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Problem Construction in Problem-Based Learning

How Students Deal with Disagreements in Decision-Making

Velmurugan, Giajenthiran (Kalle)

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HOW STUDENTS DEAL WITH DISAGREEMENTS IN DECISION-MAKING

BY
GIAJENTHIRAN VELMURUGAN

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CV

Giajenthiran (also called Kalle) is currently employed at Aalborg University Copenhagen, where he teaches various STEM programs in Problem-Based Learning. During his PhD studies he has engaged in teaching projects, such as creating interdisciplinary intercultural student projects with students from Aalborg and the University of Brasilia and had a stay abroad at Stanford University. Before this he has taught and supervised students in multiple higher education programs: Language and International Studies, Communication, English and Technoanthropology. He taught subjects, such as Discourse Analysis, Interaction Studies, Ethnographic Methods, and Problem-Based Learning (PBL). Beyond his experiences in higher education, Kalle has also taught basic English in Japan for a year and run for Parliament in Denmark. He has a Master of Arts in Communication.

PROLOGUE

In 2017 some senior PBL researchers at Aalborg University (AAU) across different faculties applied for funds from the top management of the university to study PBL across different faculties of the university to "develop" future directions for PBL; the research endeavor was thus called 'PBL Future.' In their first application round, the research was meant to be conducted by these senior researchers themselves. The funds were granted, however with a twist: instead of the senior researchers conducting the research, a new generation of PBL researchers should see the light, in other words the research that was meant to be conducted by the senior researchers, should be converted to PhD studies. At that time, I was working as a research assistant at the UNESCO Centre for Problem-Based Learning (UCPBL) at Aalborg University.

I was told that one of the offered PhDs at the Faculty of Medicine in the PBL Future project was looking for a relevant candidate and I was encouraged to apply for it. This PhD had the aim of exploring the notion of students constructing the problem themselves, simply because it is a practice conducted at AAU since its inception, and there seemed to be a lack of literature in the area. The initial PhD proposal suggested taking a textual approach towards the exploration of students constructing the problem themselves, analyzing different student projects and trying to elucidate the competences students seemed to show in their problem analysis chapters, however my passion was in studying human interaction, one of the main reasons I also chose to study communication at both undergraduate and graduate level. I applied for the position, suggesting a different approach, studying how students actually *do* problem-construction, and thus also how students actually *do* PBL. I got the fellowship, but with an emphasis on remembering that the central focus had to be on students' problem construction; this thesis is thus a first step in studying this practice.

ENGLISH SUMMARY

In Problem-based learning (PBL), an educational approach central to all education at Aalborg University, the learning takes its point of departure from a problem, is group based and is guided by a knowing other. This educational approach has been documented in at least 500 different higher education institutions around the globe and is, among other things, known for being an effective way of developing students' twenty-first-century skills, such as co-operation, creativity, critical thinking, problem-solving and much more. As the learning takes its point of departure from the problem, knowledge about how problems are constructed becomes an important factor in ensuring students learn relevant subject knowledge. Despite this, there seems to be limited literature on how to develop these problems, and the approach taken at Aalborg University where students are encouraged to construct the problem in co-operation with their supervisor, is rarely mentioned or discussed as a viable way in the international PBL literature. The focus for this thesis is this shared problem construction between students and supervisors, thus the thesis seeks to answer the following research question:

From a conceptual learning perspective, what are the challenges and benefits of shared problem construction and how does this process unfold interactively in the group and in cooperation with the supervisor?

To answer the research question, video data of a group of engineering students' work was collected from the first day of their third semester until their last. The research question is then answered from this extended summary and three articles. Article 1 explores the process from a nonempirical conceptual view and articles 2 and 3 analyze some of the video data of the students' work on the development of the problem, both with and without a supervisor present. In my first article I argue from a conceptual learning perspective that shared problem construction should lead to intrinsic motivation, which in the literature is often connected to learning transfer. I base these arguments on Dewey's notion of genuine problems and theories of intrinsic motivation. In this extended summary I further elaborate on the conceptual learning perspectives that account for previous research, stating that it leads to the development of creative and adaptable skills. Empirically, I did find instances that constitute intrinsic motivation. However, the video data shows intrinsic motivation might not look like we imagine but can be found in instances where the students directly disagree with their supervisor, and state this disagreement to him. The data shows it is quite difficult for the students to challenge their supervisor, thus this thesis tries to explore why they do so, given the fact that they know the supervisor is more knowledgeable in the area than they are, and concludes this is done simply because they are intrinsically motivated to follow a certain trajectory and they see their supervisor's advice departing from this trajectory.

My research shows that shared problem construction is a complicated process that consists of different decision-making processes. It is complicated because the first step in PBL at Aalborg University is to construct an initial problem, which can then be reformulated and amended during the course of the semester. The complication, however, is found in the construction of the initial problem, which is done in a point of time where the engineering students have just started their semester and thus have limited knowledge of their subject field. This is evident in the data, that shows the internal discussions among the students become more "qualified" during the semester. In this aspect "qualified" should be understood as the ability to use subject-specific discourses in the discussions. Another central focus was on the interactional nature of decision-making among the students. Decision-making processes are processes of power because the ability to make decisions and getting others to follow these decisions indicate an ability to direct others' future actions. This becomes interesting to explore because Aalborg University encourages a democratic approach towards the student groups, giving each group member the same amount of power. However, power is always enacted and negotiated in the interaction, thus the thesis explores how this is done both internally among the students and with the students and supervisor. In this aspect power is operationalized as the ability to make one's words match the world, but how is this interactively accomplished among the students? The thesis shows this is done by the ability to hold the floor, defined as the ability to either avoid or counter criticism directed towards one's proposals. However, from a learning perspective the thesis emphasizes the ability to counter criticism is the one that should be encouraged, as it is healthy to have one's decisions challenged because it provides an opportunity to explicitly conceptualize and reflect on why the decisions taken make sense and how this relates to specific subject knowledge. Furthermore, it also provides an opportunity to expand one's knowledge, as different angles, or knowledge other than what oneself imagined, might be put into play.

The thesis discusses how being a student in a PBL curricula is a negotiation between different cultures: a specific discipline culture and a PBL student culture. Being a PBL student becomes a novice position that in one regard provides certain freedoms and autonomy; students become enabled to form their own learning journey in regard to their interests as long as it adheres to their learning goals, and at the same time they also have to argue how their decisions make sense in an engineering culture, thus they are bridging different identities: student and engineer. As a result, shared problem construction becomes a social action in which both the specific subject identity and the PBL identity are defined through ongoing negotiations internally in the group and between group members and their supervisor. The students navigate both between a PBL student and a subject identity, neither of which are they basically equipped to do, but learn to navigate through their engagement in the community of practice. Thus, a consequence of having a project over the course of a semester with relevant coursework, is the fluid nature of the content they are approaching. They start the project as novices, who lack relevant subject knowledge, thus affecting the scientific validity of their problem, and as they become socialized in the subject culture their

problem becomes more qualified. Thus, the evolution of the problem could also be regarded as the evolution of the students becoming a member of the relevant community of practice (in this case engineering practice), providing the argument that the problem itself becomes an identity marker of the relevant subject practice and type of PBL undertaken.

DANSK RESUME

I Problem-Baseret Læring (PBL), en uddannelsesmæssig tilgang til alle uddannelser på Aalborg Universitet, starter læringsprocessen ud fra et problem, er baseret på gruppearbejde og faciliteret af en vejleder. Denne uddannelsesmæssige tilgang er dokumenteret på over 500 forskellige højere lærerinstitutioner rundt omkring i verdenen og er bl.a. kendt for at være en effektive måde til at udvikle de studerendes 21st century skills som f.eks. samarbejde, kreativitet, kritisk tænkning, problem løsning og mm. Da læringsprocessen tager udgangspunkt i et problem, bliver viden om, hvordan disse problemer konstrueres en vigtig faktor i at sikre de studerende lærer relevant viden i relation til deres faglighed. På trods af dette er der begrænset internationalt litteratur omkring hvordan man skal udvikle disse problemer og den tilgang Aalborg Universitet har, hvor studerende bliver opfordret til at konstruere deres problem i samarbejde med deres vejleder er sjældent nævnt eller diskuteret i den internationale litteratur. Fokus for denne afhandling er denne delte problemkonstruktionsproces mellem studerende og deres vejleder, forskningsspørgsmålet bliver således:

Fra et konceptuelt læringsperspektiv hvad er udfordringerne og gevinsterne ved delt problem konstruktion og hvordan udfolder denne proces sig interaktivt i gruppen og i samarbejde med deres vejleder?

For at besvare forskningsspørgsmålet er der indsamlet video data af en gruppe af 3. semesters ingeniørstuderendes PBL arbejde fra den første dag på deres semester indtil den sidste. Forskningsspørgsmålet bliver besvaret ud fra denne afhandling samt tre tilhørende artikler. Artikel 1 udforsker processen fra et konceptuelt ikke empirisk synspunkt og artikel 2 og 3 analyserer noget af video dataen fra de studerendes arbejde med problemet både internt og med deres vejleder. I den første artikel argumenterer jeg fra et konceptuelt ikke empirisk læringsperspektiv at delt problemkonstruktion burde lede til intrinsisk motivation, hvilket i litteraturen ofte forbindes med læringsoverførsel. Jeg baserer min argumentation på Deweys koncept om "genuine problems" og teorier om intrinsisk motivation. I afhandlingen uddyber jeg det konceptuelle læringsperspektiv hvor jeg redegør for tidligere forskning, der påpeger at det fører til udvikling af kreative og adaptive kompetencer. Empirisk fandt jeg episoder der konstituerer intrinsisk motivation. Videodataene peger dog på, at den intrinsiske motivation ikke viser sig som vi måske forestiller os, men kan findes i instanser, hvor studerende direkte modarbejder deres vejleder og kommunikerer den uenighed de har til deres vejleder. Dataene viser, at det er meget svært for de studerende at udfordre deres vejleder, derfor prøver afhandlingen at udforske hvorfor de studerende alligevel gør det, når de ved deres vejleder er en større faglig ekspert på området end de er, afhandlingen konkluderer at dette skyldes det simple faktum, at de studerende er intrinsisk motiveret til at følge en bestemt læringsbane og de ser deres vejleders råd som noget der afviger fra denne læringsbane.

Min forskning viser, at delt problemkonstruktion er en kompliceret proces der består af forskellige beslutningsprocesser. Kompleksiteten består bl.a. i, at det første skridt i PBL ved Aalborg Universitet er en konstruktion af et initierende problem, der løbende kan udvikles og reformuleres igennem semestret. Udfordringen består i, at det initierende problem skal formuleres på et tidspunkt, hvor de ingeniørstuderende lige har startet deres semester og dermed har en begrænset faglig viden. Dette ses også i dataene, hvor de interne diskussioner blandt de studerende bliver mere kvalificeret i løbet af semestret, i den optik skal kvalificeret forstås som evnen til at anvende fagrelevante diskurser i de studerendes interne diskussioner. Et andet fokus bliver på den eksisterende forskning på beslutningsprocesser. Beslutningsprocesser er en social praksis bestående af magtstrukturer, da det handler om evnen til at træffe en beslutning og dermed få andre til at agere ift. den beslutning, hvilket dermed indebærer en evne til at diktere andres fremtidige handlinger. Det er interessant at undersøge fordi Aalborg Universitet opfordrer til en demokratisk gruppeproces, hvor hver enkelt studerende har samme grad af magt. Magt er dog altid konstitueret og forhandlet i den sociale interaktion, dermed fokuserer denne afhandling på, hvordan magten konstrueres internt blandt de studerende og mellem de studerende og deres vejleder. I det perspektiv bliver magt operationaliseret som evnen til at få ens ord til at definere virkeligheden, hvordan sker dette blandt de studerende? Afhandlingen viser, at det bl.a. handler om evnen til at bevare ordet, her defineres evnen til at bevare ordet til at undgå eller svare tilfredsstillende på kritik imod ens forslag. Her er det vigtigt at påpege, at fra et læringsperspektiv er det evnen til at svare tilfredsstillende imod kritik, der burde fremhæves, da det er sundt at få sat spørgsmålstegn ved ens beslutninger, da dette giver mulighed for eksplicit at reflekter over hvorfor de beslutninger der opfordres til giver mening og hvordan dette relaterer sig til den fagspecifikke viden, endvidere giver det også mulighed for at udvide ens viden da forskellige vinkler eller andre typer af viden end, hvad man selv forestillede sig kan blive sat i spil.

Afhandlingen diskuterer, hvordan det at være en studerende i et PBL forløb, er en forhandling mellem forskellige kulturer i dette tilfælde en ingeniør kultur og en PBL studerende kultur, at være en PBL studerende skaber dermed en nybegynder position, der i et perspektiv giver visse friheder og autonomi, de studerende bliver i stand til at forme deres egen læringsbane i relation til deres interesser så længe de er i overensstemmelse med deres læringsmål og på samme tidspunkt skal de også afgøre, hvorfor deres valg giver mening ud fra et ingeniørperspektiv, på denne måde balancerer de forskellige identiteter, en studenter- og ingeniør identitet. Dermed bliver delt problem konstruktion en social proces hvor både en fag- og pbl identitet defineres igennem den løbende forhandling internt i gruppen og mellem gruppemedlemmer og deres vejleder. De studerende navigerer mellem forskellige identiteter, som de på mange måder mangler forudsætninger for at navigere i, men som de lærer igennem deres engagement i den sociale praksis. Dermed bliver en konsekvens af semesterlange projekter med relevant kurser til at understøtte projektarbejdet, den flydende natur af både indholdet de arbejder med, hvor de starter som lærlinge, der ikke har den relevante faglige viden, som har konsekvenser for den videnskabelige

validitet af deres problem, men som så løbende udvikles som et resultat af deres socialisering i den faglige kultur, som dermed skaber et mere kvalificeret videnskabeligt problem. På den måde kan udviklingen af problemet også blive set som en udvikling af de studerendes medlemskab af et relevant praksisfællesskab (i dette tilfælde ingeniør og PBL fællesskab), dermed kan man argumentere for at problemet i sig selv bliver en identitetsmarkør for den relevante faglighed og type af PBL.

ACKNOWLEDGEMENTS

A central argument in this thesis is how learning is examined by studying the social interaction that constitutes the learning. As a PhD thesis is also a learning process and the result of numerous social interactions, some acknowledgements are in order. I wish to thank the students and supervisor who allowed me to record their project work from the first day of their semester until the last, giving me permission to present these recordings in journals, this thesis, and even teaching situations without anonymity. This thesis could not have been written without that data, so I am grateful for your cooperation.

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CHAPTER 1. INTRODUCTION

Problem-based learning (PBL) first emerged in Canada at McMaster University's medical education department in 1963 (Barrows & Tamblyn, 1980). It can be defined as:

> "a mode of small-group guided education that uses problems as the starting point of the learning" (Servant et al., 2016, p. 1)

Thus students work in groups in order to solve a problem from authentic medical cases, and through this method, they gain relevant content knowledge (Barrows, 1996). One of the main reasons for this change of approach toward education is to improve students' learning transfer and their ability to use relevant content knowledge in authentic practice (Barrows & Tamblyn, 1980). Since its emergence in 1963, PBL has now expanded to more than 500 higher education institutions around the world (Servant-Miklos, 2019). Each of these institutions employ PBL in different ways (Chng et al., 2011; De Graaff & Kolmos, 2003; Kek & Huijser, 2017; O'Grady et al., 2012; Savin-Baden & Major, 2004). Some institutions use cases for a number of weeks (Barrows & Tamblyn, 1980; Chng et al., 2011); others take on one problem each day (O'Grady et al., 2012); and still others write a project over the course of a semester (Andersen & Heilesen, 2015; Kolmos et al., 2004). Writing a project over the course of a semester is a model that was implemented at Aalborg University (AAU) in Denmark, which from its inception in 1974 has implemented PBL in all its educational programs. Therefore, this model is also called the Aalborg-PBL model. This is quite different from the one envisioned at McMaster (Stentoft, 2019) because, among other things, students research and write a project over the course of a full semester and problem construction is shared between students and supervisors. Simply explained, the students can construct their problem from cases they find themselves if it adheres to the learning goals of the semester. This practice of shared problem construction will be the focus of this thesis. Thus, the emphasis will be an exploration of how one might construct problems in PBL that might be relevant for all institutions that employ this system of learning,

When defining PBL, it is often emphasized how learning starts or takes its departure from a problem (Albanese & Mitchell, 1993; Barrows, 1996; Barrows & Tamblyn, 1980; De Graaff & Kolmos, 2003; Savin-Baden & Major, 2004; Stentoft, 2019). Despite this, there seems to be limited literature on how to develop these problems. Hung (2016) states: "As critical and fundamental as they are, problems and their design have received far less attention than have other research areas of PBL" (p. 1). He has tried to counteract this by publishing numerous times on how instructors can design problems in PBL (Hung, 2006, 2009, 2016, 2019); however this cannot be applied in a model that fosters shared problem construction. Here Holgaard et al. (2017) have tried to develop a model of how students should carry out this process,

but few studies have focused on how this is accomplished in practice. In other words, the social learning process in which students negotiate the content of the problem remains unexplored and the focus of this thesis – and this dissertation's contribution to the international research literature – is an exploration of this process. The contribution is relevant, not just to improve or gain a better understanding of how Aalborg conducts PBL, but to illuminate the international PBL literature regarding shared problem construction. Why this focus? Quite simply, the approach of shared problem construction is, to some degree, still practiced today but the literature on the subject is limited. Therefore, the emphasis is on obtaining a deeper understanding of the practice to discuss the merits and challenges of the approach. As problems are often defined as the starting point of the learning process, a greater understanding of how these problems are developed and constructed will provide increased knowledge of how to best facilitate problem construction in all types of PBL.

The practice of constructing a problem in PBL is termed differently throughout the literature. Some call it *problem design* (Hung, 2019). When this definition is used it is often implied that the responsibility lies with the teacher/instructor, and thus the focus is centered on the design of the problem. Others call it *problem identification* (Holgaard et al., 2017), implying the problem is out there in the "real world" and students (or teachers) need to identify it. In this thesis the term *problem construction* will be used with a point of reference in Markauskaite and Goodyear (2017) who quote Belth, (1977), and state that problems are "what we form them to be, and thus are as unique as the individual minds that create them." (Markauskaite & Goodyear, 2017, p. 4). From this perspective, problems are seen as constructs that are formulated by the actors. This aligns with Jonassen's (2011) definition of problems, in which actors have to acknowledge there actually is a problem.

Coming back to the definition of PBL: "a mode of small-group guided education that uses problems as the starting point of the learning" (Servant et al., 2016, p. 1). This definition is based on a PhD thesis, which, from a historical point of view, tried to track the intellectual ideas behind the development of PBL. This definition encapsulates three aspects of PBL: 1) it uses problems as the starting point of the learning process; 2) it is based on small groups; and 3) it is often guided by a knowledgeable other. This definition seems broad enough to capture the various ways of implementing PBL as described earlier, while at the same time maintaining the aspects that constitute PBL. I will elaborate on Items 1 and 3 in the following section.

Regarding the first aspect, one might question whether the learning process starts with the problem in an institution that uses shared problem construction. One could in this instance argue that the learning process starts before the problem, as the first point is the construction and analysis of the problem, I argued for this view in my first publication (Velmurugan & Stentoft, 2020). However, now I argue that often the starting point of the group is to make a preliminary construction of the problem, thus the problem (constructed or not constructed) still starts the learning process. The third

item seems to be based on inspiration from John Dewey, who uses the term *guided education* in his writings to define the role of the teacher (Dewey, 1933). Today, words such as "facilitator" might more adequately explain the process of being guided by a knowledgeable other. In other words, aspect three refers to the notion that a more knowledgeable other facilitates the learning process. These aspects also constitute the basis of this thesis; more specifically, the thesis explores a process of shared problem construction, describes how students approach it in their group, and explains how students are guided by a knowledgeable other.

The thesis is based on three articles (Velmurugan et al., 2021, 2022; Velmurugan & Stentoft, 2020). Article 1 (Velmurugan & Stentoft, 2020) focuses on the first aspect, the problem as a starting point of the learning process. From a non-empirical conceptual perspective, it explores the benefits and challenges of shared problem construction. Article 2 (Velmurugan et al., 2021) focuses on the second aspect, i.e., that PBL is a mode of small group-guided education, and it explores how the group interactively negotiates the construction of the problem. Article 3 (Velmurugan et al., 2022) focuses on the third aspect, which acknowledges that the group is guided, and it explores how the supervisor guides the students in constructing a problem that adheres to the relevant subject knowledge for the students. The articles explore the process of shared problem construction from three aspects constituting PBL. This connection is also summarized in the table below:

Table 1: PBL Definitions and Articles

PBL Definition	Article
1) Uses problem as the starting point of the learning process	1: Velmurugan, G., & Stentoft, D. (2020). Student Centered Problem Construction. *Interdisciplinary Journal of Problem-Based Learning*.
2) Based on small groups	2: Velmurugan, G., Stentoft, D., & Davidsen, J. (2021). Disagreeing about the problem in PBL: How students negotiate disagreements regarding the problem in PBL. *Journal of Problem-Based Learning in Higher Education*, *9*(1), 42–62.
3) Guided by a knowledgeable other	3: Velmurugan, G., Stentoft, D., & Davidsen, J. (2022). Students challenging supervisors in higher education: How and why?

As the problem is the starting point of the learning process, it is one of the most important aspects in PBL. Consequently, it becomes important to have a vital understanding of the nature of the problem and how to construct it. This thesis will not explore whether "the best way" of constructing problems is through shared problem construction, nor will it be a "manifesto" of the wonders of shared problem construction. To the contrary, it will explore the process from a conceptual learning and interactional perspective, showing how this process is carried out in practice. I employ an interactional perspective because I align myself with a social view of learning, in this perspective interaction becomes the natural focus:

That is, interaction is the most basic site of experience, and hence functions as the most basic site of organized activity where learning can take place. In this view, social interaction provides not just an interactional frame within which developmental processes can take place; as a social practice, it involves the learner as a co-constructor of joint activities, where linguistic and other competencies are put to work within a constant process of adjustment vis-à-vis other social agents and in the emerging context (Mondada & Doehler, 2004, p. 502).

An exploration of interaction provides a frame in which we can gain an understanding of the processes embedded within shared problem construction. In Chapters 2 and 3, I will elaborate on this social view of learning, but for now, the consequence of this perspective leads to the notion that the group's interaction seems vital to understand the shared problem construction practices in PBL. Accordingly, by learning what happens interactively in the group, we can grasp what happens in PBL. Schlegloff stated that a thorough analyses of interaction will give us a detailed sense of how the world works (1992). These specifications can be used to improve the supervision of students and design practices that optimize the conditions for improving their learning. Therefore Articles 2 and 3 are empirical studies, which will analyze video recordings of students' group work.

1.1. RESEARCH QUESTION FOR THE THESIS

The research data for this thesis involves video recordings of third semester engineering students' work with PBL at Aalborg University. The work on their project was recorded from the first day of the semester until their last, resulting in 225 hours of video. However, in the papers submitted in this thesis only a few selected clips from the first two months are micro analyzed. This resulted in the following research question for the thesis:

"From a conceptual learning perspective, what are the challenges and benefits of shared problem construction and how does this process unfold interactively in the group and in co-operation with the supervisor?"

The motivation behind the conceptual learning perspective should also be understood in relation to the PBL literature, where different models have been developed for teachers on how to design problems (Hung, 2006, 2009, 2016, 2019) and the notion of letting the students construct their problems is directly advised against (Hung, 2016; Krajcik & Shin, 2006). The arguments supporting this point of view are that students might become too dependent on their supervisor; the problem does not take its point of departure from a professional context; it does not teach relevant content knowledge; and the problem might not be of a sufficient quality (Hung, 2016). However, this practice is allowed at AAU, which makes one wonder what kind of results are obtained when students can construct the problem themselves?

1.2. THE STRUCTURE OF THE THESIS

Chapter 2 addresses the first part of the research question detailing the challenges and benefits of shared problem construction from a conceptual learning perspective. It does so by elaborating on some of the arguments presented in the first article with a special emphasis on the historical account of AAU's implementation of PBL in 1974. Thus, the chapter both provides a summary of Article 1 and explains why shared problem construction was implemented at AAU and the theoretical notions that inspired the development. However, as the AAU PBL model is closely aligned to the model used at Roskilde University (RUC), I will first detail the development of this model, which, to a large extent, was directly incorporated at AAU. The emphasis will be on why shared problem construction between students and supervisors was recommended and implemented and the theoretical arguments presented at that time for this approach. As research indicates, there was no active collaboration or idea exchange between McMaster and the Danish development of PBL (Servant et al., 2016). The first part of the chapter focuses solely on the theories and processes used in Denmark to argue for the creation of PBL and shared problem construction. Thus, this chapter illuminates the benefits that were argued to be associated with shared problem construction. It will discuss how the different theories used at the time connect with each other. The chapter should thus be seen as a historical and theoretical discussion of the events that occurred and the ideas behind these events, adding relevant social theories of learning that is widely used today to argue for PBL. I end the chapter with an explanation of the theoretical background and the need to apply other theories to examine the interactional way of doing PBL.

In Chapter 3, I define my sociocultural theoretical standpoint and how to examine shared problem construction from this point. I take a point of departure in Jordan and Henderson's (1995) interaction analysis. As interaction analysis is an interdisciplinary method, I briefly account for other theories interaction analysis uses as a point of departure – e.g., ethnomethodology, conversation analysis, and then combined in my ethnomethodological conversation analytical perspective. I conclude the chapter by detailing how I used the theory of interaction analysis to analyze my data, detailing my analytical strategy. I finish the chapter by describing the scientific merits in

generalizing from case studies. Thus Chapter 3 presents the theory necessary for the second part of my research question in exploring how the process of shared problem construction occurs interactively.

As interaction analysis recommends the use of video to explore learning practices, Chapter 4 focuses on the methodology and method of video observation. First, however, I discuss the nature of qualitative data in academic research, what constitutes data, and how to create it. The emphasis then shifts to the methodology of video observation as a data gathering activity and the kind of knowledge that can be elucidated from video observation. This chapter continues by explaining how the method of video observation was used in my research, with an explanation of the data collection and how videos of one group of students' work was collected. Thus, the chapter explains both how I created the data and why this kind of data is a viable way to examine interaction. The chapter also reflects the limits of video observation. In relation to my research question, it addresses both the type of data and how it was collected and can provide knowledge of the interactive way of conducting shared problem construction.

Chapter 5 provides an extended state of the art regarding decision-making. As the central focus for my two empirical articles ended up being about decision-making, I review some of the literature in this regard. As decision-making has been explored from many different fields, and only rarely from a sociocultural interactional perspective, I start by briefly accounting for the field in general, account for some of the most known research in the area, and then touch upon some recent studies with a Conversation Analysis (CA) approach towards decision-making. Here I account for what to my knowledge is the latest findings in this regard.

Chapter 6 provides a short summary of my findings from the last two articles and their research contribution. I continue with a discussion where I hold my findings up against the latest findings on decision-making accounted for in Chapter 5, discussing my research contributions to the field. To the best of my knowledge, there is a lack of literature on shared problem construction from a sociocultural perspective, I try to amend this by briefly discussing what this process might entail from a sociocultural perspective based on my findings. Then I link my findings from the articles and elucidate what these state about shared problem construction. Subsequently, I link these findings to the international PBL research and explicitly discuss my findings in terms of the critique against the approach of shared problem construction in the literature. I then discuss what implications my findings might have for practice. Thus, this chapter focuses on the second part of my research question and illuminates how the process of shared problem construction occurs interactively in the group between students and supervisors, discussing how this aligns, conflicts with, and contributes to the international literature in the area and what implications these findings might have for practice.

Chapter 7 offers a conclusion by answering the research questions based on this thesis and the research contribution in the articles.

CHAPTER 2. THE DANISH ORIGIN OF PROBLEM- AND PROJECT-ORIENTED LEARNING

2.1. THE POLITICAL PROCESS

In Denmark in 1968, as part of the youth rebellion, students at Copenhagen University protested against the professors, demanding more dialogue between professors and students, influence on the curricula, and more involvement in the structuring of their study programs (Hansson, 2018). As a reaction to these protests, a committee of the Danish Ministry of Education recommended the establishment of "University Centers," which would offer many higher education programs that had previously been hosted by separate institutions (Servant et al., 2016). This resulted in the establishment of Roskilde University Center in 1972 in the city of Roskilde, 30 kilometers outside of Copenhagen. All education at Roskilde took its point of departure from problem-orientation, interdisciplinarity, project work and student-directedness (Andersen & Heilesen, 2015; Illeris, 1974); the model was named project- and problem-oriented learning. Another key feature of this model was the joint allocation of responsibility for problem-formulation between students and supervisors.

In 1974, Aalborg University Center was created. A group of local lobbyists in Aalborg had for some time advocated for the creation of a university in the region of Northern Jutland, the only region in Denmark without a university at that time. The group had lobbied for the creation of a traditional university, not a problem-oriented one. However, it became a mandate from the Ministry of Education that Aalborg would incorporate the same model as RUC, with some small alterations, to which Aalborg agreed. Another differentiating factor was that Aalborg University Center became a fusion of already existing higher education institutions in the region. Roskilde was started from the ground up (Hansen, 1997). Later, Aalborg University Center and Roskilde University Center renamed themselves to Aalborg University and Roskilde University (Servant et al., 2016).

At the start of the 90s, AAU began publishing their model under the name of problem-based learning instead of project- and problem-oriented learning. This switch in terminology to describe their educational model was mainly done for practical reasons, as it made the model more understandable in the international research literature (Servant, 2016). Today Roskilde calls their model Problem-Oriented

Learning and Project Work (PPL) (Andersen & Heilesen, 2015).[1] There has been some debate on whether the Aalborg PBL model can be called problem-based learning. I will not go into detail about this discussion, but simply mention that, according to the definition of PBL used in this thesis, "a mode of small-group guided education that uses the problem as the starting point of the learning," the Aalborg model fits within the definition of PBL.

On a practical level, the model implemented in Aalborg can be characterized as a hybrid, as it has elements of PBL and elements of traditional university courses (Hansen, 1997; Kolmos et al., 2004). In Aalborg, the general structure of education is that each semester offers three 5-European credit transfer and accumulation system (ECTS) point courses, where the students attend exams and are assessed individually and a 15-ECTS project module with associated coursework. Here, students write a project in groups over the course of a semester. Thus, students form groups each semester, from which they choose or construct a specific problem in relation to their learning goals specified in their curriculum. Each group has a supervisor they can consult to address the problem. The supervisor scaffolds the students using scientific practice, helping them to approach the problem from an academic level. The supervisors are either researchers, people from professional practice, or teachers, and it is required that all supervisors have at least a master's degree, although a PhD (or in the process of obtaining it) is preferred (Kolmos et al., 2004).

The supervisor provides feedback on different sections of the project that the students write, teaching them academic practice within their specific subject field. In the project the students identify relevant theories and methods to solve the problem. They conduct experiments, fieldwork or other data-gathering activities, depending on the field, and they analyze these data and write a conclusion of how to address the problem or try to solve it. Students submit the project and defend it in an oral examination, where their supervisor and an external examiner assess them according to the relevant learning goals. The groups vary from three to seven students per group, and the project length is usually 20 pages per group member with a maximum of 100 pages. The examiners are not told how much each group member contributed to the project but

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[1] I do not know whether there has been a renaming of the Roskilde model or the two different sources I used (Andersen & Heilesen 2015; Servant et al., 2016) just named it differently. The essence, however, is, that today RUC calls their model Problem-Oriented Learning and Project Work (PPL) and Aalborg calls their model Problem-Based Learning

need to assess each student in the oral defense of the project. Even though it is a group examination, they are graded individually (Kolmos et al., 2004).[2]

From this general description of how PBL is implemented at AAU I will account for some of the theory used in the development of the Project- and Problem-Oriented Model at RUC, which was implemented in Aalborg. In this regard, the focus will be on theories used to argue for shared problem construction. I will start by accounting for the theory as it was presented at the time and then discuss how these theories differ and relate to each other. I do this to elaborate on some of the conceptual theories presented in my first article (Velmurugan & Stentoft, 2020) in order to provide a more comprehensive answer to the first part of my research question: "From a conceptual learning perspective, what are the challenges and benefits of shared problem construction?"

2.2. A THEORETICAL OVERVIEW

2.2.1. ILLERIS AND HIS USE OF PIAGET

One scholar central to the development of problem orientation in Denmark is the Danish learning researcher, Knud Illeris. He argued with reference to Mausch (1974) that there were three significant skills for the job market: proficiency; adaptability; and creativity. Proficiency refers both to general skills, such as basic math, ability in foreign languages, and skills relevant to the individual's profession. Adaptability skills refer to changing working conditions, and the need for employees to continually adapt to a fluctuating market with new ways of doing things. Creativity relates to abilities, such as critical thinking, independence, and cooperation skills (Illeris, 1974). Illeris claimed these three skills were necessary for the modern-day worker, not as separate units but as complementary components, and, as such, indicated the need for an education system that could develop these skills. The solution, according to Illeris, was to adapt a project-oriented approach, as this would help develop these skills by focusing on a problem and working in an interdisciplinary manner to solve the problem.

The theoretical argument for this approach was taken in Nissen's (1970) development of Piaget's notion of accumulative learning (Piaget, 1954). Piaget proposed the theoretical concept of mental schemas to explain how humans develop intelligence, a theory later used as a learning theory. The individual will always try to create a correlative coordination between stimulus from the environment and inner structure. They do this by sorting information from external stimulation into mental schemas.

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[2] This is the general description and model of all the education at AAU, but, of course, there are exceptions. Some semesters the students enroll in internship, where they write an internship report and not a project. At medicine and law they work with several cases during the course of a semester and for some semesters they write a project.

The process of creating or reconfiguring these schemas is called "accumulative learning," and the process of expanding these mental schemas is called "assimilative learning" (Beck et al., 2014; Illeris, 2007; Piaget, 1954). Assimilative learning and accumulative learning in Piaget's own description should be viewed as interrelated. To use the notion in more practical terms, Nissen tried to separate these concepts by evaluating the teaching activities that would foster one cognitive process over another. He concluded that the development of creative and adaptable skills required accumulative learning processes (Illeris, 1974; Nissen, 1970).

Creativity, according to Illeris, is defined as not following traditional ways of thinking, and because assimilative learning expands existing cognitive structures, it implies following established ways of thinking. Accumulative learning, to the contrary, fosters a reconfiguration of cognitive structures, creating prerequisites for creative thinking. Because this process of accumulative learning also promotes using existing knowledge in new ways, it improves one's adaptive skills. The critique toward the existing educational system is that it relies on a division of independent subjects that do not correlate with each other. These subjects, according to Illeris and Nissen, therefore, create a learning structure of mainly assimilative learning, as it builds upon already existing knowledge/schemas of a specific subject (Illeris, 1974). Therefore, an educational structure that fostered creative and adaptable skills, which was deemed necessary for the workforce at that time, was essential. Project orientation is suggested as such an educational structure because the learning process centers around the problem and not specific subjects, and one needs to understand the complexity of the problem, which then promotes interdisciplinarity. This educational structure is, thus, presented as a way of promoting accumulative learning (Illeris , 1974). The focus on problems as the natural way of learning was mainly based on the thoughts of John Dewey.

2.2.2. JOHN DEWEY

John Dewey focused on the human experience as a natural element for growth and education. From this perspective, education was a natural process for humans, as they would always be educated in their interaction with others through their experience (Dewey, 1916). According to Dewey, learning is not simply a result of inner categorizations of different phenomena, nor is it just a result of external influences; rather, learning is the construction of our experiences in a way that gives new meaning to these experiences (Dewey, 1916). Experience is defined as having an active and passive component. The active component occurs when we do something with our body and the passive component is when we reflect over what we have done, what has happened, and how we can use that knowledge to anticipate future events. When the active and passive components are present, Dewey states that learning has occurred (Dewey, 1916). We learn by doing and by having a more knowledgeable person help us give meaning to our experiences. Dewey is often linked to problem-based learning (Andersen & Heilesen, 2015; Barrows, 1996; Kek & Huijser, 2017;

Kolmos et al., 2004), as he states that the most natural way to learn is through problems. Dewey emphasized the importance of having a more knowledgeable person (the supervisor) guide the students; these active agents learn by solving problems. Learning should, therefore, be seen as an indirect process of solving a specific problem.

Another relevant perspective often mentioned in connection with PBL is the transfer problem, i.e., the students' abilities to use their acquired knowledge in real-life practices. According to Dewey, transfer difficulties are countered by the fact that students engage in broader activities than just one specific task. By engaging in these broader activities in social contexts, one learns more naturally, as humans are innate problem solvers, which then creates prerequisites for better problem-solving and knowledge transfer into similar contexts (Dewey, 1916).

The first instance of PBL was in McMaster University's medical education in Canada (Barrows, 1996; Barrows & Tamblyn, 1980). A central argument for introducing and developing PBL was to enhance the learning transfer of the doctors so they could more easily use their theoretical knowledge in their medical practices. Interestingly, this did not seem to be a priority in the Danish context, where the initial focus was more on empowering students and enhancing the societal relevance of the education in order to foster positive social change (Servant, 2016). Another relevant point in the Danish context was Dewey's focus on authentic problems, which also had an influence on Illeris and shared problem construction.

As established earlier, learning, according to Dewey, involves giving new meaning to previous experiences. Dewey stated that problems are a part of the natural experience and the best way to learn (Dewey, 1916). However, the problem has to be genuine:

> to discriminate between genuine and simulated or mock problems. The following questions may aid in making such discrimination. (a) Is there anything but a problem? Does the question naturally suggest itself within some situation or personal experience? Or is it an aloof thing, a problem only for the purposes of conveying instruction in some school topic? Is it the sort of trying that would arouse observation and engage experimentation outside of school? (b) Is it the pupil's own problem, or is it the teacher's or textbook's problem, made a problem for the pupil only because he cannot get the required mark or be promoted or win the teacher's approval, unless he deals with it? (Dewey, 1916, p. 161)

The problem must take its point of departure from a genuine student interest. If not, the focus changes from trying to solve the problem, to trying to satisfy the teacher and giving them what they want. If the students only see problem-solving as a means to obtain a good grade, the natural problem can become how to obtain a good grade. If the natural problem becomes how to obtain a good grade, the risk is that the content knowledge acquired to obtain that grade will quickly be forgotten, as the content

knowledge was not an objective but a means to accomplish the objective (a good grade) creating rote learning. It is natural to assume students aim to get good grades (Liu & Carless, 2006), but if that is their single concern and no natural interest in the genuine problem is invoked, then the knowledge, according to Dewey, will often be forgotten and not lead to knowledge transfer. Interestingly, Illeris uses the same argument to explain why students should have a stake in the problem formulation as well, although he uses the word "ownership." Students need to feel ownership of their problem; if not, they will not care about the problem, but only about getting a good grade (Illeris, 1974). In this regard, his influence from Dewey is clear and explains why he advocated for shared problem construction. However, there was another inspiration in relation to why shared problem construction was necessary. This was mainly found in the Frankfurt school and the writings of Oscar Negt.

2.2.3. OSKAR NEGT

Oskar Negt and the principle of exemplary learning became important in the development of project- and problem-oriented learning. The principle of exemplary learning was conceived in West Germany in the 1950s (Illeris, 1985) when it became necessary to prioritize offered courses in the different education fields. The main objective was to seek out the most relevant and exemplary knowledge of a given subject. Oskar Negt developed this principle of exemplary learning and promoted the notion that working-class children suffered language barriers in the education system, which alienated them from these systems (Negt, 1975). Because the universities used subject knowledge language that the average worker did not understand, it limited the elite specialized knowledge to a select few. If one were to include and teach the workers the specific subject knowledge, the origin had to be in problems relevant to their everyday experience, which would exemplify broader theoretical principles (Negt, 1975). Instead of going from theory to practice, the notion would be to go from practice to theory. Furthermore, Negt criticized the division of academia into distinct disciplinary subjects as inaccessible to the working class. This criticism was founded in the fact that bourgeois language had no representation in the workers' experience, thus making it inaccessible to them. This is exemplified in the following quotation: "The very coexistence of the proletarian production of experience and that of scientific and scholarly knowledge is based on their diverse material foundations" (Negt et al., 2016, p. 26).

Negt directed this criticism against academia, and it became a founding principle for RUC and an important argument for its use of interdisciplinarity (Illeris, 1974, 1985, 2019). The ideas also emerged in the founding of Aalborg University Center, but the motivation was the fact that the university needed to attract and persuade the working-class children to get an academic degree. One viable way of doing this was with the introduction of exemplary problems (Servant, 2016). According to Negt, a problem was exemplary if it could demonstrate a societal structure in which the worker could identify with the relevant subject knowledge and terminology (Negt, 1975).

Thus, the notion of shared problem construction was based on a fact of recruitment, emancipation, motivation, and breaking the negative social heritage among the working class. Another emphasis was that problems had a societal relevance and were constructed in a way that would help marginalized groups in society. Although these principles were strong in the beginning, Roskilde and Aalborg developed in different ways. Aalborg quickly focused on other aspects and Roskilde was almost closed because of the Danish Parliament's fear that they were brewing Marxist and communist thoughts at the university (Servant, 2016). After these experiences, the focus on both institutions became more centered on constructivist learning theories exemplified by Piaget and Dewey (Servant, 2016).

2.2.4. RELATIONS BETWEEN PIAGET, DEWEY AND NEGT

It is evident that the theories used to argue for problem- and project-oriented learning are varied, with distinct focuses of the learning process. A way to explain this combination of theories can perhaps be found in the following quotation: *"I think it makes sense to say that it's not ideas that have been developed, it's practices that have been developed and adopted ideas"* (Quotation from Henning Salling Olesen[3] in Servant et al., 2016, p. 210)*.* Thus, one could argue the theoretical framework concerning problem- and project-oriented learning is retrospective, meaning practices were developed first and then explained using relevant theories.

When looking behind the theories described above, it becomes evident that the transition to PBL was also a transition from an instructive to a constructive practice of learning. In the instructive view of learning, knowledge becomes a collection of facts about the world and procedures for how to solve problems. In this view the goal of education is to transmit these facts and procedures to students, because people are considered educated once they possess a large collection of these facts and procedures. Furthermore, the goal of the teacher becomes the transmission of such facts and procedures to the students (Swayer, 2006).

The constructive view does not view learning as being transmitted from one person to another, but as the result of an active construction from external stimulation (Swayer, 2006). However, constructivism has developed in different ways (Davis & Sumara, 2002). These differences appear in studying learning from the individual, social, psychological, cognitive, radical, critical and trivial perspectives (Gordon, 2009). Piaget focused on how external stimulation was actively constructed as a cognitive process (Piaget, 1954), and Dewey focused on both concrete actions done with the body and later reflected upon (Dewey, 1938).

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[3] Henning Salling Olesen is a former member of a student union involved in the development of project-oriented learning in Denmark. The quotation is from an interview found in Servant et al. 2016 p. 210).

One difference between Piaget and Dewey is that Piaget conceptualized learning as a construction of cognitive structures where a Deweyan pragmatist would see learning as a formation of habits of action (Kivinen & Ristela, 2003). Looking back to the theoretical notions of problem-oriented learning, it becomes evident that Nissen and Illeris tried to take Piaget's thoughts into a more pragmatic direction, detailing exactly what kind of practices would foster which kinds of cognitive activity. An important notion in this regard is that Piaget directly advised against separating assimilation from accommodation: *"This new phase of mental development is of course inseparable from the first; object and causality are nothing other than accommodation to the reality of the schematism of assimilation"*(Piaget, 1954, p. xii).

The quotation describes assimilation and accommodation as an intertwined process of categorization of mental schemas. Although Illeris and Nissen were aware of this (Illeris, 1974), they did still try to separate the processes in order to make them more practical and test them in real-world use; one could argue this was a way of verifying Piaget's thoughts in a more practical sense. Instead of focusing solely on the cognitive processes in which learning takes place, learning is viewed as an actual social practice and a formation of habits of action. Thus, they tried to elucidate what the "doing" should be to create the right kind of learning.

Critical theory, originating from the Frankfurt school, also became a relevant factor in Oskar Negt's theory of exemplary learning. The differences between critical theory, pragmatism and constructivism lie in the focus on society's structures and how these structures marginalize certain groups. As previously mentioned, Negt described how the working class was marginalized by institutions' bourgeois language, which was inaccessible to them. A central focus for critical theory was the strengthening of student autonomy, which was also a demand being made in several countries as part of the late 60s youth rebellion (Blake & Masschelein, 2003). This was also evident in Denmark (Hansson, 2018). In this regard, critical theory laid the groundwork for the introduction of problem-oriented learning as it in part fueled the student rebellion leading to the creation of project and problem orientation.

Project and problem-oriented learning primarily resulted from three paradigms: constructivism, pragmatism, and critical theory. These were also given as reasons for the introduction of shared problem construction: constructivism because it created an active cognitive process of accommodation, which was argued to lead to adaptability and creative thinking; pragmatism with its focus on problems and "the doing" changing students' habits and actions and creating intrinsic motivation with the use of genuine problems; and critical theory emancipating students by increasing their autonomy through a joint responsibility in the problem construction, which made academic knowledge available for marginalized groups. With this historical, political, and theoretical background of shared problem construction, I will now provide a summary of my first article, as it builds upon some of these thoughts.

2.3. SUMMARY OF ARTICLE 1: STUDENT-CENTERED PROBLEM CONSTRUCTION

This article first identifies the student-centered problem construction (SCPC) process (Velmurugan & Stentoft, 2020). As mentioned previously, this took its point of departure from Markauskaite and Goodyear (2017), who quoted Belth (1977), stating that problems are "what we form them to be, and thus are as unique as the individual minds that create them" (Belth, 1977) (Markauskaite & Goodyear, 2017, p. 4). The article thus both describes the process of SCPC and examines what is known about problems in general and in relation to PBL.

The article argues that there is an agreement in the literature that the social actor must acknowledge the existence of a problem before it becomes a problem (Adolphsen, 1992; Illeris, 1974; Jonassen, 2011). Therefore, the criticism toward a teacher-designed problem is that it may not be perceived as a problem for the students. In the PBL literature of problem design, an emphasis is placed on the students developing ownership of the problem (Hung, 2016; Hung et al., 2013), which the article argues might best be achieved by allowing the students to construct the problem themselves.

Furthermore, a central argument for implementing PBL in the international literature is that of learning transfer or the ability to use the acquired content knowledge in authentic practice (Barrows, 1996). This article argues that the ability of learning transfer was based on Dewey's thoughts of genuine problems (Velmurugan & Stentoft, 2020), which should foster the ability to use one's knowledge in different contexts. The article further argues that Dewey's notion of genuine problems and its effect on the learning process can be linked to self-determination theory's concept of intrinsic motivation (Velmurugan & Stentoft, 2020). Thus, the use of SCPC is an effective means of giving students ownership over the problem, which then leads to increased intrinsic motivation, which will, in turn, lead to enhanced learning transfer.

However, giving the students this much responsibility in their learning process requires the scaffolding of a competent tutor, which the article recommends is a researcher. In this way the academic level of the problem can be ensured; furthermore, the problem should align with some predetermined learning goals. It was also argued that the process is time-consuming; thus, adequate time is necessary for the students to construct a relevant academic problem. The research contribution of this article is its engagement with the debate on how problems should be constructed in PBL, arguing for an approach of SCPC, which at that time seemed to be lacking in the international PBL literature, and linking Illeris's use of Dewey's thoughts to other theoretical frameworks such as self-determination theory. Furthermore, it also explicates the disadvantages of the approach, mainly its time-consuming nature, in that it takes time to construct a problem.

2.4. NEW KNOWLEDGE ACQUIRED SINCE SUBMISSION

Knowledge is never static, and our understanding of the field continues to evolve. Thus, I will update this section with the newest knowledge in the area since the submission of Article 1, adding some changes I have made along the way.

First, I have renamed the process "shared problem construction" to emphasize that the problem is a construction of many different actors and not just the students. Although I do emphasize this in the article, the name "student-centered problem construction" places too much emphasis on the students. It might well be the supervisor or external cooperation partner or learning goals that determine the final construction of the problem.

Since the submission of my first paper, other studies in the area have emerged. Stentoft (2019) emphasized how shared problem construction changes the learning objectives for the students in order to provide competencies in exploring scientific problems. Thomassen and Stentoft (2020) highlight the need to not only train students in solving problems but to develop skills in identifying and conducting a thorough problem analysis considering the complex and interdisciplinary realities in which problems often exist. Jæger and Jensen (2019) point out that shared problem construction gives the students an ownership over their problem making them "feel" the problem. Furthermore, it emphasizes the authenticity of the research and learning process, as students are driven by their own curiosity, with no answers or solutions provided for their specific problem. Thus, students are transformed from knowledge consumers to knowledge producers. Furthermore, as the students have the responsibility of constructing the problem, it requires the group members to actively engage in dialogue concerning the direct formulation and construction of the problem, thus the discussion of the content engages the students and creates a social learning process. This social process in which students try to reach agreement about the content of their problem is the focus of two papers submitted with this thesis (Velmurugan et al., 2021, 2022).

In this regard I want to emphasize that I have not been able to find any additional literature about shared problem construction. Initially the thought was to write a literature review for my first paper; however, at that time the only sources I could find addressing the concept of shared problem construction, were the texts from Illeris back in the 70s, thus the focus changed towards a conceptual article. In my discussion I will try to discuss the concept of shared problem construction from a socio-historical/cultural point of view.

Thus far, I have focused on the first part of my research question detailing the challenges and benefits of shared problem construction from a conceptual learning perspective. I have indicated that the benefits include an increased intrinsic motivation, better learning-transfer abilities, development of creative skills, and a way to make academic knowledge accessible for the working class. I have argued the

challenge is a time-consuming process and requires proper scaffolding. The next part of the research question focuses on how the process of shared problem construction unfolds interactively. Before I address this, I wish to elaborate on the ideas presented in Chapter 1 concerning why it makes sense to focus on the interaction. I will start with how constructive learning theories have developed since the 1970s, and then present the foundation for why it makes sense to analyze shared problem construction from an interactional perspective.

2.5. A FOCUS ON THE SOCIAL

Constructivism has developed in many different ways; however, a central thread in all its variations is the agreement that learning is an active process (Phillips, 1995). Theories differ as to which aspect of the active process to focus on, ranging from the individual, social, psychological, cognitive, radical, critical, or trivial (Gordon, 2009). One critique of constructivism indicates that it is an "anything goes" relativist discourse (Davis & Sumara, 2002). Although constructivism is a broad term, this is not problematic if the constructivist researcher clearly indicates his/her focus. Another criticism emphasizes that constructivism does not require a teacher with specific subject knowledge, as the focus is on guiding the students to actively construct their own knowledge, thus the role of the teacher changes to a facilitator rather than a subject specialist. This is, however, a misguided criticism, as it is not "either/or" but both. Teachers need to be both facilitators and subject experts who can guide students in the right direction, as explicitly mentioned by John Dewey (Dewey, 1933).

One way PBL fosters active learning is through the use of group work, where students actively cooperate to address their problem (Jæger & Jensen, 2019). Illeris indicated that group work was positive in a learning context, because it fostered more active learning (Illeris, 1974). He further believed that students would contribute more and be willing to discuss their thoughts, as it was a safe environment in which they could advance their knowledge as well as develop important cooperation skills. This leads to the critique of Piaget and his focus on cognitive development. He indicated that knowledge is solely constructed from action, independent from social interaction. This has been criticized mainly by Vygotsky for ignoring the social dimension (Cole & Wertsch, 1996).

Vygotsky claimed the mind is created through interaction with the social environment, and not as an independent intrapsychological unit itself (Rieber & Wollock, 1997; Vygotskiĭ & Cole, 1978; Wertsch, 1985). According to Vygotsky, consciousness is produced through social interaction (Vygotskiĭ & Cole, 1978). The child internalizes actions in a social environment, and from these interactions creates an independent mind. This internalization of external stimulation often transforms a person's actions. When a child moves their hand toward an object, that action can be interpreted as pointing toward an object in its social environment, whereby the child's action is transformed from reaching the arm toward pointing. The child thus internalizes the

social categorization of the kinetic movement, transforming their action from reaching out to pointing (Wertsch, 1985). Another central concept of Vygotsky was the introduction of mediational means (Wertsch, 1991). Because the self is mediated by interaction, it is embedded in a community's historically evolved sense-making tools. These tools should be understood as mediational means and can be aspects, such as language, gestures, and other tools, from which a message is delivered (Streeck et al., 2011; Wertsch, 1985, 1991). Therefore, social actions will always be facilitated through different mediational means. As such, a central claim by Vygotsky is that all psychological functions are culturally, historically and institutionally situated and context-specific (Cole & Wertsch, 1996).[4] In Chapter 3 I will address how these thoughts have developed into the sociocultural theory I position myself within.

Another theory from Vygotsky that scholars often link to PBL is the zone of proximal development (Servant, 2016). A central element of this idea is that the mind and learning are created by having a more knowledgeable person respond to the child's actions. In his concept of the zone of proximal development, Vygotsky focuses not on what the child can do, but on that which the child can do with the help of an adult that directs the child toward the zone of the child's proximal development (Vygotskiĭ & Cole, 1978). The zone of proximal development refers to a dynamic ever-changing abstraction of the development potential for the individual, and you cannot teach the child something outside of this zone (Wertsch, 1985). Although many of these theories are concerned with the child, they are also deemed relevant in the context of all human interaction, thus the case of supervision in PBL is often connected to Vygotsky's zone of proximal development. In today's literature this specific process in which a teacher guides a student is often called "scaffolding" (Glazewski & Hmelo-Silver, 2018; Hmelo-Silver et al., 2007; Reiser, 2004). Another scholar who advocated for the social development of mind and self was G.H. Mead (1934)

Mead criticized methodological individualism, by which he meant the accounts of social life and symbolic interaction that position the self, meaning, mind and intersubjectivity as epiphenomena or products of individual minds (Mead, 1934). The mind is developed socially through language: "Mentality on our approach simply comes in when the organism is able to point out meanings to others and to himself. This is the point at which mind appears, or if you like, emerges" (Mead, 1934, p. 132). Therefore, the self would develop through the significance that human beings are able to produce and interpret in their interactions through language. When we communicate, we form an idea of how our statement is understood by the recipient through a common repertoire, and it is through this expectation that our statements are understood, and the mind is developed:

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[4] Piaget did, however, acknowledge this criticism and emphasized the importance of social relations. However, his focus seemed to be on the cognitive construction of knowledge, where Vygotsky focused more on the social construction of knowledge (Cole & Wertsch, 1996).

It is absurd to look at the mind simply from the standpoint of the individual human organism; for, although it has its focus there, it is essentially a social phenomenon; even its biological functions are primarily social. The subjective experience of the individual must be brought into relation with the natural, sociobiological activities of the brain in order to render an acceptable account of mind possible at all; and this can be done only if the social nature of mind is recognized (Mead, 1934, p. 133).

The development of the mind is dependent on social recognition by other human beings to obtain significance from specific events that can form the mind. Another important factor in this regard is the importance of the reflectiveness of the single individual. In reflection, the individual is able to "take the attitude of the other toward himself" (Mead, 1934, p. 134), and by doing this, they become able to adjust or develop themselves. Thus, reflection of other responses to one's actions becomes important in the development of one's own mind. We see how Dewey also defines learning as new meaning given to previous experiences, and, in that regard, his thoughts and Mead's are aligned.

2.6. SOME DELIMITATIONS FOR THE REMAINING THESIS

In the above the social nature of learning has used Mead and Vygotsky as points of reference. Although these theories are focused on the development of the self, they also explain how learning is a result of the social interactions human beings encounter in a community's historically evolved sense-making practices (Streeck et al., 2011). Consequently, one could argue that they also explain why group work in PBL fosters learning if the group actively discuss the academic content of their study. In this regard, students formulate and negotiate a specific understanding of the content that becomes a viable concept in their minds, showing how learning happens through the active use of their acquired knowledge.

As numerous studies have pointed out, most learning in PBL occurs in active collaboration within the group (Barrows, 1996; De Graaff & Kolmos, 2003; Dolmans et al., 2001; Hmelo-Silver, 2004; Krogh et al., 2013; Savin-Baden & Major, 2004; Schmidt, 1983). A common aspect for all theories introduced previously in this chapter is that they can all be argued to have a constructive view on learning, which means that learning is an active process. This, however, is still an "anything goes" discourse, and given the fact that most of the learning in PBL is said to take place in the social interaction of the group, the focus for the empirical part of this thesis will be on this social interaction. As a result, critical theory, cognitive processes, and reflections, unless they are made socially available, will be excluded. In other words, this thesis will focus on the social interaction in the group regarding problem construction. Interaction occurs in a specific community's historical evolved sense-making practices and, until now, the focus has been on analyzing these practices, which is also a central point in my first paper (Velmurugan & Stentoft, 2020). Additionally, to study the practice of shared problem construction, the focus shifts to

how this process is carried out interactively among the students themselves, and in their interaction with their supervisor. Thus, a problem occurs in relation to using the previous constructive theories to analyze these practices as evidenced in the following quotation:

> An obvious problem with most attempts to impose such discourses [Piaget and Vygotsky] onto formal education is that these perspectives were never intended as sources of practical advice. They were developed as theoretical accounts of human knowing and knowledge -- phenomena that are presented as complex events through which biological predispositions, cultural contexts, and idiosyncratic experiences are stitched together into interpretations that are adequate to maintain coherence within immediate situations. (Davis & Sumara, 2002, p. 417)

As exemplified in the above quotation, the constructive theories just accounted for (Piaget, Vygotsky and Mead) are more suited for analyzing human knowing and knowledge in general instead of formal education. This might seem contradictory, as I have just accounted for scholars who have done this, and I have done this myself in my first publication. However, I would argue that these discourses are suited to analysis from a conceptual learning perspective, but not to analyze empirical data of actual social practices. These theories have provided sufficient knowledge to answer my first part of the research question regarding the conceptual learning perspective, and they provide relevant background knowledge to analyze the social interaction. However, another theoretical and methodological framework is needed that will adhere to the same constructive and social principles and simultaneously allow for an analysis of the concrete social interaction evident in the group's interaction, which I will elaborate in the next chapter.

CHAPTER 3. INTERACTION ANALYSIS

In this chapter, the focus becomes the method of interaction analysis. However, this method draws upon the methodology of conversation analysis and ethnomethodology, which can be combined in a framework known as "ethnomethodological conversation analysis," which again takes its point of departure from a sociocultural perspective derived from the theories of Mead and Vygotsky accounted for in the previous chapter. In the following, I start accounting for the method of interaction analysis, briefly go deeper into the notions of ethnomethodology, conversation analysis and ethnomethodological conversation analysis, account for how these fit within the sociocultural framework and then I return to the method of interaction analysis, describing the way I handled and analyzed my data. I finish by discussing different types of generalizations from case studies.

Interaction analysis (IA) is an interdisciplinary method for the empirical investigation of human beings and their environment (Jordan & Henderson, 1995). As my research question for this thesis is how shared problem construction is interactively accomplished, IA provides me with the necessary theoretical and methodological framework to analyze how students interactively accomplish this. In the two empirical publications submitted with this thesis (Velmurugan et al., 2021, 2022), I stated that I analyzed my data using conversation analysis (CA). However, a more accurate statement would have been to state that I took my point of departure from IA, which partially bases its foundation on CA. From an IA perspective, CA is one of many ways to study interaction, thus if one conducts a CA analysis, it does not conflict with the theory of IA, which emphasizes different ways of analyzing interaction and encourages using a combination of methods.

A basic assumption in IA is that knowledge and action are social in origin, organization and use, and situated in the interactions among members of communities engaged with the material world. When cognition is viewed as socially and ecologically distributed, the primary focus for IA becomes the details of social interactions in time and space in the naturally occurring everyday interactions among members of community of practices (Jordan, 1992; Jordan & Henderson, 1995; Lave & Wenger, 1991). IA focuses on human activities, defined as talk, nonverbal interaction, and the use of artifacts and technologies. Emphasis is placed on authentic practices with natural interactions in specific communities of practices. Applying these assumptions to learning practices, it becomes evident that the best way to understand and examine learning activities according to IA is to focus on how people collaboratively participate in learning. In part, IA bases its foundation on ethnography, ethnomethodology and conversation analysis (CA). I will briefly elaborate on the last two items in the following sections and a combination of these.

3.1. ETHNOMETHODOLOGY

The term "ethnomethodology" refers to the study of common-sense knowledge and a range of procedures and considerations on which ordinary members of society interpret and act (Heritage, 1984). It was developed by Harold Garfinkel to study concrete practices in situations where they are produced (Garfinkel & Rawls, 2002). A central claim of Garfinkel is that social actions are orderly and if an individual aims to pursue a certain goal, the individual must produce recognizable social practices to do so (Garfinkel & Rawls, 2002). Accordingly, it is the task for ethnomethodological researchers to study these concrete practices in situations where they are produced. By using ethnographic methods and engaging in natural practices, it becomes evident how order is displayed and maintained in social interactions. The focus is on studying members' practices. Ethnomethodology is often characterized as a kind of microanalysis; however, it does not acknowledge this distinction between micro- and macroanalysis, as they state social practices are evidence of both (Garfinkel & Rawls, 2002). The following quotation illustrates this matter.

> A formatted queue's exhibited order of service, and all the order phenomena that accompany it, appear as properties of the queue that transcend its production cohort's actions. The queue appears to be completely disengaged from the work its members do to produce and maintain it. It is an immortal queue, a queue that could continue indefinitely. Yet, without the members of a queue – its local, production cohort – the queue would not exist. It would have none of its local, particular-queue, queue-specific properties (Garfinkel & Livingston, 2003, p. 26).

In this quotation Garfinkel and Livingston explain how a queue exists both as a phenomenon, a concept we know and recognize that goes beyond the social actions of forming a queue, and at the same time, a queue only exists because of the social actions that produce it. Thus, the queue exists as both "immortal" and as a practice of a local production cohort. Accordingly, the focus of ethnomethodology is on concrete empirical social practices wherein both macro-and micro structures and their interrelations are produced, reproduced, used and managed (Hilbert, 1990). Consequently, a central focus is the empirical nature of the examined social practices. This does not mean that ethnomethodology is atheoretical; it does not remove the analyst as an interpreter of data. It simply binds its analysis in these data and from the concrete empirical and observable database of their claims (Hilbert, 1990). An often-used way of conducting ethnomethodological analysis is with the help of conversation analysis (CA) (Button, 1991; Heritage, 1984; Lynch, 1993; Sacks & Jefferson, 1995).

3.2. CONVERSATION ANALYSIS (CA)

A central focus for CA is the examination of natural conversations in order to determine how different social actions are accomplished by the interlocutors' behavior (Heritage, 1984). CA aligns with constructionist and interpretivist principles

in educational research. Its epistemological and ontological assumptions are that social interaction is orderly at all points and that interactants orient to that order, an order which can be discovered and described (Heritage, 2009). CA aims to identify structures within this social interaction that involve detailed transcriptions of the interaction taking place through a reliance on a case-by-case analysis that leads to generalizations across cases but without allowing them to aggregate (Stivers & Sidnell, 2013). In its most simple explanation, CA examines what an utterance does in relation to the preceding one(s) and what implications an utterance poses for the next one(s) (Arminen, 2005). As such, CA links to ethnomethodology (Garfinkel, 1967). What differentiates CA from ethnomethodology is the specific approach toward how to analyze interactions. A central focus for CA is the recording of natural conversations. CA developed specific forms of transcribing (Jefferson, 2004) and different tools to examine features of conversations (Stivers & Sidnell, 2013). As the focus is on the smallest details of these conversations, this is not necessarily a requirement for ethnomethodological studies (Lynch, 1993).

Data used for the conceptual development of CA involved tape recordings of phone conversations (Sacks & Jefferson, 1995) and numerous studies have focused on audio recordings (e.g.) Arminen, 2005; Drew & Heritage, 1992; Heritage, 2005, 2012, 2013; Sacks et al., 1974; Schegloff, 1992; Schenkein, 1978). Another benefit of having these recordings is the ability to show the data to fellow researchers in a way other data collection does not offer. Conversations are transcribed in a specific way following the Jefferson Transcription System (Jefferson, 2004), which allows the analyst to focus on the minor details of interaction.

CA studies have often been used to analyze educational practices. As Mondada states, "Interaction is consequently the most basic site of experience, and hence functions as the most basic site of organized activity where learning can take place" (Mondada & Doehler, 2004, p. 502). Thus, a CA approach fosters a study in the most basic site of the students' learning process. Another development in this regard is that of interactional practices within an institutional setting, also referred to as "institutional CA" (Arminen, 2005; Drew & Heritage, 1992). When analyzing interactional practices within an institutional setting, the task is to specify the verbal practices and interactional arrangements through which the institutional practice is talked into being (Arminen, 2005). The analyst's task is to demonstrate the relevance and the procedural consequentiality of the institutional context. This is evident in two of the articles included in this thesis (Velmurugan et al., 2021, 2022). These analyses have been inspired by recent developments within the field of ethnomethodology and conversation analysis.

3.3. ETHNOMETHODOLOGICAL CONVERSATION ANALYSIS (EMCA)

In this thesis, I position myself with scholars such as Goodwin and Erickson. Goodwin is the author of the article: "Professional Vision"(1994), which as of 2018 was the most cited article published in *American Anthropologist* (Goodwin, 2018). The article took its point of departure from the Rodney King trials, a case in 1991 where four white police officers were caught on camera beating Mr. Rodney King an African American motorist, who had been stopped for speeding. The trials took place in 1992, and in the first trial the four police officers were acquitted of charges by the jury[5] I am mentioning this article not because of the issue of police brutality but because of the approach Goodwin took in his analysis. By using public recordings of the trials and with an EMCA approach he examined why the jury might have come to the verdict of not charging the officers, given the video records of the beatings were so vivid. Thus, the aim with CA is reconfigured not just to examine structures within social interaction, but also to examine why different interlocutors act as they do based on interactional observations (Goodwin, 1994). In this case Goodwin showed how the defense lawyers' strategy became an example of professional discourse, being able to convince the jury that the police were acting accordingly within their profession, and it was Mr. Rodney King who escalated the situation, by moving his torso up while getting beaten. Thus, by calling in an expert witness, who used a coding scheme of escalation/de-escalation, he was able to transform the perceptual field of the recording, transforming it into careful, systematic police work. This was then additionally supported by highlighting certain actions and using graphic representations, transforming Mr. Rodney King from an agent into an object (Goodwin, 1994). Coming back to the theory of how to analyze social interaction, Goodwin argues:

> Such work contributes to efforts by linguistic anthropologists, practice theorists, and conversation analysts to develop anthropologically informed analyses of human action and cognition as socially situated phenomena, activities accomplished through ongoing, contingent work within the historically shaped settings of the lived social world. In this process some traditional dichotomies that have isolated subfields from each other, such as the assignment of language and the material world to separate domains of inquiry, disappear.(Goodwin, 1994, p. 626)

In this perspective, it is important to emphasize, that Goodwin throughout his authorship (Goodwin, 1980, 1994, 2000, 2004, 2007, 2013, 2018) makes anthropological claims about how humans in general are forming and are formed by the historical shaped settings of the lived social world. In other words, by analyzing

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[5] As riots followed the results of this verdict another trial was held in which two of the officers were found guilty.

different examples of micro interaction, he makes claims about why and how we interact as humans, thus combining anthropology with ethnomethodological studies and conversation analysis. In relation to this thesis, the point is I similarly address the why question when analyzing different instances of interaction, interpreting why students act in certain ways instead of others. Furthermore, as I am analyzing small sections of interactions within PBL, these sections can still exemplify broader principles relevant for all cases of (PBL) education. Erickson also argues for the combination of micro analysis to broader discourses in society: "the enactment of communication creates reflexively its contextual framing at the same time as it is being framed by its context" (Erickson, 2004, p. 7); in other words, we both produce and reproduce certain discourses in our interaction. He further criticizes the emphasis on the local conduct of talk:

> Specialists in the study of the local conduct of talk – sociolinguists and conversation analysts – have sometimes tended toward tunnel vision – focusing so closely on specific features of talking itself that they overlook the global aspects of talk's ecologies. Specialists in the study of the global workings in society – social theorists and historians – purchase their breadth of view at the expense of depth and nuance. They usually do not pay much attention to the actual talk of local social actors – what specifically is said and how that is done behaviorally, in myriads of local encounters. (Erickson, 2004, p. 108)

Thus, the point Erickson is arguing for is an analysis that focuses on the combination of micro interactions with broader discourses in society. In other words, he also deals with the "why" question in his study of interaction: why do certain actors act as they do and in which regard does broader discourses shape these interactions? With this thesis I try to position myself in the same sociocultural ethnomethodological conversation analytical field as Goodwin and Erickson. In this regard Erickson further argues for making ethnographic generalizations from micro studies, focusing on both how certain discourses are produced and reproduced in the interlocutors' interactions. I will continue this discussion, by discussing generalizations from case studies later in this chapter.

In sum, drawing on the notions from Vygotsky, Mead, Garfinkel, Sacks, Goodwin and Erickson I position myself within a sociocultural framework, which: "stress[es] that learning activities are both negotiated and accomplished in local contexts and transmitted and elaborated across historical contexts" (Mondada & Doehler, 2004, p. 504). Another central idea in this line of thought is Vygotsky's notion of mediation, where higher forms of mental functioning are mediated by tools (objects and symbolic means such as language) collaboratively constructed by members of a culture. As Wertsch (1991) noted: "Human mental functioning is inherently situated in social interactional, cultural, institutional and historical contexts" (p.6). (Mondada & Doehler, 2004, p. 504). My way of conducting an analysis within the sociocultural framework will be with interaction analysis.

3.4. DOING INTERACTION ANALYSIS

IA builds on ethnomethodology and CA regarding the assumption that verifiable observation provides the best foundation for analytic knowledge of the world. Thus, theories of knowledge must be grounded in empirical evidence. IA focuses on video as its empirical evidence:

> Selectively employed video analysis is a particularly valuable analytic tool for the study of learning activities and work practices in complex real-world settings for a number of reasons. One of these is that by approximating direct observation, video provides a shared resource to overcome gaps between what people say they do and what they, in fact, do. Video provides optimal data when we are interested in what 'really' happened rather than in accounts of what happened. (Jordan & Henderson, 1995, p. 50)

Although I will return to the merits of what kind of knowledge can be derived from video data, in the next chapter I wish to emphasize the main argument, i.e., exploring what really happens in the interaction. This aligns with my sociocultural positioning and a productive way to explore these practices is with video, as this provides the possibility for partially reproducing the social interactions I wish to study.

The goal of IA is to identify regularities in the way participants utilize the resources of the complex social and material world of actors and objects around them. These regularities are grounded within concrete empirical evidence, where the focus is on how social order is achieved and maintained (Jordan & Henderson, 1995). Although the focus remains on the social practices of the actors and their mutual orientation toward each other, the complexity of this interaction has grown. It is not only how participants orient to one another in their verbal interactions, which is evident in societal and organizational structures, but also how they orient with the use of their embodied actions and various objects and artifacts within these specific communities of practice (Goodwin, 2013; Norris, 2019). By using video as a data-gathering method, the complexities of the social action can be described as they happen and indicate how the environment plays a role in that interaction. IA focuses on the social learning processes and defines learning as "a distributed, ongoing social process, in which evidence that learning is occurring or has occurred must be found in understanding the ways in which people collaboratively do learning" (Jordan & Henderson, 1995, p. 42). The emphasis is on grounding the results in concrete empirical observations to determine the legitimacy of the findings concerning the social practices under study. In the remaining part of this chapter, I will switch between accounting for how Jordan and Henderson suggest one could conduct IA and how I approached it for this dissertation.

3.4.1. ANALYTICAL FOCI

A central focus for interaction analysis is the identification of interactional "hot spots," which are defined as "sites of activity for which videotaping promises to be productive" (Jordan & Henderson, 1995, p. 43). IA encourages the use of ethnographic fieldwork. This fieldwork is meant to provide a "background against which video analysis is carried out" (Jordan & Henderson, 1995, p. 43). In this study, I only did limited fieldwork. This is aligned with Jordan and Henderson's (1995) recommendations: "For tapes from settings with which analysts are not intimately familiar, more extensive and more careful ethnographic fieldwork is necessary" (p. 58). While exploring my own institution and my four years of teaching and supervision experience before starting my PhD studies, I was familiar with much of the background knowledge regarding the institution. I then focused my time on recording and backing up every meeting the students had in relation to their project from the first day of the semester to the last day. However, the notion of hot spots is still relevant to determine which parts should be chosen for further analysis.

The next step they recommend is to create a content log that is a "very rough summary listing of events as they occur on the tape" (Jordan & Henderson, 1995, p. 43). I did this for the first two months of recordings, noting whether there was any analytical potential in regard to the shared problem construction. Thus, I knew before I started the recording that shared problem construction would be the main analytical focus and recordings for further analysis were selected from this criterion. During the first two months, I found 21 instances in which the problem was actively addressed by the group. In this context I define an "instance" as a particular day in which questions regarding the problem were raised. In these instances I observed the video several times to: "allow for the discovery of aspects of the organization of interaction that we do not already know about" (Sidnell, 2013a, p. 87). From these 21 instances I decided to focus on 4, all of which had been marked by different interlocutors' disagreements regarding the content of the problem. Thus, my selection criteria for the detailed analyses were based upon internal disagreements in the group or between the group and supervisor. I chose this focus primarily based on a curiosity regarding what kind of knowledge the students would utilize to argue for their view in the construction of the problem. These instances chosen for further analysis can also from a CA perspective be argued to be the "deviant cases", I will get back to this in my discussion.

3.4.2. DATA SESSIONS AND ANALYTICAL PROCEDURES

The next step in IA is what Jordan and Henderson term "group work," which is also called data sessions within CA (Antaki et al., 2008; Stevanovic & Weiste, 2017). Here you present your data to fellow researchers and receive their feedback on the content. This is recommended because it "is particularly powerful for neutralizing preconceived notions on the part of researchers and discourages the tendency to see

in the interaction what one is conditioned to see or even wants to see" (Jordan & Henderson, 1995, p. 44). Although you have chosen the segments and potential research interests in the data, fellow researchers can now, using the video, provide their feedback as to which elements they find interesting in the segments. The rule is to always base one's comments on concrete instances of interaction in the data. This proved valuable for my second publication especially, which was initially designed to analyze different kinds of knowledge the students utilized in their internal discussions regarding the content of the problem. However, after receiving feedback from more experienced researchers, I changed the focus to how students made decisions regarding the problem. Thus, a central focus for my second article became internal decision-making processes regarding the problem (Velmurugan et al., 2021). Here, three different instances of decision-making were analyzed in order to argue for a general structure the students used in their decision-making processes (Velmurugan et al., 2021). This complements the way IA recommends focusing on events, which is defined as "stretches of interaction that cohere in some manner that is meaningful to the participants" (Jordan & Henderson, 1995, p. 57).

Smaller units of coherent interaction are identified within these events. In this regard, I exemplify how decision-making processes are a result of initiation, question(s), answer to question(s), and accepting or declining the initiation (Velmurugan et al., 2021). The last data I analyzed was a supervision meeting, in which the students directly challenged their supervisor regarding their problem (Velmurugan et al., 2022). I found this interesting because I wanted to know what motivated the students to directly challenge a supervisor who they knew was a content expert. I was also curious as to how the supervisor would deal with these confrontations. Here I focused on the production of different learning trajectories between the students and supervisor and the interactional techniques they used to bridge their different trajectories (Velmurugan et al., 2022). Thus, the empirical articles ended up having a distinct focus on disagreeing in decision-making in relation to the problem, a focus I had not expected when doing the initial data collection, and a focus that first became clear to me when writing this extended summary. A consequence of this becomes an extended state of the art in Chapter 5, where I account for the research done in relation to decision-making.

Coming back to my data collection, before I started analyzing selected hot spots, the first step was to transcribe the data. Although, I had transcribed the data before the data sessions, I will complete this chapter by describing the transcription process and what it does for the information I can elucidate from the data.

3.4.3. TRANSCRIPTION OF DATA

I based my transcripts on the Jefferson Annotation System (Jefferson, 2004) developed in CA. The system was developed to transcribe audio recordings and "has often been considered the model for comprehensive transcription" (Jordan &

Henderson, 1995, p. 48). However, it is impossible to include all potentially relevant aspects of interaction in a transcript (Mondada, 2007); thus, writing a transcript becomes a "selective, interpretive activity conducted to transform audio (visual) recordings of spoken language into written texts that are more readily reread, studied, and analyzed" (Ellingson & Sotirin, 2020a, p. 53). From this perspective, the analysis starts in the transcription by focusing on some aspects of the interaction. Thus, in IA the question becomes how adequate the transcription is for the more thorough analysis to be performed. In this regard, I complemented my transcripts with pictures of the nonverbal interaction when relevant to the point I was making in my analysis. In these cases there is a nonverbal description according to the Jefferson Annotation System accompanied by an arrow pointing to the relevant picture, as seen in Figure 1 below

Figure 1:

Nonverbal Description Transcript


```
192    V: this is ((points at his drawing)) a typical profile for your household jaeh




193    M: okay
194    V: this is((points at another point in his drawing))ø:::h solar if the sun is
195    shining
196    M: ja
          yes
197    V: and what you ((points at the last point in his drawing)) should put here in
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Mondada (2007) indicates that transcribing is a situated practice, and refers to it as "reflexively tied to the context of their production and to the practical purposes of their accomplishment" (Mondada, 2007, p. 810). This is evident in the written description I have made of the above interlocutor's nonverbal action. In line 192 I state that he: "points at his drawing" and then especially in line 194, I emphasize that he: "points at another point." None of these written descriptions gives a comprehensive description of the action, and especially the second description is oriented to the first, in which I specify that the pointing has changed, but not how or where, as this was not relevant for the analytical point I was trying to make. Thus, the written description was meant to place the nonverbal action temporally in relation to the speech actions and the picture was meant to accurately show the embodied position in accordance with the material structures. When approaching and conducting the analysis, I always treated the video itself as the primary data as also evidenced by IA and CA (Hutchby & Wooffitt, 1998; Jordan & Henderson, 1995); however, when

submitting the papers, the transcripts are only available for editors and readers. This then creates a question as to the role of these transcripts.

3.4.4. TRANSCRIPTS AS MAPS

If we consider transcripts as artifacts (Davidson, 2009) that include temporal-historical dimensions (Duranti, 2006) representing a mapping of interactions relevant for the specific researcher's goal (Ellingson & Sotirin, 2020a), transcripts lead in particular directions and move the reader and researchers to some specific places and spaces and away from others. Transcripts can thus be constructed in ways that feature words, pauses, turn-taking, gestures and facial expressions. The relevant interactions to focus on in the transcripts depends on the individual researcher's destination. Thus, a transcript can be compared to a map that guides the reader into a "data jungle." However, like maps, transcripts often seem like innocent, transparent and truthful accounts of reality, but maps are never innocent; rather, they reify intersecting webs of power from the cartographer (Ellingson & Sotirin, 2020a). Thus, the transcript I produced to arrive at specific research points focuses on some elements of the interaction while leaving out others, just like maps leave out some information of the terrain and focus on others relevant for reaching your destination.

After having accounted for my analytical approach regarding my data analysis, I wish to focus on the notion of generalizations. As I look at very small instances of interaction, the question becomes how these findings can be generalized to other types of learning situations.

3.5. GENERALIZING FROM CASE STUDIES

A case study can be defined as: "an in-depth study of, as the case may be, a person, a phenomenon or a complex situation to such an extent, that the insights gained allow an understanding of the core dynamics at heart" (Zittoun, 2017, p. 171). In my thesis, this case becomes the complex situation of shared problem construction. It becomes in-depth as I focus on micro-interactions that I argue are a vital part of shared problem construction and complex because I study them over longer time frames and focus on different interlocutors' interactions; however, I also try to reduce the complexity by mainly focusing on decision-making processes in disagreement, thus I focus on understanding the "core dynamics at heart," first internally in the group, and subsequently between group and supervisor.

In relation to case studies, de Saint-Georges (2018) states: "Case study researchers often see their work praised for the richness of their data, but critiqued on the grounds that case study research is unable to illustrate anything beyond itself" (p.95). Thus, case studies are often criticized for their lack of generalizability. In this regard it might be relevant to define what generalization is. Steinberg (2015) defines generalization as:

> *a logical argument for extending one's claims beyond the data*, positing a connection between events that were studied and those that were not. No methodological tradition should be considered exempt from the requirement to demonstrate a compelling logic of generalization. (p. 153, orginal emphasis)

Based on the quote above a central claim from Steinberg is that generalization is an integrated part of every research aspect, the criteria for which kind of generalization different studies can accomplish is, however, based on the specific nature of that study. Maybe the most dominating generalizable logic today is the probabilistic or statistical logic. In this generalizable logic, the questions are whether the findings are generalizable to a larger population and whether it is a representative sample of any kind (de Saint-Georges, 2018). However, as Yin (2014) points out, the question of statistical logic is rarely heard within the natural sciences where single experiments are seldom questioned in regard to generalization. Steinberg (2015) exemplifies this with how archaeologists' discovery of a single ancient human skull in Israel was generalized to the idea that both humans and Neanderthals lived in same area at the same time. The question then becomes, how is this possible from a single piece of evidence? The answer is that the archaeologists draw upon a stock of knowledge based on insights from previous studies thus they relate a single finding to broader logics within their subject field. Steinberg concludes that archeologists as well as other scientists work from certain logics that produce generalizable knowledge. Thus, as de Saint-Georges (2018) states, there are many different types of logic for generalizations.

In this thesis, I argue I employ theoretical generalization where the aim is not to come to standardized results, but to "look for complication" (Becker, 2017), whereby the objective becomes getting involved in the field, and in return the field provides information of what can be said about it. This type of generalization is not based on a representative sample of a defined population but on the theory used to explain the phenomenon being explored, thus arguing it is applicable beyond the particular case (de Saint-Georges, 2018). This kind of research can contribute to showing contradictions, tensions and processes that traverse the phenomenon investigated (Flyvbjerg, 2006). These generalizations are thus accomplished by moving from concrete observational data to abstract descriptors. The abstract terms thus present the advantage of not being linked directly to the specific social practice I am investigating but can be applied in a wide variety of learning situations, thus the abstract concepts become powerful cultural tools for generalizing, as they connect the specific findings of a case to more abstract concepts that can be used in a wide variety of situations (de Saint-Georges, 2018). Furthermore, a principle of abduction will also be employed in this thesis, which can be defined as:

> the process by which an idea [that] could explain a new, or a newly surprising phenomena, or an apparent unrelated collection of elements or events. The abductive suggestion appears as something that, if it were true, may explain this phenomenon or list of events. (Zittoun, 2017, p. 175)

To sum up, the important notion is that the type of generalizations I use is the theoretical generalization where I aim to look for complication, by analyzing the micro interactions with the use of different abstract concepts, which will aid me in making my findings relevant for other learning situations. Furthermore, if I find a surprising phenomenon, I will present suggestions as to how these actions can be explained, linking them to the sociocultural ethnomethodological conversation analytical approach, accounted for earlier. As another vital part of these types of generalizations is to connect the findings to other broader sets of logics and findings within the field, it becomes important to account for existing literature on the abstract concepts I find in my data. When I started to look at my data, it was in no way given that I would end up focusing on decision-making processes or disagreement in decision-making, thus as this becomes my focus, I aim to consult the literature on this aspect, which therefore entails an extended state of the art chapter on decision-making in Chapter 5. For now, I will elaborate on what kind of knowledge can be derived from video data.

CHAPTER 4. DATA CREATION: WHAT DATA (AND VIDEO) DO

To answer my problem statement concerning how the process of shared problem construction unfolds interactively in the group and with the supervisor, I created data with video observation, as dictated by IA. In this chapter, I will elaborate how I view qualitative data in general. When I use the word "data," I am thus referring to qualitative data. After elaborating on how I view data, I will continue by highlighting the kind of knowledge that can be derived from video observation, exemplifying other studies that have used video in research. I conclude the chapter by detailing my data creation journey. As I used a 360-degree camera to create my video, I will detail the difference that such a camera makes on video data.

4.1. HOW DATA IS CREATED

There is a tendency to bracket meta-theoretical discussions of what really happens when researchers create data, thus not dealing with the epistemological complexities when reporting study results (Ellingson & Sotirin, 2020b). I do not consider data as objective, impartial or transparent accounts of reality. On the contrary, data are created when researchers bring information into being. Therefore, data is co-constructed (Charmaz, 2006) between embodied researchers and participants at specific socio-historical moments, in particular cultural contexts and places (Creswell & Poth, 2018). Data provides insight into participants' sense-making and experiences, facilitating the acknowledgement of commonalities, such as values, choices and beliefs across participants, and constitutes evidence to support knowledge claims about a topic (Lindlof & Taylor, 2019). I concur with Ellingson and Sotirin (2020a) who argue for an approach of data engagement in which the researcher acknowledges "that data are *made* rather than found; *assembled* rather than collected or gathered; and *dynamic* rather than complete or static" (Ellingson & Sotirin, 2020a, p. 5 (emphasis in original))

"What we call data are always produced, constructed, mediated by human activities" (Brinkmann, 2014, p. 721). Data is created when we imagine and categorize information as data (Gitelman, 2013). Data do not pre-exist researchers' interpretive engagement. Thus, researchers bring data into being; we create them. When researchers engage in their field in order to make data, participants provide access to part of their lives, and researchers sample these parts with a number of resources, reimagining how these are put together, creating an assemblage that hopefully provides new kinds of significance (Markham, 2013).

When data is conceptualized as an assemblage, it includes researchers as an integral part rather than owners (Denshire & Lee, 2013). Researchers engage in the process of

assembling data through the mutual constitution of researchers, participants, material objects and cultural discourses within particular places and times (Ellingson & Sotirin, 2020a). Assembling data includes a generative messiness. In research there is a tendency to deny the messiness and construct well-ordered and compelling findings (Law, 2007). Law (2007) further argues rejection of this messiness is a legacy of positivism. Data itself can never be clean and proper, and researchers should be aware of the messiness of their data creation. Data do not passively exist but are in an ongoing process of becoming in a fluid and unstable creation. For example, each time a researcher goes through their recordings, they encounter recordings within a different socio-historical moment, in a variety of settings (sharing with co-workers, late evenings, early mornings) and in different cognitive, emotional and physical relations (Nordstrom, 2015). What becomes important in this aspect is to create an assemblage that provides new kinds of significance to our established understanding of a given area. A part of the assemblage I have tried to create consists of video observation.

4.2. VIDEO OBSERVATION

Looking historically at video observation, Leland Stanford (the founder of the university) encouraged Eadweard Muybridge in the 1870s to combine a series of images to capture a sequence of actions to settle a dispute regarding how horses galloped. Muybridge recognized the scientific potential of the technology and conducted research based on it (Heath et al., 2010). In the 1930s the anthropologist Gregory Bateson encouraged the use of video in research, particularly for its ability to get the data reviewed by fellow researchers to avoid particular cultural biases from the researcher (Bateson & Mead, 1942). Besides educational research, a number of recent workplace studies have used video extensively in, for example, surgical operations, control centers, surveillance rooms, medical consultations and financial trading rooms (Engeström & Middleton, 1996; Luff et al., 2000).

Video captures different modes of an event as it happens. Modes, such as gestures, object handling, and the visual layout of the place are captured on video and provide rich data. The multifaceted nature of the data similarly limits a reduction of the event compared to other kinds of social scientific data (Heath et al., 2010). The fleetingness of social interaction is partially preserved, creating the prerequisites for revisiting the empirical data (Liegl & Schindler, 2013). Audio recordings can also be presented to fellow researchers, but video shows the temporal relationships of speech to visually depicted actions and events (Lemke, 2006). This makes the analysis of video more complex as the sum of simultaneously relevant elements increases (Liegl & Schindler, 2013). When exploring a group's social interaction, video offers a comprehensive view of the interaction taking place, creating opportunities not just to focus on the participants, but also on how the material structures affect the interaction taking place. Additionally, video provides the opportunity to show data to fellow researchers and peers, giving them the opportunity to co-analyze research findings on a more

transparent level. This capturing of events thus offered me the opportunity to create detailed analyses of the interactions taking place, details often missed in ethnographic field work (Goldman, 2007). Additionally, video provides the opportunity to re-examine data and the interaction numerous times. In this way, I was able to capture the minor details of learning situations and explain the complexity of these minor events. From this perspective there is a consensus that video provides an opportunity to study the minor details of situational practices (Goldman, 2007).

From a critical perspective, some would argue video does not give an authentic view of the social interaction analyzed and the placement of the camera might manipulate the social actors to behave differently (Lomax & Casey, 1998). There are two things to address here: 1) whether video data presents an authentic view of the social interaction; and 2) how the camera affects the interaction under study.

Concerning the first point, Black (2017) states,

> Video recordings are particularly prone to problematic, unreflexive acceptance as objective 'data,' perhaps because of a cultural privileging of the eye and vision as metaphors for truth, understanding, and knowledge. (p. 54)

Mondada (2007 further argues,

> Nevertheless, video recordings are often considered as 'transparent windows' onto social reality: their technical and formal features, their materiality, their editing, the choices that make certain details visible or invisible are ignored by analyses focusing exclusively on what they make available, such as glances, gestures, body postures, spatial arrangements, object manipulations, etc. (p. 68).

These quotes emphasize the points mentioned in the introduction in this chapter that data are not objective, impartial or transparent accounts of reality. Thus, the quotes criticize the tendency to view video as objective accounts of truth without reflecting on the part of exactly what the video makes available. Video is always a partial insight into certain focus points the researcher highlights.

Second, there is the concern that video affects the area under study. Some researchers claim that we do not know whether the cameras have an effect on the participants, just as we do not know the differences when it is compared to traditional ethnographic observation or no observation at all (Lemke, 2006). Others indicate that the presence of a video camera is commented on in the beginning but then not directly addressed, providing an authentic view of the interaction (Caronia, 2015). These concerns, however, are based on the notion that data is collected from some pure independent reality and that the data itself presents objective truths, which I have just criticized. Video also provides a partial account of a given social reality represented in a mediated object, which is the recording. Tuncer (2016) emphasized how the recorded

participants domesticate the camera into their social interaction; thus, there is an orientation to how the participants adapt to the presence of the camera, and how this orientation changes over time. Furthermore, digital recording devices could yield positive effects if they are categorized as an invitation to participants to collaborate and show their story to the researcher (Wilińska & Bűlow, 2017).

There is also the argument of how video shapes the phenomenon under study. Although video is characterized as rich data, it can still only see and hear, thus transforming a rich three-dimensional situation into a two-dimensional audio-visual channel of perception (Liegl & Schindler, 2013). Furthermore, there is a problem of tacit knowledge in the interaction being information. You might not be aware of this if you were not present during the recording or if you do not have a membership perspective and understand the social practice you are studying. As such, it is important when conducting video observation to gain an overall understanding of the social practices to understand the forms of tacit knowledge taking place, enabling the researcher to assess whether a given social interaction is natural.

Conducting research with the use of video observation is a time-consuming process, especially if the theoretical framework involves making a detailed analysis of a given interactional situation (Lemke, 2006). Time must be allocated for preparation, editing, and writing transcriptions. When the focus is on students working in teams, it must be determined what to look at and how much should be captured from the scene. Even 360-degree cameras do not capture all activities in the room, especially in this post-digital world where a lot of interactions are mediated by different technologies such as laptops and smartphones. To gain maximum information, it is necessary to record screen time on electronic devices used by the students, which would be more of a hazard for the participants under study. Furthermore, this approach limits the amount of recorded time that can be analyzed. As there are numerous simultaneous events occurring, a meaningful analysis will only focus on a few seconds. Often these studies want to catch all activities to show the complexity in the interactions as well as how fluidly it is navigated by the social actors. Consequently, these studies often lose the long-term perspective, which is also a problem for analyses that just look at face-to-face interactions. This is seen in published research where videos are used. According to Lemke (2006), many articles examining five-minute learning situations are published, but very few offer a long-term perspective on learning and the development of the individual learner over time.

The initial idea was to conduct such a long-term study with this thesis, but it quickly became evident that this involved too much work for one researcher in the given time frame. However, by using a specific focus, i.e., shared problem construction in problem-based learning, I was able to select instances for further analysis during the first two months of the students' work. In these instances, certain hot spots were chosen as evidence for interaction analysis to exemplify the practice of problem

construction. Before I describe my own data creation journey, I aim to highlight some other studies that have used video in their research.

4.2.1. SOME EXAMPLES OF VIDEO OBSERVATION STUDIES WITHIN THE FIELD OF LEARNING

Video observation is widely used in education research and has played a dominant role in classroom research (Baker & Green, 2007). A well-known concept is the interaction of the I-R-E form: **I**nitiation by the teacher to the student (by asking the student questions that the teacher knows the answer to), **R**esponse by the student, and **E**valuation of the response by the teacher (Mehan, 1979). Other findings are the focus on teachers' use of gestures (Alibali & Nathan, 2007; Flevares & Perry, 2001), teachers' assessment in the classroom (Antón, 2015), second-language acquisition (Toth, 2008) and second-graders' use of gestures when collaborating on touch devices (Davidsen & Christiansen, 2014). Video observation has also led to research on learning in informal settings. For example, studies on dinnertime conversation in families shows that epistemologies are socialized even though the activity is not intended for that purpose (Ochs et al., 1992), and also show how dinnertime narratives contribute to self and identity (Forrester, 2001).

Video observation has additionally been used to examine PBL in higher education (Azer & Azer, 2015; Bernhard et al., 2019; Davidsen & Ryberg, 2019; Hendry et al., 2016; Koschmann et al., 1997; McQuade et al., 2019). One study examined how group cohesion is performed in problem-based learning tutorials. The concrete study looked at how group members turned the use of disparagement to laughter, creating cohesion in the group. This was often done by the members comparing one version of the group with either a previous version or an ideal imaginary version of that group, then indirectly criticizing the current version of the group (Hendry et al., 2014). The study is interesting because we can visualize how cohesion is created in the moment, making us more knowledgeable about how to facilitate cohesion in PBL environments. Furthermore, videos provide insight into how more negative aspects of group work (as in this example, disparagements or evaluation of less ideal versions of the group) can be used in constructive ways (Hendry et al., 2014).

Another example is from a study where student groups from three different education fields at three different higher education institutions were video-recorded. Some of the groups were recorded in a tutoring session where a tutor led the discussion, and others were without a tutor. The analysis of the interaction shows that some students resisted using academic discourse in various ways, thus resisting academic identity. In the sessions controlled by the tutor, the students resisted the assigned tasks. The tutor handled this by using irony and politeness, democratizing an asymmetrical relationship with the students. In the sessions without a tutor present, those students showing enthusiasm or using academic discourse were also met with negative categorizations by fellow students, resulting in a form of self-censorship from the

enthusiastic students. However, as the students must use academic discourse to complete the tasks given to them, irony is used to balance the shift between student identity and academic identity. Being a student is seen as being in contrast to academic activities (Benwell & Stokoe, 2002). The use of video has highlighted a contradiction, that does not seem to be logical. Students enroll in higher education to become academics; however, they resist academic discourse in their interactions. The study does conclude that students navigate in a multitude of identities, and the way they bridge these identities is through irony, which is both utilized by the tutor to address resistance and among the students themselves. Irony, therefore, becomes an effective tool in navigating between different identities. In this example, video provides an insight into natural interaction and what happens when students try to solve academic tasks. How the students categorize each other during the assignment solving provides viable insight into the natural interaction, which provides us with an understanding of the process students enter when embedded in an academic institution. This is also the kind of knowledge I wish to elucidate from my data in relation to shared problem construction.

Another study examined the students' co-construction of knowledge based on the notion that students who actively elaborate and discuss newly achieved knowledge seem to retain it for a longer time than those who do not actively discuss it. However, video observation shows that not all students actively engage in these discussions, which might be problematic if the underlying philosophy is that knowledge is retained longer through active discussion. The study does, however, mention that the role of being a quiet student seems to rotate and as long as this rotation is evident, every student gets the opportunity to contribute something at some point (Visschers-Pleijers et al., 2004). Thus, this study is another example of what happens in the students' real-life practices and how this aligns with how things ideally should have been according to theory.

There are numerous other studies that have used video to study students' cooperation (Hendry et al., 2016; Hendry et al., 2003; McQuade et al., 2018, 2019; Ryberg & Davidsen, 2019; Stokoe, 2000), which show that video is widely used when exploring students' practices.

4.3. MY DATA CREATION

As the focus of my thesis is shared problem construction and how this is done interactively, I needed students to follow and record. I selected one group of engineering students to follow from the first day of their third semester until their last. With agreement from the coordinating lecturer, I participated in the group formation seminar, where students formed groups. I was given five minutes to introduce my project and would ask one group permission to observe them with the video camera. I chose a group that decided to formulate their own problem statement instead of

selecting a case from a project catalogue. They immediately agreed and had no objections.

The initial idea behind this decision was to follow the process of problem construction and how it was dealt with over the course of a semester. At Aalborg University, engineering students form groups the first day of the semester and are provided with a room for their daily meetings. Over the course of a semester, only the students (and cleaning personnel) can access or use the room. The students get keys to the room and lock it when they are not there, I was given a key as well. The room has tables, chairs and blackboards for student use. The group I followed met every day from 8 a.m. to 4 p.m.. When they did not attend classes or have assignments connected with the classes, they were working on the project. This work schedule was set and agreed upon by the students.

My primary interest was how the students negotiated and constructed the problem they wanted to work on in their project. Confidentiality agreements were created between the students, supervisor and me, giving me permission to use the video for academic journals, data sessions, conferences, and teaching without any kind of anonymization. A template of the agreement is found in the appendix. A stationary camera was placed in the room as a backup camera and a 360-degree camera was placed in the middle of the table over a set of books, so the camera caught the group members' facial expressions and not the back of their laptops, as seen in Figure 2 below.

Figure 2:

Layout of the Room
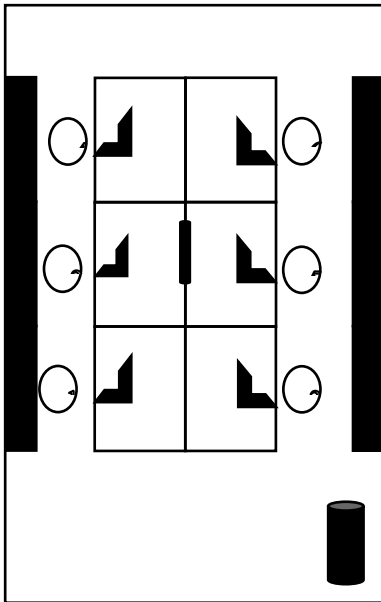
Table

Student

Camera

Laptop

Blackboard

4.3.1. 360-DEGREE VIDEO

Mcllvenny (2020) describes how a 360-degree video "allows a viewer to see a flat 2D visual representation of the *totality* of a scene from a single location but in all directions at once" (p. 3, original emphasis). In other words, you can navigate in your recording turning the angle the other way with the help of your mouse. However, 360-degree video is not a "Bird's eye view;" – you record from inside out and not inside in. Figure 3 below illustrates this inside-out view, where the blank space in the middle is the position of the camera and the arrows illustrate the spatial dimensions the camera can capture.

Figure 3:

Inside-out View of 360-degree Video Recording

The camera I used was not volumetric; therefore, if objects block the camera's view, you cannot see it from behind, similarly to Google Maps. For example, it is not possible to see the content of the laptop screens from the recording shown in Figure 4 below. Another aspect of 360-degree recordings is the distortion that occurs when navigating in the recording. An example is seen in Pictures 1, 2 and 3 below, which display three pictures from the same 360-degree recording at the same time. I used the cursor to change angles in the recording, which creates a distortion. Picture 2 shows the distortion, when the direction is changed. Notice how P seems close in Picture 1 but further away in Picture 2.

Figure 4:

360-degree Distortion
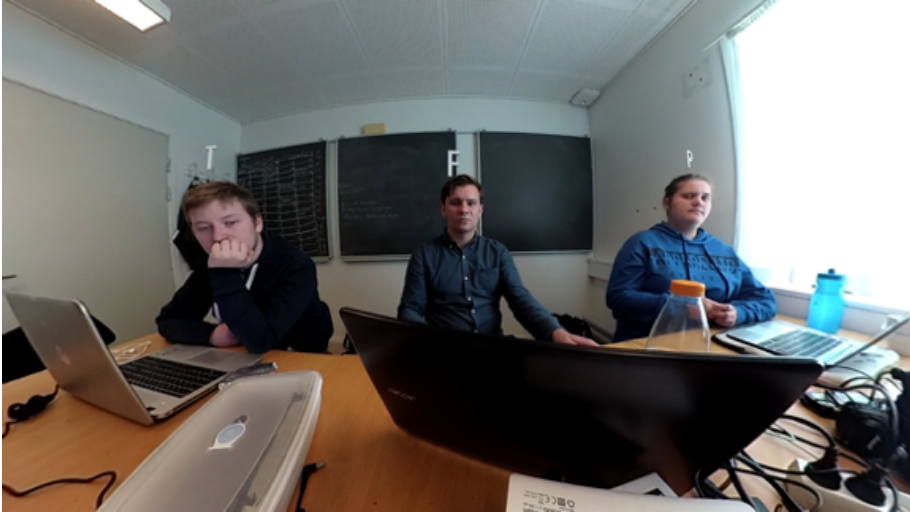
The space is flattened, and the objects and social actors are pushed away from the viewer. Thus, the way you navigate in the recording does not reproduce how the eye would adjust to this navigation if a person turned his/her head toward P. Using natural eyesight, P. would not be pushed further away. The problem of reproducing spatial relations differs on video from what an eye would see (McIlvenny, 2020). Thus, you do not see the event as it "naturally happens." If one's research question examines the interlocutor's proximity, the analysis would only focus on certain angles, which give the most "truthful" view of the situation. However, video is a partial representation of the social interaction taking place, creating some advantages. It offers the ability to go through the same interaction numerous times, and the possibility to create very detailed analyses. On the other hand, the disadvantages include a reduction (and in some cases distortion) of the complexity of the social interaction taking place (Liegl & Schindler, 2013).

In the beginning I tried putting additional cameras in the room to catch the computer screens of the students but given that the video was to be collected over the course of a semester, the amount of data proved to be too much and recording screens with an external camera often gave unclear pictures of the screens. The initial thought was to enter the students' room every day to turn the camera on and off when they were done and finish the day by emptying the security digital (SD) cards. However, given the dynamic nature of when the group would decide to meet (for example if a lecture was cancelled or finished early, the group would work on the project instead, and then I might not be available to turn the cameras on), it seemed more effective to give the students SD cards and the responsibility for turning the camera on and off. In this way, the data really was co-created on several levels, as the students in many cases were the data creators. Thus, SD cards that could last a week were placed in the room with one jar for empty cards and one for filled cards. The students were given the

responsibility turning the camera on and off when they entered the room and worked on the project and the students themselves switched SD cards on the cameras. This also created some risks. By giving the students the responsibility for turning the cameras on and off and changing the SD cards, they also controlled what I could and could not see. They could erase recordings from an SD card, or they could choose not to turn the camera on, or they could forget to do this. However, giving the students the freedom to turn the camera on and off seemed ethically responsible. The students should choose what they want me to see, and given General Data Protection Regulation on data privacy, they always had the right to ask me to delete data they did not want me to have. Furthermore, as I would back the data up every week, I would be able to check whether the camera really had been turned on. In this case I did not experience any problems with students turning the cameras on or off, as they always remembered to do this. There was a problem at times when the students did not have enough empty SD cards available. Another consideration was that the students could discuss sensitive matters without the cameras being turned on. However, looking through the data it was apparent that many sensitive matters were discussed while the camera was recording.

I was invited to join their Facebook chat group, which was their primary means of communication when they were not together. Once or twice a week I would empty the SD cards, creating backups both on an external crypted hard drive and on the institution's server for research data. This process was very time-consuming. Once a month I would do ethnographic observations in their project work to ensure a membership perspective was obtained to create the necessary prerequisites for doing a detailed analysis. I would not participate in the discussions regarding their project. However, in order to obtain rapport (Spradley, 1980), I engaged with them when they had off-topic talks. Another measure was buying candy and snacks and placing them in their room as a way of expressing gratitude for their participation. An interesting note in this regard is that the video never caught the group's reaction toward these snacks, creating the impression that some things might be negotiated or talked about before the group decided to turn the cameras on. However, during their PBL work there seemed to be no interruptions.

Processing the Video

The next step was to stich the video together, which is a process that must be done on some cameras recording 360-degree video. The post-processing alone took almost as much time as the collection of the data. The first two months of the video were watched and categorized in a rough content log, as advised by IA. One could ask why so much video was needed. As I recorded the students every day it ended up being 225 hours of video, which then required 225 hours of post-processing (where the video was stitched together). The initial argument was that the amount of data was relevant given that all supervisors of projects know that the problem transforms and changes character over the course of the semester. It is this transformation and evolvement that was my initial interest in the study, and as such, a longer observation period was

required. Another thought was that the data could be used afterwards to look at other interesting phenomena regarding PBL. In hindsight, however, this amount of data requires more work than a single researcher can accomplish in the given time frame. As a result, I was not able to watch all the video, and the focus changed to the first two months, from which selected instances were chosen for further analysis.

Another question that might be posed is what difference does 360-degree video create? There is no question that a 360-degree recording provides a better feeling and navigation of the interaction than a traditional camera. This is seen in the ability to navigate in the recording and being able to zoom in and out on specific persons and the room in general. As such, 360-degree creates easier opportunities to focus on specific aspects of the interaction, widening the range of interesting analytical points. This was especially used in my third article, where I showed both how the students were placed in the room with a 180-degree distorted view and zoomed in on a relevant person's embodied expression. I will conclude this chapter by showing an example of this below:

Figure 5:

180-degree Distorted View

```
86   M: men som vores problemformulering er lige nu
        but as our problem statement is right now
87      (1.0)
88   M: der siger vi at vi gerne vil ((går imod sin plads igen og sætter sig ned))
        we say we we want to ((walks towards his seat again and sits down))
89   V: ((læner sig tilbage og sidder med armene over kors))
        ((leans back and crosses his arms))
```

CHAPTER 5. EXTENDED STATE OF THE ART

It might seem a bit strange to place an "extended state of the art" chapter at the end of an extended summary of a PhD thesis. However, besides the limited literature accounted for in Chapter 2, it has not been possible for me to find research conducted on shared problem construction. As Hung(2016) suggests/states, this may be because: 'As critical and fundamental as they are, problems and their design have received far less attention than have other research areas of PBL" (p. 1). I will amend this by discussing the practice of shared problem construction from a sociocultural perspective in the discussion, with a point of reference in the findings of my articles. Thus, the purpose of this chapter is to expand my criteria for relevant state-of-the-art literature. Here, my focus will be on decision-making, I do this because two of my articles submitted in this thesis are focused upon disagreeing in decision-making processes. I still had some difficulties in finding literature on decision-making in the educational field. Thus, in this chapter I will start with a general overview in the area of decision-making and then I will account for some recent studies within decision-making from an interactional point of view. In the next chapter I report my findings towards these recent studies.

5.1. THE FIELD OF DECISION-MAKING

The modern scientific field of decision-making emerged in the 1950s, defined by the study of actual behavioral tendencies linked with formal mathematical models of judgement and decision-making in statistics, economics, and philosophy of logic. Today it is a broad field with various areas of research, such as cognitive psychology (Kelly & Jacoby, 1998; Markman & Medin, 1995; S. E. Simonson & Tversky, 1993; Sloman, 1996; Slovic & Lichtenstein, 1968; Tversky & Kahneman, 1974), social psychology (Dawes, 1988; Nisbett & Ross, 1980; Wilson & Gilbert, 2003) economy (Camerer, 1990; Loewenstein, 1987, 1996; Thaler, 1980), marketing (Johnson et al., 1993; I. Simonson, 1989) and other academic disciplines (Rachlinski, 1998; Redelmeier et al., 1990; Simon, 1957; Ubel et al., 1998). As decision-making is a central part of life and practice within all areas of life (social and professional), it makes sense that the field has attracted attention from various academic disciplines.

The mathematic models of decision-making have often been criticized for taking their point of departure from the "economic man," defined by a decision-maker who considers every possible action in every possible future state of the world, the probability of that state and calculate the choice that would lead to the best outcome. However, this concept of economic man has been criticized for being unrealistic and not in line with actual human behavior, given that this kind of decision-making

requires an immense amount of knowledge and calculation ability, which does not fit with how humans make decisions in daily practice (Simon, 1957). Thus the field of decision-making evolved to be focused on the tension between how decisions ought to be made versus how decisions are actually made (Gillovich & Griffin, 2010).

Central research in the field of decision-making is developed by Kahneman and Tversky (Kahneman & Tversky, 1979; Shefrin & Statman, 2003; Tversky & Kahneman, 1974, 1981), especially known for their prospect theory, where they show how heuristics and bias influence judgement and decision-making. They identify three heuristics that are employed when people make decisions/judgements under uncertainty; 1) representativeness; 2) availability of instances or scenarios; 3) adjustments from an anchor (Tversky & Kahneman, 1974).

The representativeness heuristic is defined as follows: "probabilities are evaluated by the degree to which A is representative of B, that is by the degree to A resembles B" (Tversky & Kahneman, 1974, p. 1124). The example they use to explain the heuristic of representativeness, is where they are explaining personal traits that in public discourse often would describe a librarian, and then ask people to guess the occupation from among predefined choices, while at the same time informing them of the statistics of how many people from the predefined choices are currently on the job market, which is not many librarians. However, most people choose to match the librarian occupation with the personal traits, despite knowing the statistics. Thus, there is a bias towards representativeness that prevent people from including several other factors, that might have relevance for the decision to be made.

The availability of instances or scenarios heuristic is defined as: "the probability of an event by the ease with which instances or occurrences can be brought to mind" (Tversky & Kahneman, 1974, p. 1127). The example shown here is where participants listen to two long lists of male and female names, and then asked to answer if the list with males are longer than the list with females and vice versa. The determining factor of which list gets defined as the list with most males or females is the number of celebrities in each gender. Thus, if there are more celebrities on the male list, but fewer males than females on the lists, participants would state there are most males on the list, the same was true for the female list. From this, they state we have a heuristic in our decision-making, that makes us orient towards instances that are familiar to us.

The adjustment from an anchor heuristic can be defined as: "different starting points yield different estimates, which are biased towards the initial values" (Tversky & Kahneman, 1974, p. 1128). The example mentioned here is when participants are told to estimate the percentage of African countries in the United Nations, thereafter in the subjects' presence a fortune wheel is spun, and the participants are asked to assess whether the number the fortune wheel spun is higher or lower than the real result. They found that the number the fortune wheel spun had a marked impact on the

estimates the participants would come up with later. Thus, the starting point (the anchor) affects the estimates later given.

Thus, in sum Tversky and Kahneman (1974) find three heuristics that are used in judgement and decision-making; representativeness when people are asked to judge the probability that event A belongs to process B; the availability heuristic – when people are asked to assess the frequency of a class or the plausibility of a specific development, they tend to favor things that are easily available to them; and adjustment from an anchor heuristic, which is used in numerical predictions when a relevant value is available that anchors the subsequent values suggested.

5.2. FROM COGNITIVE DECISION-MAKING TO SOCIOCULTURAL DECISION-MAKING

As might be quite evident from above, the research just accounted for takes its point of departure from a more cognitive view, where the focus is on the intrapersonal reasoning processes, which does not align with my own sociocultural view. The reason why I am accounting for the cognitive view is because I have not been able to find much literature on the sociocultural dimension of decision-making, and I have not been able to find anything that examines decision-making from a sociocultural view within the field of education. However, if one should take the findings from Tversky and Kahneman, their three heuristics could be argued to be valid from a sociocultural view as well. I will argue why in the following.

The representativeness heuristic could be argued to be a comparison between doing logic rational analysis, where one is holding up one's judgement towards official statistics, or doing a discursively constructed judgement in which the character is described out of discourses associated with a librarian; thus, the findings indicate that it is the discourses of the librarian that dominate peoples' judgement and decision-making and not the rational statistical analysis. This is aligned with the sociocultural perspective, claiming we are socialized into specific cultures, which affects who we are. Thus by describing a discourse of a librarian that matches the cultural stereotype of a librarian, this discourse overrules normal statistics. The same could be argued for the availability heuristic, stating that the hegemonic (to borrow a concept from Critical Discourse Analysis) discourses dominate peoples' judgement into assessing which list has the greatest number of a specific gendered people, this is again not dominated by the sheer number, but by the availability of relevant discourses in each list; thus the names that cannot be linked to specific discourses do not "count as much" in peoples' consciousness. In relation to the anchor heuristic, one could argue that using a fortune wheel should in many ways contrast logic discourses into assessing the number of African countries, thus it might not be discursively relevant to use a fortune wheel in judging the number of African countries. On the other hand, one could also argue that being in a setting where one is instructed to make a judgement, and then given an artifact (the fortune wheel), could also be argued to have an impact – in other words,

the social circumstances in which the decision/judgement is to be made has an impact on the final judgement. Thus, these findings can, as stated earlier, also be relevant from a sociocultural perspective. Basically what I am trying to argue is that culture and discourses matter for the decisions we make, and one might even state they dominate our way of making decisions.

5.2.1. DEFINING DECISION MAKING FROM AN EMCA PERSPECTIVE

The definition for decision-making used in this thesis will be "commitment to future action" (Huisman, 2001). When examining interaction at the micro level, it can be quite difficult to pinpoint the exact moment in which a decision is made. Rarely do interlocutors explicitly state that "now a decision has been made," nevertheless decisions are made all the time and are an incremental activity in ensuring that: "members of an organization move their agendas forward, step by step" (Huisman, 2001, p. 70). An ethnomethodological conversation analysis (EMCA) approach towards the analysis of decision-making allows us to locate the emergence of decisions at the turn-by-turn level of the interaction. Thus, we can identify specific instances of talk in which decisions are made, and what is important in these situations is that the talk often will consist of a current state of affairs and a trajectory towards the future state of affairs, therefore decision-making is imperative in order to form a future, that aligns with ones' aims.

Decision-making is also a contextualized activity: "the 'rationale' of decision made in interaction is a socially situated construct of the interaction" (Huisman, 2001, p. 71). Huisman (2001) further argues: "the formulation and content of decisions is inextricably connected to the situations in which they are produced and that what counts as a decision depends on the communicative norms of the group that is talking" (Huisman, 2001, p. 69). In other words, the situated nature of the specific culture determines how decisions are made. When looking at decisions from a micro interactional perspective it becomes clear that for a decision to emerge a proposal has to be formulated, and in this proposal a speaker names a source of action to be realized. The actualization of this proposed future action is formulated as contingent upon the other recipients' approval (Stevanovic, 2012). In other words, a decision is not solely taken by the decision-proposer but through a social process in which other interlocutors approve, reject or amend the specific proposal (Sarangi & Clarke, 2002).

Garfinkel's Study of Jurors Decision-Making
According to Garfinkel, different institutions have different procedural ways of making decisions, thus jurors are instructed to make decisions in a certain way. For example they are told to focus on what is legal and not what is fair, not to show sympathy, only pay attention to law and evidence etc. (Garfinkel, 1967, p. 109). Thus, one could argue they are encultured to make decisions from a specific kind of "juror culture.," However, as Garfinkel also states, one does not engage 100% in that specific culture; on the contrary, he states that 95% of our decision-making process in

institutions is determined by how we make daily life decisions. What does then determine whether we orient towards the institutional way of making decisions and how we make decisions in our daily life? According to Garfinkel (1967), the two ways of making decisions are performed in parallel. Thus, it is not one way or the other, but the management of the ambiguity of the different practices that characterize a specific social practice (Garfinkel, 1967). In other words, the specific cultural way of making decisions becomes intertwined with the interlocutor's normal way of making decisions. Furthermore, Garfinkel also states that the decision is made first and then the argument behind the decision is found:

> jurors did not actually have an understanding of the conditions that defined a correct decision until after the decision had been made. Only in retrospect did they decide what they did that made their decisions correct ones. When the outcome was in hand they went back to find the "why" the things that led up to the outcome, and then in order to give their decision some order, which namely, is the "officialness" of the decision. (Garfinkel, 1967, p. 114)

Thus, jurors suggest different decision-proposals and then analyze whether these decisions can be legitimized from the juror's cultural way of making decisions. This also aligns with the previously accounted definition of decision-making from a micro-perspective, with a proposal presented first contingent upon the other recipients' approval, and thus a negotiation starts in arguing for the validity of the decision. Thus, what I want to highlight from my reference to Garfinkel is that often the decision is proposed first and then the argument behind the decision is presented – unless, as will be elaborated in Chapter 6, one fears the answer/suggestion is dispreferred, then the arguments are often presented first and the decision proposal afterwards. Furthermore, I also want to highlight that although there is a specific institutional cultural way of making the decision, these are not necessarily followed by the actors.

5.2.2. ANALYZING DECISION-MAKING FROM AN EMCA PERSPECTIVE

In my third article I briefly touched upon CA research in epistemics, which focuses on the knowledge claims that interactants assert, contest and defend in their turn taking (Heritage, 2013). Within social psychology and sociology it has been recognized that mutual action and interaction rest on parties' abilities to recognize what each knows about the world and to adjust actions and understandings in accordance with that recognition (Garfinkel, 1967; Heritage, 2012; Mead, 1934). The social significance of epistemics became clear with the recognition that knowledge is socially distributed (Knorr-Cetina, 1999), which can form the basis for specific epistemic communities. Furthermore, epistemic claims that are enacted in turns-at-talk are central in the management and maintenance of identity (Heritage & Raymond, 2005), the way we produce our utterances and orient towards specific recipients in which a categorization of the recipient is often entailed. Thus, the epistemic claims the different interlocutors produce in their interaction incorporate a categorization of the actor that is addressed, determining the knowledge level of that actor and whether what one states is new

knowledge or not. This perspective proved useful in an analysis of interaction where a negotiation of different epistemic claims became the focus. However, recently I have stumbled upon a new development within interaction research, focused on a CA analytical approach towards decision-making called deontics developed by Stevanovic (Arminen et al., Forthcoming; Stevanovic, 2012, 2013, 2018), it can be defined as:

> Deontics refers to participants' relationships to obligations and permission in interactions in which a party states a proposal or plan that recipients either accept or reject, as well as the party's right to make it. (Arminen et al., Forthcoming, p. 1)

Thus the study of deontics is focused on: "who we are to each other" (Stevanovic, 2013, p. 11) giving some actors the right to make the final decision (for example, a leader in a meeting with his/her employees) and others the right to challenge these decision-proposals. Thus actors can build up "deontic authority," which can be defined as: "their right to determine others' future actions" (Stevanovic & Peräkylä, 2012, p. 297) in other words the right to make decisions that have consequences for other actors future work (often seen when leaders delegate tasks). Analyzing deontics thus becomes a study of the interlocutors' social interactions in which they are constantly negotiating and establishing the deontic rights of themselves and of the participants they engage with, thus recipients can accept the deontic authority of the speaker or they can reject it. This becomes interesting in a decision-making perspective, because when a speaker proposes a decision, they claim a deontic right in doing so, the other actors can then accept, reject, or suggest alterations to it and, at the same time, they also either acknowledge the right to make the proposal, or they can reject that right. Thus, even though actors are given some formal or official authority, these kinds of authorities are constantly negotiated and enacted in the everyday interaction. In other words, our deontic rights shape our interactions with other people and are shaped by them. The difference between deontic authority and epistemic authority is that:

> Epistemic authority is about getting the words to match the world, and deontic authority is about getting the world to match the words; epistemic authority is about knowing how the world "is"; deontic authority is about determining how the world "ought to be" (the ancient Greek word deon, "that which is binding"). Of course, people's epistemic and deontic orientations can be intertwined in many ways (we both know our plans and decide about them). (Stevanovic & Peräkylä, 2012, p. 298)

Thus, deontic and epistemic authority can be intertwined, but the main focus here is, that deontic authority is the right to define how the world is, thus giving one the right to shape its future as well. It has then been argued that, in decision-making, actors orient and negotiate each other's deontic rights, and these utterances also distribute

the deontic rights between the participants. However, it might be a bit more complex than just to look at the spoken word:

> In this future-oriented context, the existence of deontic rights, and their interactional expression, may have a complex relation: Speakers with strong deontic rights in a domain might not need to display those rights, for example, by "commanding," while speakers with fewer deontic rights might be willing to inflate their authority with more assertive directives. (Stevanovic & Peräkylä, 2012, p. 299)

Furthermore, one could also argue that the negotiation of deontic rights is also a negotiation of power, something very common for all types of meetings (Arminen et al., Forthcoming; Huisman, 2001; Stevanovic & Peräkylä, 2012). Although much has been written about power, in this thesis I will simply align myself with Stevanovic (2013) and define power in social interaction as claiming and/or being recognized for having deontic authority, in other words being acknowledged for having the ability to match one's words with how the world ought to be, thus making one able to make decisions on behalf of the group. Analyzing power from a CA approach creates an interesting dilemma:

> In CA, the analysis of power is further complicated by its methodological credo that the researcher has to show how the proposed mechanism of power is procedurally consequential for the observable patterns of interaction, because the shifting distribution of resources that enable the local achievement of interactional effects may be an outcome of sequential courses other than power (Arminen 2017; Schegloff, 1991). Given the hardship to fulfill the requirement for procedural relevance, the deontic approach offers promise. It allows us to identify the first speaker's suggestions for future events and then explore the second speaker's responses, which acquiesce to or resist the plans, and also indicate the second speaker's understanding of the first speaker's entitlement to propose. (Arminen et al., Forthcoming, p.3)

Although I position myself in a wider EMCA approach within sociocultural psychology, allowing me to interpret a bit further on the statements produced by the different interlocutors than a normal CA-approach, the deontic approach provides excellent resources to analyze how deontic rights are established and negotiated in the different interlocutors' statements.

5.2.3. FINDINGS OF DECISION-MAKING FROM A DEONTIC PERSPECTIVE

As previously mentioned, in decision-making a speaker names a course of action suggesting it to be realized, however the actualization of this proposed course of future action is contingent upon the recipient(s) approval. Thus, when making a proposal, a person suggests that at least one person other than the proposer has the right and

obligation to be involved in the decision-making process (Stevanovic, 2012). Proposals differ from "informings" and "announcements" where the speaker may refer to decisions already made; they are also different from suggestions or advice, actions in which the recipient has the responsibility to decide whether or not to acquiesce to the future action recommended (Sarangi & Clarke, 2002), thus when proposals are made, people do not decide on the matters themselves, they do not leave it to others to decide, instead they invite others to approve the proposal and then implicitly suggest this proposal should be reached together. Thus, they are sharing deontic authority with other participants.

It is important to emphasize a proposal is not yet a decision, something needs to be done after the proposal for the decision to emerge. As stated earlier, a lot of research exists in regard to decision-making, but according to Stevanovic (2012) the exact interactional mechanisms that people use to turn proposals into joint decisions lacks research. She has explored this interactional framework, and her data suggest that joint decisions emerge when the recipient:

- establishes access to the content of the proposal;
- expresses agreement with the proposer's views; and
- displays commitment to the proposed future action.

(Stevanovic, 2012, p. 781)

"Access" is here understood as "access to the subject matter of the first speaker's proposal" (Stevanovic, 2012, p. 784) – in Stevanovic's examples it is to a hymn book. The recipient can then express agreement and in the last phase display commitment to the proposed future action. She further concludes that decisions are not rejected outright but instead get "not approved," thus, to save face, people do not directly reject decisions, they just do not approve them. This can then lead to the following structures from the recipient:

- "try" to gain access to the content of the proposal without succeeding in it;
- treat the successful establishment of access as the main point of the interaction; or
- emphasize his/her agreement with the proposers' views without yet displaying commitment to future action.

(Stevanovic, 2012, p. 799)

These results will be discussed further in my discussion and put in relation to my own findings.

CHAPTER 6. FINDINGS FROM ARTICLES AND DISCUSSION OF RESEARCH CONTRIBUTIONS

In this chapter I provide a short summary of my findings from the last two articles and how it links with existing research in the area. I then continue with a discussion where I link all the findings from my articles and elucidate what this means in regard to shared problem construction – here I also discuss shared problem construction from a more sociocultural perspective. Subsequently, I will link these findings to the international PBL research and discuss my findings against the critique found in the literature regarding shared problem construction. I conclude with a discussion on the implications my findings might have for practice.

6.1. ARTICLE 2: HOW STUDENTS NEGOTIATE DISAGREEMENTS REGARDING THE PROBLEM IN PBL

In this article I looked at decision-making processes regarding the problem construction. Three interactively and discursively different examples where a group member had a proposal toward the content of the problem were analyzed. In one instance, the proposal was rejected, and in the other two cases the proposals were accepted after questioning. The findings indicated that the conversation's structure had an impact on whether the decision-proposal was accepted or not. The qualitative content of the analyzed discussions differed, but the interactional structure remained the same: proposal of an idea; questions concerning the idea; addressing the questions; and a decision. Sometimes the arguments in the discussions would use academic discourses, other times not. Thus, I could not pinpoint a certain kind of argument that would satisfy the other group members, as this was also according to the situated nature of the decision. However, if a decision proposal was met, it seemed to be due to the initiator's ability to keep defending their proposal (Velmurugan et al., 2021). Thus, the initiator's ability to hold his/her position and answer questions regarding the proposal determined whether other group members accepted the proposal.

6.1.1. ARTICLE 2'S RESEARCH CONTRIBUTION

Holding these findings up towards the theory and findings in relation to deontic authority, one could state that the first utterance sequence I focus on – proposal of a decision – is detrimental in every decision-making instance, it is what determines whether the interactional sequence I am looking at is a decision-making sequence or a mere discussion/informing of a previously made decision. Stevanovic's (2012) findings then point towards the fact that other interlocutors are aiming to gain access

to the content of the proposal; one could state that the questions asked towards the decision-proposal is a way for the other interlocutors to gain access toward the proposal, and the continuing questioning is a way of ensuring that access. Furthermore, when a decision is not made, my research seems to confirm the notion that decisions are rarely directly declined, they are just not accepted because of reasons, given in the questioning and discussion of the proposal. Where my research can elaborate on the findings of Stevanovic is that it shows more directly how deontic authority is established in a structure, where everyone on paper has equal power status. What I examine is a group of students who organizationally should be seen as equal, where everybody's opinion matters the same amount, in contrast with an organizational structure where there might be a leader present. As a main finding, I argue that one builds up deontic authority either by not being challenged or by the ability to keep the floor while being challenged. Thus, holding the floor does not necessarily mean the ability to talk all the time, although this could be one way of ensuring not to be challenged, but what is most important in this regard is the ability to keep the floor while being challenged. I will elaborate on this in the discussion of the third article, but for now I will emphasize the argument that by holding the floor one gains the ability to make one's words match the world, thus being able to determine future actions to take in this instance. In other words, if one is successful in managing to hold the floor, one gains deontic authority/ interactional power, because one gains the ability to define how the world is, and thus also the ability to determine what the relevant courses of actions are to meet this world.

6.2. ARTICLE 3: STUDENTS CHALLENGING SUPERVISORS IN HIGHER EDUCATION: HOW AND WHY?

The AAU PBL model encourages student autonomy while simultaneously receiving assistance from a supervisor, who ensures the academic content of students' work. This article investigates conflicts this model may produce and discusses what happens when students disagree with their supervisor about the direction of their project in relation to their problem. The article focuses on the intersection of ensuring academic relevance and student autonomy. Specifically, the focus is a supervision meeting between the students and their supervisor, where the students want to challenge the direction in which their supervisor wants them to go. The article argues that the students challenged the supervisor because they felt an ownership toward their constructed problem (Velmurugan et al., 2022). Furthermore, it claims both the students and the supervisor entered the meeting with different learning trajectories as to why the students disagreed about the direction of the project. Thus, a great deal of the meeting was centered around understanding these. Another interesting finding was that the students could ensure a productive outcome of a supervision meeting by asking relevant questions, challenging some directions in the literature of supervision that only focused on the supervisor's responsibilities in order to ensure a productive outcome of the supervision (Velmurugan et al., 2022).

6.2.1. ARTICLE 3'S RESEARCH CONTRIBUTION

Where Article 2 focuses on decision-making in a "flat" power structure, this paper looks at decision-making from a more unequal power structure, where the supervisor has a higher power position than the students. Here it is important to pay attention to the point Stevanovic and Peräkylä (2012) made when participants have unequal deontic authority, where the person with the highest deontic authority might not need to display this by "commanding" but can listen to the objections people with less deontic authority have; this also explains why one student; Magnus does most of the speaking, because he has less deontic authority than the supervisor, but he is trying to establish more authority. This article also shows a concrete example where Magnus does most of the talking but does not manage to keep the floor. The supervisor does not approve his suggestions for the decisions he is questioning and ends up taking the floor in the last section, explaining vital theory for the students that they did not have. Thus, even though Magnus fights for the floor, he is not successful in maintaining it. From a learning perspective, however, this is a good thing. It is good to have one's assumptions and arguments challenged because it forces the actors to explicitly state why their knowledge/proposal is the right one and should be accepted by other members, and it is also in these cases that learning occurs, as this is where we see a direct transformation of how one conceptualizes different forms of knowledge.

Thus, to sum up, in relation to decision-making my findings confirm that participants require access to a proposal and do not directly reject it, they just do not accept it. What my research also shows is how students build up deontic authority in constellations with a flat power structure – basically, this resides in the ability of being able to hold the floor, which is important because it provides the opportunity to make one's words match the world, enabling power to determine the future directions of the group. In this regard it is important to state that I am not arguing for the fact that if you are able to get deontic authority you are also right in your claims or that other group members agree with you, but as long as these other group members do not speak up either in meetings or in actions, their actions are not accountable, therefore it allows the person with deontic authority to lead the way. Furthermore, I argue that, from a learning perspective, it is healthy to have one's decisions challenged because it provides an opportunity to explicitly conceptualize and reflect on why the actions taken make sense and how this relates to the specific subject knowledge. Furthermore, it also provides an opportunity to expand one's knowledge, as different angles, or knowledge other than what oneself imagined, might be put into play. This comes back to the two definitions of learning provided in this thesis: "learning is rooted in learners' participation in organizing talk-in-interaction, structuring participation frameworks, configuring discourse tasks" (Mondada & Doehler's 2004, p.504) and viewing learning as: "a distributed, ongoing social process, in which evidence that learning is occurring or has occurred must be found in understanding the ways in which people collaboratively do learning" (Jordan & Henderson, 1995, p. 42). Thus disagreeing in decision-making provides optimal conditions for learning to occur,

which I will elaborate in the following discussion of shared problem construction from a sociocultural perspective.

6.3. SHARED PROBLEM CONSTRUCTION FROM A SOCIOCULTURAL PERSPECTIVE

Goodwin argues that: "human cognitive activity is inextricably lodged within the activities and settings of the lived social world: that is, that knowledge is intrinsically situated" (Goodwin, 2018, p. 367), thus what counts as knowledge is socially situated within the examined interaction. In my case, it is in the internal negotiations between group members and between the group and supervisor that what counts as knowledge is defined. However, social interaction consists of more than different interlocutors interacting with each other through language, it is also a result of: "material tools, historically shaped and socially distributed forms of knowledge, processes of social interaction and the forms of social action they produce, and recognizable patterns of activity in a specific setting" (Goodwin, 2018, p. 367). Thus, social interaction in itself is shaped by these historically shaped and socially distributed forms of knowledge – in other words, the way we interact in a specific community is shaped by a certain "culture" that contains recognizable patterns of activity. Thus, the interaction examined in this thesis is a result of students being enrolled in a specific culture of both engineering and PBL practice. One step in this socialization is what constitutes a problem within engineering in a PBL curricula. In the same way that knowledge is argued to be socially situated, the same can be said for a problem. Thus, a problem in PBL becomes an entity shaped by a PBL and subject culture. In the case of shared problem construction, a relevant factor becomes the students' interests and what they deem as a relevant problem. An issue in this context is students' lack of cultural understanding within the subject field. Because students have limited knowledge of their subject field, their initial interest or problem is often transformed along the way, as their knowledge of the field increases, but this is not always done that easily.

A central notion in CA and interaction analysis is the: "next-turn procedure" – the notion that the response of an utterance provides the analytical focal point, and not the utterance in itself (Sidnell, 2013b). However, sometimes recipients do not answer in a preferred way by the prior turn, or no response occurs. In these cases, the utterance can be followed by a long pause, or a reason is given for not answering in a preferred way. Furthermore, the previous talker can follow up on the dispreferred response with a follow-up question. These examples are called "deviant cases" within CA (Sidnell, 2013b) and they: "often provide the strongest evidence for the analysis because it is here that we see the participants' own orientations to the normative structures most clearly" (Sidnell, 2013a, p. 79). I am mentioning this, because the analytical focal points for my two empirical articles (Velmurugan et al., 2021, 2022) focus on this; the deviant cases, where interlocutors answer in dispreferred ways. I argue these interactional situations of deviant cases are situations, in which learning occurs.

I previously defined learning as: "a distributed, ongoing social process, in which evidence that learning is occurring or has occurred must be found in understanding the ways in which people collaboratively do learning" (Jordan & Henderson, 1995, p. 42). When students disagree about which learning trajectory to follow, they start negotiating/arguing for why their proposal is the one to follow, or why a certain trajectory should not be followed, thus they are trying to establish the right way into becoming a member of a specific engineering and student practice. As previously argued, Erickson states: "the enactment of communication creates reflexively its contextual framing at the same time as it is being framed by its context" (Erickson, 2004, p. 7), thus the students are both producing their own culture /contextual framing and are framed by their institutional setup in regard to PBL and relevant coursework.

In the students' negotiations, I found a certain structure: proposal of an idea; questions concerning the idea; addressing the questions; and a decision (Velmurugan et al., 2021). Furthermore, I found the ability of the initiator to hold the floor determined whether the students would follow them, which aligns with the research of deontic authority. As previously stated by Goodwin, knowledge is situated, which is clearly seen in the empirical data I analyze in the article. In the first interactional situation, relevant knowledge becomes discourses of procedure, whether a decision has been made or not. The second example focuses on the theory of batteries, and the last example on different kinds of power (AC or DC). As these interactional situations are analyzed across different temporal instances, in which the students have had numerous coursework in between, we see a gradual transformation of the students, and how they become more competent members of the engineering culture, thus we see their gradually becoming a part of their relevant communities of practice. Building on the findings of Garfinkel's juror studies, we see how the students in the beginning make decisions, like they would do in "daily life," but gradually they become encultured in the discipline's way of making decisions, and gradually start accounting for why their decision makes sense, from that perspective. In this way, it can be argued that being a student in a PBL curricula is also a negotiation between different cultures: an engineering culture and a student culture. Being a student is a novice position that in one regard provides certain freedoms and autonomy; students become enabled to form their own learning journey in regard to their interests as long as it adheres to their learning goals, and at the same time, they also have to argue how their decisions makes sense in an engineering culture, thus they are bridging different identities; student and engineering. This also aligns with Mondada and Doehler's (2004) view:

> learning is rooted in learners' participation in organizing talk-in-interaction, structuring participation frameworks, configuring discourse tasks, interactionally defining identities, and becoming competent members of the community (or communities) in which they participate, whether as students, immigrants, professionals, or indeed any other locally relevant identities. (p. 504)

Thus, what we see in the deviant cases analyzed in my articles are the students' becoming professional members within the situated practice of PBL and engineering

culture. Thus, shared problem construction becomes a social action in which both the specific subject identity and PBL identity are defined through ongoing negotiations internally in the group and between group members and their supervisor. This can be related to a study previously accounted for (Benwell & Stokoe, 2002), in which the authors found that the students resisted academic discourses in their interaction. Although this is not entirely the case here, the conclusion made by Benwell and Stokoe (2002), that students are bridging different identities, is the same point I am making here. The students navigate both between a PBL student and an engineering identity, neither of which they are basically equipped to do, but learn to navigate their way through their engagement in the community of practice.

6.3.1. CONSTRUCTING A PROBLEM OVER LONGER TIMESCALES

By using an EMCA approach within interaction analysis, my focus has been on short instances of interaction chosen for further analysis. However, a criticism, that can be directed towards CA is that few studies within this approach have been occupied with transformations of meaning over time (Back, 2020), as Goodwin also states:

> We're always in this world where we inherit the solutions that earlier actors have found. So, we're constantly in a world of not just objects, but of things that are shaping both our actions and our thinking, that has an historical sedimentation. And we can't ignore that historical sedimentation, which I think is what happens in CA. (Goodwin & Salomon, 2019, p. 17)

In other words, only looking at the members' orientation and response to each other's utterances is not enough, as they are a product of a socially and historically shaped culture, which affects the ongoing interaction.

In this thesis, my focus turns into the semiotic transformations concerning the construction of the problem over time. Thus, as the interactional situations show, it might seem like I am looking at the "same" phenomena, with the "same" actors over different temporal spaces. In this regard, I have argued that the students become more competent over time, both in constructing their problem and understanding their specific subject culture. From this point of view, it could be relevant to shortly introduce mediated discourse analysis (MDA). This focuses on: "linkages between discourse and action and how these play out in complex social situations" (S. W. Scollon & de Saint-Georges, 2012, p. 66). Norris and Jones (2015) elaborate: "The focus of mediated discourse analysis is not discourse per se, but the whole intersection of social practices of which discourse is a part" (p.4). Thus the central focus becomes the social action. A way to do a mediated discourse analysis is with the ethnographic methodological strategy called "nexus analysis" (Norris & Jones, 2015; R. Scollon, 2001; R. Scollon & Scollon, 2004; S. W. Scollon & de Saint-Georges, 2012). Here it is argued that a social action takes place at a nexus of discourses, interaction order and historical body (R. Scollon & Scollon, 2004). The notion of historical body, is of especial interest to my analysis, which they define as: "the life experiences of the

individual social actors" (p.19); they relate it to Bourdieu's Habitus concept, but prefer the notion historical body to emphasize the changing nature of it. What becomes relevant in relation to my findings is that the historical body is constantly changing among the students, qualifying them to perform a problem construction within their subject culture. Thus, they are not only influenced by the discussions they have internally but also by the lectures they attend, as they are used more and more in the discussions, I have examined in article two (Velmurugan et al., 2021). In other words, the fact that the problem is constantly renegotiated over longer timescales, implies that it is not the "same" phenomena or the "same actors" as the actors' historical bodies have changed since their last discussion, which affects how they understand the phenomena, the problem being in the project. Thus, a consequence of having a project over the course of a semester with relevant coursework is the fluid nature of the content they are approaching. They start the project as novices, who lack relevant subject knowledge, which thus affects the scientific validity of their problem, and as their historical body develops as a result of being socialized in the subject culture, their problem becomes more qualified. Thus, the evolution of the problem could also be regarded as the evolution of the students becoming a member of the relevant community of practice (in this case engineering practice), returning to the previous argument, that the problem itself becomes an identity marker of the relevant subject practice and type of PBL done.

Next, I will try to connect the results from my three articles together, and then relate these to the international PBL research literature.

6.4. DISCUSSION OF RESEARCH CONTRIBUTION IN RELATION TO MY RESEARCH QUESTION

Considering the contributions of my research in relation to the research question for this thesis, I stated that, from a conceptual perspective, shared problem construction would lead to intrinsic motivation, which would lead to learning transfer. In this case I argue that I found interactions of intrinsically motivated students in my empirical findings, which most arguably is seen when they confront their supervisor.

In this regard I want to step back and look at various faculty meetings I have participated in where teaching is discussed. At these meetings I often hear a lecturer complain about the nature of students and how he or she misses students who are there for the sake of learning and not just to get a good grade. In other words, the lecturer is looking for intrinsically motivated students. When I hear this wish, I often get a mental picture of students who are eager to learn. My imagined intrinsically motivated students light up if I suggest they read something and they immediately comply because it might enrich them from a learning perspective. They are intrigued by the content and how to best address it, instead of just knowing what level they are on and how to improve their grade with the least amount of effort. These imagined students correspond with the self-determination theory research on intrinsic motivation, where

satisfaction is the activity itself instead of the external reward associated with the activity, as referred to in my first article (Velmurugan & Stentoft, 2020).

I argue that the students confront their supervisor because they are intrinsically motivated to follow a certain trajectory, and they feel their supervisor's trajectory redirects them from their initial interests. Thus, what according to my data constitute intrinsically motivated students are quite different from my imagined intrinsically motivated students, where students just comply with the advice of their supervisor; in fact, it is quite the opposite: when students confront their supervisor this might constitute a case of intrinsically motivated students. In this instance, one could argue that possibly the students challenge their supervisor because they do not view him as competent in his field, and thus fear following his advice will give them a lower grade. This might indeed be the case, but in this instance, I watched the video up to the supervision meeting and the debates the students had internally before they requested a meeting with their supervisor where they planned to challenge him. These arguments were never presented internally among the students. On the contrary, the internal discussion among the students was more centered on the fact that this was not what they set out to do. It took two internal meetings among the students before they decided to invite the supervisor for a meeting where they would challenge his proposed direction, thus it was not an easy thing to do for the students, evidence of the fact they know they are engaging in a dispreffered way. Holding this up with my analysis of shared problem construction from a sociocultural perspective, one could argue that different identities are clashing. The student identity, marking that the students have autonomy and control their own learning process, with the more engineering identity, where the research the students do has to make sense from an engineering perspective; balancing these two types of identities can be quite challenging, as it requires a supervisor to constantly be aware of the students' knowledge level.

One could thus argue this thesis conducts an interactional exploration of whether Dewey's notion of a genuine problem can become a result of shared problem construction in problem-based learning in higher education. With the arguments presented above, I state that this might be the result, however it is not an easy task to accomplish. From the supervisor's perspective the challenge is to facilitate this natural interest while simultaneously relating to the relevant learning goals. Because the students are learning as they progress through the semester, it becomes vital for the supervisor to assess the students' knowledge level; however, based on my findings this can be quite challenging.

6.5. LINKING MY FINDINGS TO THE INTERNATIONAL PBL LITTERATURE

Hung et al. (2019) identify three megatrends within PBL research. The first trend polarization from 1990 to mid-2000 focuses on whether PBL works when compared

to more traditional ways of educating. The next trend, outcomes to process, took place from mid- 2000 to 2010 and its focus is on how and why PBL works. The third wave from 2010 onward focuses on how PBL works in specific contexts. My research takes its point of departure from the third wave. This does not mean my findings are not relevant for a wider area of PBL scholars. On the contrary, it shows how the situated institutional nature enables certain practices and what seems to be the requirements for these practices. Furthermore, it does this in a more detailed interactional way than the majority of PBL research. In the following, I will discuss my results in relation to previous PBL literature on problem construction, specifically the criticism towards shared problem construction.

6.5.1. MY FINDINGS PUT IN RELATION TO CRITICISM TOWARDS SHARED PROBLEM CONSTRUCTION

As previously established by other scholars, constructing problems is an important skill when engaging in the job market (Holgaard et al., 2017). When scholars criticize the notion of shared problem construction, the following arguments are presented, most notably by Hung (2016):

1. There is too much responsibility put on the facilitator, and the quality of facilitation can vary even with proper training.

2. The students might be overdependent on the facilitator if their problem is too vague, which would defeat the goal of developing their independent problem-solving skills.

3. Some problems might be so poorly designed that students do not understand them properly and thus do not solve them in a scientific manner.

Furthermore Krajcik and Shin, (2006) emphasize that:

4. It is extremely difficult for students to develop a good driving problem that adheres to their learning goals.

First, although I have not been able to specifically locate what kind of model of PBL Hung uses, I expect it is a model closely aligned to the McMaster model, in which students are given different cases or problems for a more limited amount of time, which they try to solve (Barrows & Tamblyn, 1980). Thus, it is not based on the Aalborg model where students address one problem over the course of a semester. However, a growing trend at Aalborg University is the introduction of project catalogues or predefined problems (Hüttel & Gnaur, 2017); thus, I will address this criticism in regard to the Aalborg Model.

Hung's first and second criticisms are directed against the facilitator. If the facilitator does not have adequate competence, the students might miss important learning goals. I agree with this criticism. If an institution has an approach of shared problem construction and the facilitator does not have the necessary competencies in facilitating or developing good problems in cooperation with the students, the result could be a lack of learning. As my research shows, the facilitator has an important role in securing the academic content of the problem (Velmurugan et al., 2022), and my results also show the researcher can have a difficult time in aligning his trajectory with that of the students (Velmurugan et al., 2022). However, this same criticism can be applied to all manners of teaching, including the instructor who has the responsibility of developing the problem for the students. Thus, the criticism is something to be aware of in all teaching situations. The way an institution can make sure this does not happen is to focus on the competencies of their facilitator and ensure continued education in facilitation techniques. Furthermore, as we teach the students to become self-directed learners (Barrows, 1996; De Graaff & Kolmos, 2003), the students themselves have a partial responsibility in ensuring a productive outcome.

The third criticism presented by Hung concerns the involved risk that the problem will lack quality. This risk exists both with shared problem construction and teacher-designed problems. This can, to some extent, be amended by requiring the students to conduct a proper problem analysis as a part of their problem-solving (Thorndahl et al., 2018). Krajik and Shin's (2006) criticism concerning the difficulties of constructing a problem that aligns with the learning goals is backed up by my findings in the second article detailing the decision-making processes in problem construction. We show the difficulties the students have in constructing a good problem (Velmurugan et al., 2021), which is why it is important to maintain an emphasis on the shared problem construction, in which the supervisor scaffolds the students in the construction of the problem, ensuring the problem adheres to the learning goals and subject-specific practices. Another important notion of shared problem construction is that it requires time for the students to develop a problem of sufficient quality. Additionally, a central finding in my second article is that the debate the students have internally becomes more academic and qualified as their knowledge levels progress during the semester.

6.5.2. IMPLICATIONS FOR PRACTICE

A recent trend at Aalborg University is the introduction of project catalogues (Hüttel & Gnaur, 2017). Students are presented with an overview of cases or problems supervisors have constructed on which students can base their project. The project catalogues should be seen as an inspiration for the students, and they are free to choose whichever problem/case interests them the most. However, it has become a growing tendency to use these catalogues for problem selection. The question arises as to whether this contradicts the goals of shared problem construction. Hütel and Gnaur (2017) point to the fact that the project catalogues have been a requirement for the

accreditation of the university's different educations from the government, to ensure the quality of the education provided to the students. Thus, the catalogue gives external stakeholders a conception of what kind of projects the students will write during their education. Furthermore, the project catalogues can provide inspiration for the students and cooperation partners where the students can engage with external stakeholders.

If students choose the case/problem out of genuine interest, we can ensure the students stay intrinsically motivated. In this way it is important to remember that the whole argument of why students should construct their own problem is because of the learning benefits of invoking a genuine interest in the problem, and shared problem construction is seen as an effective way of doing that. If the catalogues serve the same purpose, they should, from a learning perspective, be welcomed. Additionally, they might serve to secure authentic problems from real-life cases, which can motivate the students as well. During my research at Stanford University, which also used problem-based learning, a common mantra for engineering was: "Reality is the best teacher." Cases from industry were required to qualify the students' problem-solving competences in a specific situation that was relevant for their future career. However, based on my research, it is important that students maintain a choice of which case to engage in or find their own, as the students need to experience the problem to invoke the benefits of shared problem construction. I am not stating the only way of securing intrinsic motivation from students is through shared problem construction; however, it can be one way of ensuring it.

What has this research established in connection to problem-based learning? It has looked at specific practices of shared problem construction. This practice has been debated in the international PBL literature, and it is often argued against. It shows the benefits that can be derived from this process, most specifically intrinsic motivation. This research also shows empirically what intrinsic motivation might look like and how it is shown in practice combined with how longer time frames are necessary for the students and supervisor to interactively agree about the content of the problem. Additionally, we have been given a greater insight into what goes on in the students' work when they are doing PBL.

CHAPTER 7. CONCLUSION

This thesis set out to answer this research question:

"From a conceptual learning perspective what are the challenges and benefits of shared problem construction and how does this process unfold interactively in the group and in co-operation with the supervisor?"

Initially I argue from a conceptual learning perspective that shared problem construction should lead to increased intrinsic motivation, which in the literature is often connected to learning transfer. I base these arguments on Dewey's notion of genuine problems and theories of intrinsic motivation. The challenge is its time-consuming nature in constructing the problem. Seen from a more sociocultural perspective, I argue the problem in problem-based learning becomes an identity marker, marking the type of PBL conducted at the institution, and what kind of subject knowledge the problem is constructed within. This presents some challenges, as the students should both be encultured in a specific "PBL culture" and a specific "subject culture," thus the problem can be seen as an entity that connects these two types of cultures, but this also explains why the problem is of such a fluid nature, as the students develop their skills and knowledge throughout the semester, thus the changing nature of the problem in a process of shared problem construction is a testament to the students' ongoing socialization in the PBL and subject culture.

Essentially, the problem becomes a result of a series of decision-making processes both within the group and with the supervisor. By using video observation of the students practices with the project, I examine how they determine what kind of decision ought to be made in relation to their problem construction. In these cases, I focus on the deviant examples that do not follow normal procedures, as these most actively show how the different interlocutors orient towards the normative structures of their conduct. Thus, I focus on disagreeing in decision-making. Focusing on the EMCA literature of decision-making, it becomes clear that making a decision is detrimental in ensuring progress in the endeavor undertaken, however decision-making processes from a social perspective are also a negotiation of power. In this case I define power as deontic authority, meaning the ability to make one's utterances fit with the world, in other words the ability to construct a worldview to which other participants agree or follow. This ability then provides the power to make decisions regarding how to navigate in this world. This deontic authority is constantly negotiated and constructed within interaction. In this research, student groups were defined as a group with flat power structure, meaning every student, on paper, has an equal amount of power or say in the decision-making. My research shows how some students establish more deontic authority than others by maintaining the floor. Maintaining the floor should in this instance be understood as either avoiding criticism or addressing it to the other members' satisfaction. When this happens, you establish

deontic authority. When confronting a supervisor, the social nature changes. Here there is not a flat power structure: the supervisor holds a greater power position than the students, and thus the students are dependent on the supervisor's approval of their decisions. Therefore, when they disagree, they have to actively engage in dialogue with the supervisor, arguing for their view. This can be challenging if they are not aligned on the same learning trajectory; however, if the students continue to engage into dialogue with the supervisor, understanding eventually emerges. In this case, the students lacked some knowledge to properly understand their problem field, which the supervisor then clarified for them, confirming again my argument that the students are novices, both in PBL and in their specific subject, requiring high facilitation requirements from the supervisor. I also conclude that when students confront their supervisor, it should be seen as proof of their intrinsic motivation, as it is a really difficult thing to do interactively. I therefore confirm empirically my conceptual notion of intrinsic motivation, but also show that it might not be as we imagine it is.

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APPENDIXES

Appendix A. Template for Confidentiality Agreements

SAMTYKKE- OG FORTROLIGHEDSERKLÆRING
VEDR. DATAINDSAMLING AF GRUPPEARBEJDE PÅ AALBORG UNIVERSITET

Kort beskrivelse af projektet:

Projektet er et delprojekt, i et større forskningsprojekt på Aalborg Universitet (AAU), kaldet PBL Future. Projektet har til formål at indsamle data om, hvordan studerende arbejder med problemer i relation til Problem Baseret Læring. Dette vil ske igennem konkret observation fra forskeren selv (Giajenthiran), der vil være til stede under gruppemøderne. Yderligere ønskes følgende typer af data indsamlet: Videooptagelser af gruppearbejdet, ad hoc interviews med de enkelte studerende, screenshots af kommunikationen imellem gruppedeltagere på digitale platforme, historik af redigeringer i forskellige arbejdsdokumenter på digitale platforme, samt feltnoter under observation af gruppen. Dataene vil blive gjort tilgængelig for den dataansvarlige (Giajenthiran), forskningsgruppen Centre for Health, Science Education and Problem Based Learning samt personer involveret i forskningsprojektet PBL Future. Dataene vil blive opbevaret efter gældende regler og love om databeskyttelse.

Datatansvarlig:

Navn: Giajenthiran Velmurugan, Ph.D. Stipendiat

E-mail: vel@hst.aau.dk

På baggrund af ovenstående giver jeg hermed tilladelse til (kryds af, hvad der gives tilladelse til)

> at bruge dataene i relevante forsknings- og formidlingssammenhænge (publikation af videnskabelige artikler, bogkapitler, konferencer, bøger) **med** anonymisering
> at bruge dataene i relevante forsknings- og formidlingssammenhænge (publikation af videnskabelige artikler, bogkapitler, konferencer, bøger) **uden** anonymisering

at bruge dataene i workshops og undervisning **med** anonymisering
at bruge dataene i workshops og undervisning **uden** anonymisering

Hvad betyder anonymisering?

- de indsamlede data bliver før publicering fuldstændig anonymiseret. Ift. videofilmene så bliver ansigterne sløret og enhver angivelse af navne, steder eller andet, der kan føre til genkendelse, gøres utydelig. I transskriptionerne bliver alle navne (både personer og steder) anonymiseret

Jeg er informeret om og indvilliger I, at

- jeg, til enhver tid både før og efter dataindsamlingen har mulighed for at tilbagetrække indvilligelsen om at deltage i projektet. I så fald vil dataene blive slettet.

Deltageroplysninger:

Navn:

_____   _____

    Underskrift   Dato

Appendix B: Index of Video Data

The following index of the video data is a rough estimate of the activities of the group. I have tried to categorize the different activities; however, it is important to state, that natural interaction is not so schematical. For example, the group can be in the middle of a brainstorm, engage in off topic talk, get back to the brainstorm, suddenly talk about their supervisor etc. I have not marked these shifts in this index, unless they are approximately over 15 minutes long, but oriented towards when the students mark a shift, thus, when they clearly mark, they are going from one type of activity towards another, even though their previous activity has incorporated many different types of activities. I have not noted the breaks they take during the day either, which explains why the time estimate in column one (date + number of minutes of recording that day) does not always match with the total hours of all activities that day. Also note the students have a lot of coursework in the beginning of the semester, which is why they meet less, than in the end of the semester, where there is not so much coursework. The index contains the activity for the first two months as this is the data, I have chosen my extracts from. I have counted the hours of video I have for the rest of the months, but not categorized it yet. Furthermore, I have highlighted the sections I have analyzed in my papers. In the index, I have created different categories, within the themes; Group Meetings, Supervision, Divided Work, Off-Topic. Within these themes, I have created some categories, these categories are described below, and are the ones noted in the index.

<u>Theme 1: Group Meetings:</u>

<u>Categories:</u>

Group Interaction: Common interaction where everybody is encouraged to pitch in. Activities might include planning, brainstorm, discussion of different topics, different directions to go in the project etc. In the index below I will mark which form of interaction it is.

Delegating tasks: A specific form of meeting, where they delegate tasks among themselves, the difference between delegating tasks and Group Interaction Planning, is that delegating tasks, is often done from day to day, making a specific person responsible for the task, where Group Interaction Planning, takes a longer project perspective, and focuses on the project.

Friday's Meeting: Evaluating what works well and not so well in their project every Friday. Planning activities for next week

<u>Theme 2: Supervision</u>

Preparing Supervision Meeting: Discussing agenda for the meeting, both when they e-mail the supervisor and right before a supervision meeting.

Supervision Meeting: Meeting with the supervisor, it will be marked what they discuss in these meetings.

Evaluating Supervision Meeting: Right after the supervision meeting, they discuss the supervisor's feedback and what this means for their future project work

Theme 3: Divided Work

Divided Group Work: When the group divides up writing or researching for themselves. Usually done in pairs sometimes done individually. It is not always clear exactly what the different members work on, and as time progresses it becomes more and more difficult to elucidate exactly what the different members work on. When it is possible, I will mark it in the data index, when not I will just note: "Divided Group Work"

Theme 4: Off-Topic

Playing Boardgames: When the students play board games

Off-topic talk: Talk not related to the project with a duration of over 15 minutes.

September 2018
Total Number of Video Hours: 40,2 Hours

Activities and total time of activities in September

Date and total hours of recording that day	Activity	Number of Minutes per activity
4.9.18 – 2 Hours and 33 Minutes	Activity 1: Group Interaction: Brainstorming project topic: 45 Minutes **13-14 minute – First clip analyzed in Article 2.**	45 Minutes
	Activity 2: Group Interaction: Matching Project Topic to learning objectives in curriculum	8 minutes

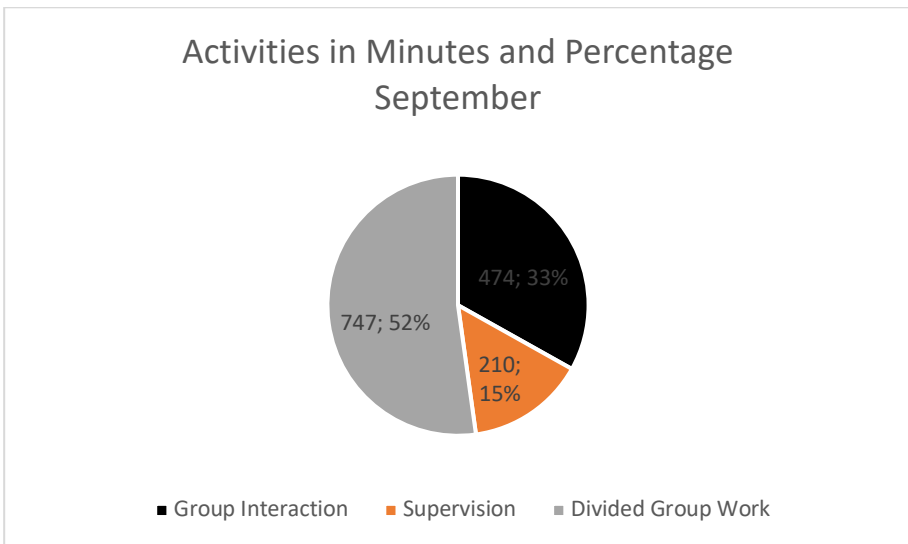|		
	Activity 3: Group interaction: Discussing project requirements and standards (language to write in, it-tools, synopsis that have to be sent to coordinator etc.)	10 minutes
	Activity 4: Group Interaction: Negotiating Group Contract:	1 hour and 30 minutes
5.9.18 – 1 Hour	Activity 1: Group interaction: Planning by making a time-schedule for their project	1 Hour
6.9.18 – 44 Minutes	Activity 1: Group Interaction: Brainstorming about how to examine their project topic. Knowledge sharing, discussing different directions to go in their project.	44 Minutes
7.9.18 – 2 Hours	Activity 1: Group Interaction: Knowledge sharing, the group shares their knowledge from research they have done in relation to the project.	1 hour
	Activity 2: Group interaction: Planning the project work for the next week.	20 minutes
	Activity 3: Divided Group Work: Learn to use IT tools (Mendeley)	40 minutes
10.9.18 – 3 Hours and 3 Minutes	Activity 1: Preparation of Supervision Meeting: Discusses the first mail to their supervisor and the agenda for their first meeting with the supervisor.	20 minutes
	Activity 2: Divided group Work: The group examines existing technologies on the market relating to their project and share new knowledge as they find it and discuss how this affects the direction of their project.	2 hours and 43 minutes.
12.9.18 – 6 Hours and 48 Minutes	Activity 1: Preparing the supervision meeting: Repeating the agenda of the supervision meeting being held the same day.	35 Minutes

	Activity 2: Supervision Meeting: Discussing formalities regarding the supervision, project, project scope. Supervisor recommends limiting scope of their project	1 hour
	Activity 3: Evaluating supervision meeting: The group discusses what the supervisor recommended and how this affects their project scope.	30 Minutes
	Activity 4: Group interaction: Starts to make a disposition of the project, setting up the master project file, delegating tasks among group members. Plans the work for the week **1 hour into activity 4, data for article two about battery size**	3 hours
	Activity 5: Divided Group Work on Problem analysis	2 hours
17.19.18 – 48 Minutes	Activity 1: Preparing next supervision meeting	5 Minutes
	Activity 2: Group Interaction: Discuss agenda for semester meeting and if their coursework relates to their project **35 minutes into activity 2, data for article two about ac/dc electricity.**	42 minutes
18.9.18 – 1 Hour and 48 Minutes	Activity 1: Supervision Meeting 2: 1.1 Discusses the disposition of their project – 16 minutes 1.2 The group asks the supervisor about the technical installation of the battery component in households – the supervisor draws the installation on the blackboard – 16 minutes 1.3 Plans the next supervisor meeting – 4 minutes	48 Minutes

	1.4 Discuss the learning goals and scope of the project – 12 minutes	
	Activity 2: Evaluating Supervision Meeting: The group is dissatisfied with "how simple" the project becomes.	12 Minutes
	Activity 3: Group Interaction: Rewriting the disposition of the project, based on the feedback from supervisor.	18 Minutes
	Activity 4: Group Interaction: Plans the work for the rest of the week.	24 Minutes
19.9.18 – 52 Minutes	Activity 1: Delegating tasks among group members	5 Minutes
	Activity 2: Divided Group Work: On different sections of the problem analysis	45 Minutes
20.9.18 – 2 Hours and 56 Minutes	Activity 1: Divided Group Work: The work in subgroups from yesterday continues, they have divided two and two and work in the same room. They are mutually sharing or asking each other questions while working divided.	1,5 Hour
	Activity 2: Group Interaction: Group discussion over which part of the market they should explore in the problem analysis.	1,5 Hour

24.9.18 – 2 Hours and 20 Minutes	Activity 1: Group Interaction: Continuing the discussion from last week of which part of the market to explore and delegating tasks	20 minutes
	Activity 2: Divided Group Work	2 Hours
25.9.18 – 2 Hours and 52 Minutes	Activity 1: Group Interaction: Knowledge sharing and group discussion	16 Minutes
	Activity 2: Divided group work on problem analysis	2 Hours and 30 Minutes
26.9.18 – 1 Hour and 36 Minutes	Activity 1: Group Interaction: Makes a status of the progress and plans the rest of the week and delegates task accordingly	10 Minutes
	Activity 2: Divided Group Work where they work with different sections of their problem analysis	1 Hour and 20 Minutes
27.9.18 – 3 Hours and 10 Minutes	Activity 1: Delegating tasks internally	2 - Minutes
	Activity 2: Divided Group Work: Subgroup work on Problem Analysis	3 Hours
28.9.18 – 2 Hours and 16 Minutes	Activity 1: Group Interaction: Status of the project	10 Minutes
	Activity 2: Delegation of tasks	2 Minutes

	Activity 3: Divided Group Work: Students continue to work on problem-analysis.	1 Hour and 22 Minutes
	Activity 4: Fridays Meeting: 4.1 Evaluation of the week- 45 minutes 4.2 Planning of next week – 10 minutes	55 Minutes

Total Number of Video Hours: 40,2 Hours

Activities in Minutes and Percentage September

474; 33%

210; 15%

747; 52%

■ Group Interaction   ■ Supervision   ■ Divided Group Work

October 2018

Total Number of Video Hours: 41,8 Hours

Activities and total time of activities in October

Date and Total Hours	Activity + Number of minutes dedicated to activity	Minutes per Activity
1.10.18 – 3 Hours and 28 Minutes	Activity 1: Group Interaction: Discusses the feedback they have done over the weekend	43 Minutes
	Activity 2: Group Interaction: Brainstorming relevant lab experiments and problem statement	26 minutes
	Activity 3: Off topic talk	30 Minutes
	Activity 4: Group Interaction: Continuing brainstorming	20 Minutes
	Activity 5: Group Interaction: Discussing the problem statement. No direct disagreements as they are brainstorming, just mentioning different options.	28 minutes

	Activity 6 - Preparing Supervision Meeting: Prepares agenda for supervision meeting – 22 minutes	22 Minutes
	Activity 7: Divided Group Work	38 Minutes
2.10.18 – 3 Hours and 36 Minutes	Activity 1: Group Interaction: Readdresses the brainstorm concerning the lab experiments and what the purpose of them are.	15 Minutes
	Activity 2: Group Interaction: Writes up the purpose with each suggestion they have for their experiments.	45 minutes
	Activity 3: Group Interaction: Brainstorming structure of their project report.	44 minutes
	Activity 4: Group Interaction: Writes up the structure in their master document.	6 minutes
	Activity 5: Group Interaction: Delegating tasks.	10 minutes

	Activity 6 – Group Interaction: Discusses the electronic system in solar cells and batteries.	50 minutes
	Activity 7 – Group Interaction: Receives written feedback from supervisor – They look through it.	30 minutes
	Activity 8 – Leaves for lunch – Camera is on for the rest of the time.	16 minutes
3.10.18 - 4 Hours and 32 Minutes	Activity 1: - Preparing Supervision Meeting: Discusses the written feedback they have received from their supervisor and prepares for supervision meeting.	16 minutes
	Activity 2: Supervision meeting. 1) Discusses the problem analysis - 20 minutes 2) Discusses the problem statement – 20 minutes 3) Discusses their suggestions for their lab experiments – 20 minutes 4) Discusses theory to include in the	1 Hour and 40 Minutes

	project – 2 minutes 5) Discusses requirement specifications - 12 minutes 6) Discusses project structure – 8 minutes	
	Activity 3: Break –	20 minutes
	Activity 4: Evaluating supervision meeting: They discuss the outcome of the supervision meeting.	32 minutes
	Activity 5: Group Interaction: Planning future group work.	20 minutes
	Activity 6: Divided Group Work: Lunch & Divided group work.	1 Hour and 28 minutes
4.10.18 – 2 Hours and 32 Minutes	Activity 1: Group Interaction: As Magnus was sick yesterday, they discuss the supervision meeting and planning done yesterday with Magnus.	24 minutes
	Activity 2: Group Interaction: They discuss their lab experiment.	8 minutes

	Activity 3 – Divided Group Work on requirement specifications.	52 minutes
	Activity 4 – Group Interaction: Discussion where they become dissatisfied with the fact they cannot conduct the experiment but lab workers has to do it. This leads to a discussion of what relevance the experiment has to do with their problem statement. The students are not able to properly answer this question.	16 minutes
	Activity 5 – Divided Group Work, continuing to work on requirement specifications.	52 Minutes
5.10.18	Activity 1: Friday's Meeting: Discusses the experiment guide, is still frustrated about the experiment they have to do. Ends up inviting their supervisor to a new meeting. 30 minutes 1.2 Group Interaction: Planning for next week. – 17 minutes	1 Hour and 15 Minutes
	Activity 2: Group Interaction: Discussing their	28 Minutes

	attendance to "Karrieremesse".	
8.10.18 – 2 Hours and 16 Minutes	Activity 1: Divided Group Work	2 Hours and 16 Minutes
9.10.18 – 3 Hours	Activity 1: Divided Group Work	3 Hours
10.10.18 - 1 Hour and 10 Minutes	Activity 1: Supervision meeting about the experiment's relevance for their problem statement. ==15 minutes in, data for article 3==	44 Minutes
	Activity 2: Evaluation of Supervision Meeting.	6 Minutes
	Activity 3: Divided Groupwork	22 Minutes
11.10.18 – 6 Hours and 24 minutes	Activity 1: Off-topic talk	16 Minutes
	Activity 2: Group Interaction: Status over the project writing	10 Minutes
	Activity 3: Divided Group Work	48 Minutes

	Activity 4: Board games	36 Minutes
	Activity 5: Divided group work	28 Minutes
	Activity 6: Discusses the Problem Statement	50 Minutes
	Activity 7: Board Game	16 Minutes
	Activity 8: Divided Group Work	3 Hours and 8 Minutes
12.10.18 – 1 Hour and 43 Minutes	Activity 1: Divided group work: 1 Hour	1 Hour
	Activity 2: Friday's Meeting	42 Minutes
15.10.18 – 2 Hours and 56 Minutes	Activity 3: Divided Group Work	42 Minutes
	Activity 2: Group Interaction: Brings an absent group member (who had to undergo surgery) up to date with their project and problem statement.	2 Hour and 12 Minutes
16.10.18 – 1 Hour and 41 Minutes	Activity 1: Divided Group Work	1 Hour and 41 Minutes
17.10.18 – 2 Hours and 18 minutes	Activity 1:	6 Minutes

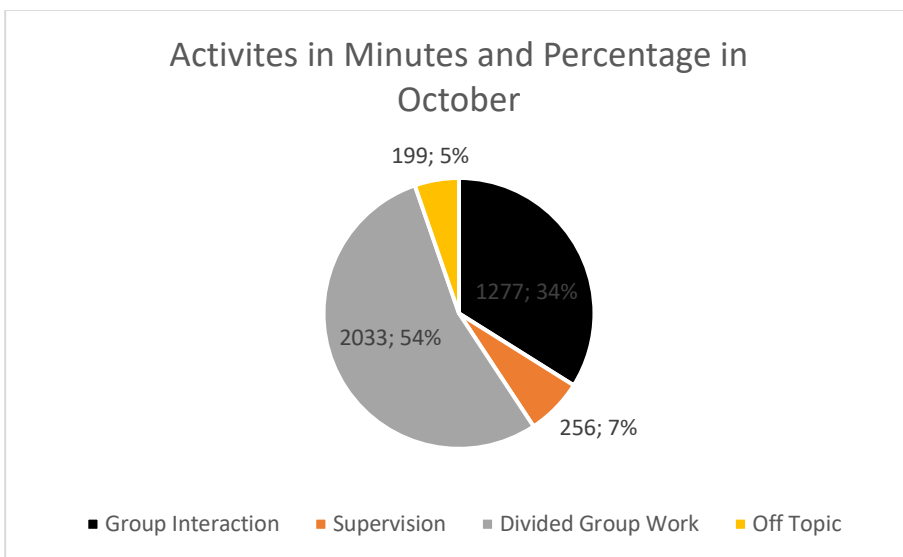|	Delegating Tasks 6 Minutes	
	Activity 2: Group Interaction: Discussing disposition for a new chapter in the project.	1 Hour and 14 Minutes
	Activity 3: Divided Group Work:	58 Minutes
18.10.18 – 3 Hours and 12 minutes	Activity 1: Group discussion brings absent group members up to date about the calculations for their project. Discuss and work on this the rest of the day.	3 Hours and 12 Minutes
22.10.18 – 1 Hour and 48 Minutes	Activity 1: Friday's Meeting: Discussion about an absent group member, and that they need to confront this group member about his lack of meeting in. They decide to confront the member next time the member meets in. – 6 Minutes	1 Hour and 48 Minutes
	Activity 2: Group Interaction:	35 minutes

	Refreshes the work done in the previous week.	
	Activity 3: Group Interaction: Confronts the absent group member about his lack of meting up after his surgery.	8 Minutes
	Activity 4: Answers a survey about their semester.	58 Minutes
23.10.18 – 3 Hours and 16 Minutes	Activity 1: Group Discussion: Discusses lecturers, experiment, plans the week, project disposition, calculations for the project.	40 minutes
	Activity 2: Delegating tasks.	8 minutes
	Activity 3: Divided Group Work – Writes about the calculations, corrects mistakes in the master document, update it tools.	2 Hours and 36 Minutes
24.10.18 – 2 Hours and 56 Minutes	Activity 1: Group Interaction: Discusses the math in their project, conducts a	15 Minutes

	status over each group member's work.	
	Activity 2: Divided Group work.	1 Hour and 24 Minutes
	Activity 3: Boardgame	1 Hour and 16 Minutes
26.10.18 3 Hours and 44 Minutes	Activity 1: Divided Group work	3 Hours and 44 Minutes
29.10.18 – 3 Hours	Activity 1: Group Interaction: Status over their work and delegation of tasks	44 Minutes
	Activity 2: Divided Group Work	2 Hours and 16 Minutes
30.10.18 – 5 Hours	Activity 1: Divided group work	4 Hours
	Activity 2: Preparing Supervision Meeting	36 Minutes
	Off Topic Talk:	25 Minutes
31.10.18 – 3 Hours and 31 Minutes	Activity 1: Group Interaction: Discussing how much theory to include in their project	15 Minutes

	Activity 2:	3 Hours and 16 minutes
	Divided Group work	

Total Number of Video Hours: 41,8 Hours

Activites in Minutes and Percentage in October

- 199; 5%
- 1277; 34%
- 2033; 54%
- 256; 7%

Legend: ■ Group Interaction ■ Supervision ■ Divided Group Work ■ Off Topic

Note: The students often turned off the camera during off-topic activities in September. They did not do that in October.

November 2018
Total Number of Video Hours: 75,4 Hours

December 2018
Total Number of Video Hours: 56 hours and 50 minutes

January 2019
Total Number of Video Hours: 11 hours and 16 minutes

(Note the students hand in their project in December and January is used to prepare their oral defense).

Total number of hours recorded: 225 Hours