the social (cf. Section 7.1) and the meeting between the roles of professional partner and friendship (cf. Section 6.7), which characterises PBL project work.

Hybridity and the construction of workspaces

In Chapter 6, I have identified the meetings between seemly distinctive elements. These meetings relate to boundaries between digital/analogue, online/onsite, and contexts and roles inside and outside the university. The MP students use digital and analogue tools in various combinations (Section 6.3.1) – not as a matter of technical skill but as what seems beneficial in the given situation. The onsite and online are part of different relationships; by way of examples, the Sociology students navigate and talk about their shared Google Docs as a place, which expands their colocated onsite workspace (Section 6.2.1), and the digital becomes an almost separate world consisting of different space platforms in the Robotics group online meeting (Section 6.4.1). The relations between the seemly distinctive appear dynamic – like a dance between foreground and background – and for ongoing negotiation.

The meetings show how the students' construction of workspace implies negotiations of online/onsite, digital/analogue, and inside-/outside-university boundaries and indicate that the construction of a shared workplace is part of the groups' maintaining social coherence.

The meetings represent a kind of hybridity in student project work. In the analysis of collaborative situations, the identifications of the meetings became a way of describing elements and dynamics that were difficult to capture in other ways. Definition of categories immediately seemed to reinforce dividing lines, which appeared more fluid and dynamic in practice. The hybridity can be considered fluid (Eyal & Gil, 2021), a matter of the students' choice and autonomy to cross boundaries between dichotomies characterised by changeability and indefinability. I find that the

definition of distinctive categories is primarily a concern of the extent to which they contribute to new perspectives and insights on student practice. It differs immediately from the design of hybrid learning environments, in which the distinctive categories act as thinking tools and are part of a methodology to create new experimental learning environments. The consideration of hybrid as fluid raises questions about how we can work with hybridity in analysing student practices. Inspired by Ryberg et al. (2021), I propose the concept of ecotones as a possible lens when working analytically with hybridity. The distinction between conceptual and affective dimensions and spatial and material dimensions offers a way to approach different relationships between distinctive elements depending on the given situation (see, if necessary, Chapter 8).

Six dimensions of group work

To capture the student collaboration practice diversity and dynamics. I have proposed six dimensions of group work, described in Chapter 7. The dimensions are expressions of tensions and balances that the students orchestrate differently in their project work.

A summary of the six dimensions of group work follows. *The social – academic dimension* relates to the balancing and tension between the social dimension and the interpersonal relationship between members, motivating the professional work and creating a breeding ground for an open and trusting dialogue, on the one hand, and the social taking over and 'stealing' time and focus from the academic work, on the other. *The PBL collaboration – PBL cooperation dimension* includes different orchestrations of work modes and labour division. *The individual – shared dimension* relates to the interplay between individual and shared processes, practices, and preferences in project work, which can support each other constructively and give rise to tensions and conflict. *The planning – improvisation dimension* contains different approaches and strategies for planning the project work; in some situations, practice and collaboration seem planned and predictable, while in others, practice is more characterised by improvisation and unpredictability. *The routine – ad-hoc dimension* concerns the pattern of processes; some activities and practices are understood as routines with repeatability and similar structure, while other activities and practices arise more out of the situational context and needs. *The together – apart dimension* relates to the student orchestration of time and space: Should the group work be co-located or distributed? Should they work synchronously or asynchronously? Where should they work, and how should they construct their workplace?

The dimensions substantiate that the project work can take multiple forms and show that no specific balance point exists towards which the students should strive. At the same time, dimensions contribute to concretise and conceptualise the breadth of practice and possible constellations in the students of the PBL collaboration.

Technology is not an explicit part of the six dimensions; however, as Chapter 7 illustrates, it plays a central role in balancing dimensions. The use of technology to build structures for collaboration – both for routines and ad-hoc to meet situational

needs – and the groups' construction of workplace are examples of how students use technology to balance the dimensions.

For analysis of collaborative practice and student reflection on practice

The six dimensions of group work have both analytical and more practical potential by forming analytical questions regarding student collaborative practice and questions requiring students to reflect on their collaboration practices.

For this purpose, I have found inspiration in the conceptual and affective dimensions and spatial and material dimensions of ecotones (Ryberg et al., 2021). Conceptual and affective dimensions and spatial and material dimensions of ecotones describe how the relationship between seemly distinctive entities can be both contrasting or complementary and sharply divided or interwoven, respectively. The relationship between the entities making up the individual dimension can be contrasting and complimentary, sharply divided and interwoven, depending on the given situation. The dimensions of ecotones can help describe and elucidate differences in the students' orchestration of the six dimensions of group work, as exemplified in Section 8.3.2. Additionally, they emphasise situation dependency by highlighting the importance of 'when': "When is the co-existence peaceful and calm […], and when do tensions arise? […] When are the ecotones experienced as sharply divided environments, and when do they unproblematically blend together?" (Ryberg et al., 2021).

Analytic questions based on the six dimensions of group work	
How is the relationship between academic and social entities in the given situation? … between collaboration and cooperation…? … between individual and shared practice and preferences ...? … between planning and improvisation…? … between routine and ad-hoc practices…? … between together and apart…?	contrasting/complementary/ sharply divided/entangled

Figure 9-3 Analytic questions based on the six dimensions of group work

Building on this, the six dimensions of group work inspire questions about student collaboration practice. We can ask how the relation between the entities constitutes a dimension in a specific situation, as illustrated in Figure 9-3.

For purposes of requiring students to reflect on their collaboration practice, I propose questions demanding identification situations characterised by specific relations and reflections on when the different relations between the entities, which constitute the dimensions of group work, are most beneficial. Examples based on by the social – academic dimension follow (for more examples, see Section 8.3.4):

> When does it work well that the social and the academic are sharply divided? Are there situations in which the social and the academic are advantageously intertwined?
>
> When do the academic and the social substantiate and enrich each other? In what situations do the academic and the social conflict?

Notes on future work

My study of student hybrid collaboration points in two directions concerning future research: 1) exploration of the potential of the study's conceptualisations, and 2) elaborating research of aspects of group collaboration, touched on in this dissertation.

The actual potential of concepts and models for both analysis and reflection presented in this dissertation could advantageously be investigated further. It includes whether and how the student recognises the categories and conceptualisation and how the six dimensions of group work function as a platform for student reflection of practice.

With this PhD project, I have taken an open and exploratory approach and sought a broad understanding of the student PBL collaboration and the role of technology. It would be interesting and relevant for future research to focus on more narrow aspects.

Based on my studies, there are predominantly two aspects that I find interesting to explore more narrowly. The first relates to the social – academic dimension and the student's creating and maintaining social coherence. Ryberg, Davidsen, et al. (2018) emphasise the importance of social processes and presence in nomadic group work and point out a need for further insights into how students create and maintain social coherence. My study confirms the importance of the social dimension of group work and elaborates on this in different ways. The importance of the social dimension stands forth by the consideration of student orchestration of group work, implying balancing the social – academic dimension. Further, the study indicates that the construction of workplace is critical to the students' creating and maintaining social coherence. In particular, it would be relevant to more closely scrutinize the latter.

The second relates to the Routine-Ad-hoc dimension and how the project groups build and adjust, sometimes break down and rebuild, structures for the group work and how

the digital and the analogue play together in this process. What are the rationales in building and adjusting certain structures and associated practices? What infuses small and large changes?

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APPENDICES

Appendix A. Information letter

In accordance with the data protection regulations, Aalborg University is obligated to provide certain information in connection with your data being processed for research purposes. If you have any questions, you are welcome to contact the project manager.	
Data processor:	Aalborg University (AAU) CVR No. 29102384 Fredrik Bajers Vej 5 9220 Aalborg
Contact information for the project manager:	Ph.d.-studerende Mia Thyrre Sørensen, mts07@hum.aau.dk
Data protection officer:	Teia Melvej Stennevad, dpo@aau.dk
Purpose:	Your data will be used for the following purpose: The project deals with collaboration in a hybrid PBL environment. It aims to collect data that illuminates how students collaborate across virtual and physical spaces on a semester project, where problem-based learning forms the framework for the project work. The data will consist of ethnographic observation, including field notes, screenshots of communication between group participants on digital platforms, history of edits in working documents on digital platforms, interviews, and images, and audio and video recordings in connection with interview and observation. Please note that your data may be processed for use in other research projects. The processing will comply with the data protection regulations. Your data will be used only for research purposes.

Legal basis: *In accordance with the data protection regulations, all processing of personal data requires a legal basis. This basis must be disclosed to the persons whose personal data are being processed.*	Your data will be collected using research purposes as a legal basis, cf. the General Data Protection Regulation (GDPR), article 6(1)(e) and article 9(2)(j), cf. article 89(1). Please find the regulation here.
Possible recipients of personal data:	When your data are processed for research purposes, they cannot be used for other purposes. Thus, any possible recipients of your personal data can only be researchers. These may include other researchers from Aalborg University or researchers from other universities, etc. If your data will be disclosed for other research purposes, this will be in accordance with the data protection regulations.
Transfer to countries outside of the EU:	Your personal data will not be transferred to any country outside of the EU.
Categories of personal data: - General personal data *(name, address, age, self-published data, etc.)* - Confidential personal data *(civil registration number, grades, significant social issues, etc.)* - Sensitive personal data *(health data, ethnicity, political opinions, etc.)*	☒ General personal data ☒ Confidential personal data ☐ Sensitive personal data
Period of time:	Your personal data will be processed in the period 01-10-2018 to 01-09-2021 and will be anonymised or deleted after this period. This date may be changed if the research project is delayed or if data from the project, including your personal data, are reused

	in another research project in accordance with the data protection regulations.
Rights:	Deletion You can request that AAU delete your personal data. AAU will delete your personal data if your data are no longer required for the research purpose. However, AAU is not obligated to delete your personal data in all respects. In accordance with the Danish Data Protection Act paragraph 22(5), the following rights do not apply when your data are being processed for research purposes: • The right to objections • The right to rectification • The right to restriction of processing • The right of access If you wish to make use of your right to deletion, you are welcome to send an email to the project manager.
Complaints:	You may file a complaint with the Danish Data Protection Agency if you believe that AAU disregards the data protection regulations in connection with the university's processing of your personal data for research purposes/the research project. Since AAU might be able to solve the issue, you are encouraged to contact the project manager or AAU's data protection officer before filing a complaint with the Danish Data Protection Agency.