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Group work as an arena for learning in STEM education: negotiations of epistemic relationships

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ABSTRACT

The relationship between learning and group work is often treated as self-evident, but the finer workings of this relationship require further study into the social organisation of group work. The aim of the research that forms the basis for the current article is to locate, describe, and gain new understanding of how peers organise their group work with a focus on epistemic negotiations. Based on detailed micro-analyses of several situations where pupils express their knowledge and orient to other's expressions of knowledge regarding the current assignment, we focus on describing and exemplifying how participants organise their social interaction and cooperation in group work. There appear to be important factors that may affect the group work. These include access to physical resources, participants' expressed knowledge and orientation to co-participants' expressed knowledge, and access to new knowledge. Through a micro-analysis of group work, we can better understand the dynamics of group work and better pinpoint cooperation and communication skills and strategies that are important to consider as learnables, themselves.

KEYWORDS

Cooperation; social organisation; interaction; learning; group work

Introduction

Exploratory methods through problem-based learning, experiments and classroom discussions are positively associated with pupils' motivation and learning outcomes in science, technology, engineering and mathematics (STEM) subjects (Nilsen & Frøyland, 2016). When pupils learn about scientific and mathematical issues and processes, it is crucial that they are allowed to work practically with the phenomena through “hands-on” activities, so that their experiences are relevant, realistic and exciting. Across nearly 600 studies and over 100 development projects – comparing collaborative, competitive, and individual working methods – throughout the last century, group work has been found to consistently result in better performance, greater productivity, more supportive relationships, enhanced mental health, heightened social competence, stabilised self-perception, and increased capacity to manage adversity and stress (Johnson, Johnson, Haugaløkken, & Aakervik, 2006). Evidence from practical STEM classroom research illustrates that the use of group goals and individual accountability significantly shapes the learning outcomes of group learning and affect cognitive processes by motivating

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students to engage in peer modelling, cognitive elaboration, and collaborative practice – activities that make them feel responsible for each other’s achievements and thus motivate students to engage in cognitive processes which enhance learning (Slavin, 2014). Immersing themselves in subject matter and receiving feedback, students reflect on their own learning and receive assistance with understanding relationships; they are impelled, in this framework, to engage in elaborate explanations and epistemic negotiations with each other in groups (Sporer, Brunstein, & Kieschke, 2009; Webb, 2008).

The relationship between learning and group work is often treated as self-evident, but the finer workings of this relationship require further study. On one hand, the dynamics and optimal conditions for group work are contested (Rohrbeck, Ginsburg-Block, Fantuzza, & Miller, 2003; Roseth, Pellegrini, Bohn, Van Ryzin, & Vance, 2007; Webb, 2008), while, on the other hand, research on the micro-level social organisation and structure of group work interaction is limited, compared to similar research on teacher-centric activities (Gardner, 2012; Sahlström, 2008). However, the body of micro-analytical research on peers’ learning in interaction in group work is currently growing and has shown, for example, that peers orient to and co-construct roles as “teacher” and “learner” (Lilja, 2014). Peers also employ interactional resources for learning in interaction, as is common in pupil–teacher interaction (Jakonen & Morton, 2015; Rusk, Sahlström, & Pörn, 2017), and in forms of wordplay that resemble form-focused language drills and teaching activities (Cekaite, 2006; Melander, 2012; Sahlström, 2011). Additionally, a study on manual guiding in practical assignments indicates that practical resources are of vital importance for the social organisation within the groups (Kääntä & Piirainen-Marsh, 2013). That is, pupils position themselves within the group not only through talk and conversation but also through bodily action: grasping and handling objects. There is also a relationship between the task and the social organisation in the groups. Seedhouse (2004) suggests that there is a reflexive relationship between the purpose of the task (form-focused task or a meaning-and-fluency focused task) and how pupils organise turn-taking in group interaction. Thus, turn-taking is more or less institutional, or conversational, depending on the task in question. However, research into social organisation and interaction in classrooms, including a focus on group work at micro-level, is not much more than approximately 10 years old (Gardner, 2012). In other words, the field has only just started to scratch the surface. Hence, within this body of research, there is room to expand the understanding of how specific practices in the locally situated contexts appear to afford learning in peer-to-peer group work, since current research has demonstrated that group work fosters student dynamics that are essential to learning.

The aim of this article is to locate, describe, and gain new understanding of how peers organise their group work with a focus on epistemic negotiations. This will be done through analysing how pupils orient to and co-construct epistemic statuses in group work. Thus, the focus is both on the social organisation of the group, as well as the epistemic relationships that are oriented to and made relevant in the immediate local contexts.

Conversation analysis and epistemics in interaction

Using conversation analysis (CA), we analyse in detail the pupils’ social practices¹ during group work with a focus on the social organisation and the organisation of epistemic relationships (Heritage, 2018; Schegloff, 2007). From a CA perspective, a radical participant’s perspective, the organisations of talk-in-interaction are not

automatic running processes; they are the ongoing sense-making practices of participants' social interaction. How the participants understand the situations then and there and how they orient to the situation is in the centre of the analysis, which in turn is based on systematically established empirical findings situated in naturally occurring settings (Schegloff, 2007). The analysis is inductive, and the focus of the analysis is on what the participants do then and there at that particular time and in that particular situation. The analysis is therefore grounded in how the participants understand the actions in the interaction and not based on deconstructing ready-made classes or categories (e.g. Schegloff, 2007). The series of turns can be tracked for what participants may be doing through them, which responses may be relevant or possible, and where the sequence is going, i.e. what outcomes the participants seem to pursue.

Many CA studies on learning approach learning as observable, accountable, and reportable social actions that participants actively do in interaction, calling it "doing learning" (cf. Melander, 2012; Lee, 2010; Rusk, 2016; Tanner & Sahlström, 2017), and consider the learning object as an emergent, shared pedagogical focus that is locally established, co-constructed, and relevant for the participants doing learning (Lee, 2010). In this article, we view learning as social action and focus on how participants, in our case pupils doing group work, orient to and co-construct epistemic statuses in group work.

CA studies that view learning as social action often rely on the notions of epistemic status and stance. Issues related to knowledge appear to have a ubiquitous role in social interaction (cf. Goodwin, 2013; Heritage, 2018; Heritage & Raymond, 2005; Stivers, Mondada, & Steensig, 2011). The epistemics framework conveys the epistemic complexity and the epistemic orientations of participants' practices from their perspective. In the organisation of epistemic relationships, participants express their "epistemic stance," that is, the expressed reflection of the speaker's "epistemic status" regarding the oriented-to epistemic domain and the co-participants (e.g. Heritage, 2012; Heritage, 2018; Stivers et al., 2011). Epistemic stance concerns the moment-by-moment expression of social relationships relative to an epistemic domain in interaction (Heritage, 2013, p. 558). A participant can express a relatively "knowing" or a relatively "unknowing" stance. The epistemic status involves a participant's position – a more knowledgeable (K+) or a less knowledgeable (K-) position – on an epistemic gradient related to the co-participants and to the relevant epistemic domain (Heritage, 2012; Heritage, 2018). Epistemic status is an intersubjective fact achieved in the unfolding of the social interaction (Heritage, 2013); it is not an expression of the possible, actual, factual knowledge that participants possess. The epistemic statuses of the involved participants are central, pragmatic resources when participants determine whether an utterance is requesting or asserting information. The linguistic design seems to be trumped by the participants' epistemic statuses for determining whether, for example, an interrogative is asserting or requesting information (Heritage, 2012; Heritage, 2013).

Recent studies on the epistemics of interaction have established that the management of knowledge is key to understanding issues of cooperation and affiliation in human interaction (Heritage, 2012; Heritage, 2018). The dynamic relationships between participants' knowledge of oriented-to learning object(s) are vital in the practices used to express one's own knowing and understanding, as well as to understand the other's expressed knowing. The management of knowledge is often actualised in the interaction

in educational institutions between pupils in group work assignments, where they are given space to express their knowing and thinking (Melander & Sahlström, 2010; Rusk et al., 2017). Based on the epistemics framework, this article investigates how the pupils make their knowledge regarding the current task relevant for the purposes of their situated interaction and cooperation.

Data collection and selection

This study employs video recordings and a participant's perspective on the analysis in the study of groups' social organisation in Newton-rooms. A Newton-room is a learning arena shared by schools in a municipality that has state-of-the-art STEM equipment for exploratory, investigative teaching and learning. School owners are responsible for the activities in the rooms, which are carried out by teachers who have received specific training regarding the "learning modules" that are offered in the rooms. The learning modules are developed either by so-called Newton teachers or by the foundation First Scandinavia² and have undergone a quality assurance process before being published on the Newton-room website (www.newton.no). Typically, classes visit the Newton-room once or twice each school year. The class does preparatory work at the school before the visit and follow-up work after the visit. During the visit in the Newton-room, pupils attend lectures and work in groups of two to four pupils to solve different STEM-related tasks.

The data have been collected as part of the research project *Newton-rooms as an arena for learning and recruitment* and includes video recordings from one Newton-room teaching one module to one class of 11-year-old pupils. The content of the module includes building and operating a LEGO-robot, where the latter entails making the robot carry out different operations on a table with different obstacles, involving calculations and coding on a PC. The module is organised through plenary teaching and pupils' group work. The video data amounts to approximately 20 h. The recordings were organised to capture both the plenary teaching, as well as the group work and include four out of eight groups present. In this way, there is a better possibility of studying and analysing the situated and contextual social organisation of the groups during the group activities (Rusk, Pörn, Sahlström, & Slotte-Lüttge, 2014). In the current article, we focus on the data of pupils' group work.

CA's analytical evidence is data-internal; that is, the analyst constructs the analysis based on the empirical findings in the data. It begins with the analyst (1) identifying a phenomenon, noticing a distinctive feature of behaviour in social interaction. Following this, the analyst needs to conduct an inductive search through the database and (2) collect multiple similar instances of selected phenomenon and (3) identify a specific criterion for the collection to be able to compare all instances with this criterion. The last step is to (4) describe and identify the differences between instances of the phenomenon (Seedhouse, 2004; Sidnell, 2010). Hence, the analysis is constructed by adopting a participant's perspective – a CA perspective – and by being open to discovering new phenomena instead of searching through the data with preconceived notions or hypotheses (Schegloff, 1999; Seedhouse, 2004). This analytical approach revealed that pupils appeared to make use of diverse interactional practices when interacting and cooperating in the Newton-room, and two dimensions seemed to be

of particular importance. Firstly, pupils seemed to open up for more or less cooperation in their situated interaction. They either tried to solve the task through *individual* or *joint* efforts, and this was connected to how the pupils shared available resources (e.g. robot and PC). This led to the selection of the first dimension in our model of analysis (cf. Figure 1). Secondly, an initial analysis of how pupils talked to, and with, each other during group work revealed that they either *opened* up for or *closed* down further epistemic negotiations in how they expressed their epistemic stances, and this was the case whether the task was solved individually or through joint efforts. In other words, how they expressed their knowing and oriented to the other's knowing seemed to open up or close down further negotiation and cooperation with regard to the current problem or task. Therefore, degree of openness regarding the negotiation of knowledge forms the second dimension in the model. In addition to these two dimensions, other aspects that participants make relevant in the situations then and there will also be included in the analyses of the situations. The two dimensions in the model are related to the aim of this research. The first dimension is related to the aim of studying how pupils *organise* their group work and the other dimension relates to the *epistemic negotiations*.

The current article focuses on four groups of pupils doing assignments in a Newton-room. These groups are Mona and Isabell; Aslak and Per; Håvard and Kari; Peter and Hanna (faux names). The analytical focus is the local context, the oriented-to content, and the actions that the participants recognise the epistemic stances to accomplish in situations when the participants explicitly orient towards doing assignments in the Newton-room. With this focus and based on an initial analysis with regard to the two dimensions of the model, the collection of situations for closer analysis amounts to 26 situations. The

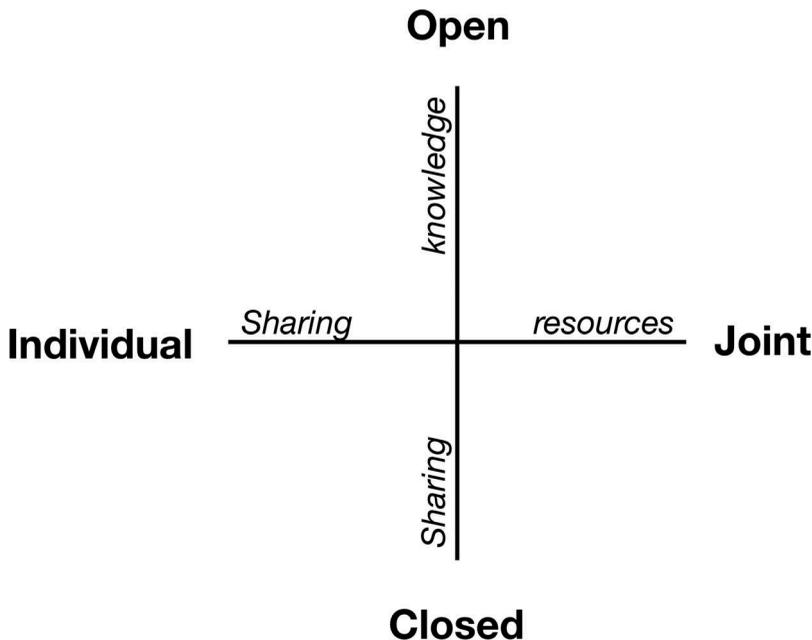


Figure 1. Model for analysis

collection includes instances in which the participants' expressed epistemic stances could be understood as social actions that open up for or minimise the opportunity for cooperation and sharing knowledge when working with group assignments in the Newton-room. Hence, the point of departure for the study is the practices used to express knowledge regarding the current assignment and, subsequently, how these expressed epistemic stances appear to be part of the organisation of the cooperation. Development of the model and the analysis is based on the larger body of analysed material, and out of 26 selected situations, we present 5 situations to exemplify how the cooperation seems to be organised by participants' social practices with regard to sharing knowledge and/or resources. The data were analysed according to the aims of the article, using a CA stance (Schegloff, 2007). The situations have been transcribed in accordance with CA conventions for transcription, including details of both what is said and how it is said (e.g. pitch, volume, speed, and/or prosody, see Hepburn & Bolden, 2012; Jefferson, 2004).³

The study follows ethical standards and privacy policies and is reviewed and approved by the Norwegian Social Science Data Service and the Norwegian Data Protection Authority. In addition to the teachers and pupils, the pupils' parents had to give their written consent to the filming. Only pupils with parents who gave this consent were part of the recording procedure. The participants' well-being and confidentiality was continuously considered during the filming procedures. The sample is well balanced with regard to gender and social background, since this was a class of pupils from a public school in a Norwegian town, where pupils attend their local school and thus represent the population in the area.

Analysis

The five excerpts that are analysed in detail, showcase different ways and practices that participants use to express knowledge regarding the current assignment and organise the cooperation through said practices. These excerpts fall into one of the four squares offered by the model above; individual – closed, individual – open, joint – closed, and joint – open, including one situation where the interaction moves from one square in the model to another. However, it is important to note that all groups moved continuously and dynamically in and between the squares of the model. The interaction alternated between the squares, since epistemic statuses change depending on the situated micro-context, which may change from moment-to-moment, from one turn of talk to another (cf. Heritage, 2018). In other words, no groups were clear-cut and stable “individual – closed” or “joint – open”.

Excerpt (1): joint – open

Excerpt (1) displays how the involved participants cooperate and share knowledge in-and-through epistemic negotiations. One party is oriented to as more knowledgeable than the other. However, this is done in a manner that is sensitive to the less knowledgeable co-participant and does not overtake the project without being invited to do so. In other words, there is a mutual negotiation regarding the joint project and how to solve it and help each other.

The situation starts as it is Mona's turn to continue building the LEGO-robot, which they are supposed to code and program in the next stages of the day. Isabell hands the next LEGO-part to Mona (line 1). Mona checks the PC screen with instructions and explicitly expresses and points where she is to put the part (lines 2–3). However, her turn on line 5 indicates that she saw where it was supposed to be on the screen, but not on the robot itself. On line 5 she expresses where it is on the robot itself. On lines 6–7 she looks at the robot, and then again at the screen, indicating that she does not understand what to do. On lines 8–9 she explicitly expresses that there is a problem by saying that she does not understand and gestures (waves hand in frustration) at the screen. These turns indicate that Mona is constructing a local epistemic status of less knowledgeable. Mona retracts this orientation as she attempts to press the part onto the robot on line 13. Isabell confirms and aligns to Mona's previous construction of a less knowledgeable epistemic status by saying *næhhæ* "okay" (lines 11–13) at the same time as Mona retracts it. Isabell's turn indicates that Isabell is orienting to Mona's construction of a new local identity and to the situation as one in which Isabell can claim the project to herself, since she is more knowledgeable. Mona still orients to herself as knowledgeable and tries placing the piece on the robot (line 14).

On lines 15–16 Isabell explicitly claims that Mona is doing it wrong, thus projecting Mona as less knowledgeable than Isabell. Isabell asks if Mona wants Isabell to show her how it is done, at the same time as she takes the robot and the piece. Mona is somewhat reserved to this and does not actively give the robot to Isabell. However, Mona aligns with Isabell's request and projection of Mona as less knowledgeable (line 16). Instead of claiming the project to herself, Isabell shows, instructs and involves Mona in building the robot (lines 18–21) and gives the robot and piece back to Mona. Isabell, then, projects Mona as knowledgeable after having received the instructions. Mona attempts to do it according to how she understood the instructions (line 23), but Isabell claims that it is wrong and shows her where she should press the part. Mona does not seem to understand (line 26), so she gives the project to Isabell who builds it, but at the same time instructs Mona on how she builds it.

<p>1. Isabell: ((gives part)) 2. Mona: [den skal inn, (.) der oppe <i>it goes in up there</i>] 3. [((looks at screen with instructions))] 4. (2,8) 5. Mona: her <i>here</i> (3,8) 6. 7. [((looks at robot, then at screen))] 8. Mona: >skjønner ik-< >don't get i-< 9. [((gestures at screen))] 10. (1,4) 11. Isabell: næhhæ, <i>okay</i> 12. [((looks at robot, leans over to take part, but then leans back))] 13. Mona: [((tries placing piece on robot))] 14. (2,3) 15. Isabell: n(h)e(h)ei [(0,4) >ska æ vis deg.< n(h)o(h)o >shall I show you.<] 16. 17. (1,6) 18. Isabell: den ska- <i>it goes-</i> 19. (1,2) 20. Isabell: [Først ska du: fest den i rø: på hver sin sia der og der <i>first you fasten it in red on each side there and there</i>] 21. [((shows where to press the part onto the robot))] 22. (3,4) 23. Mona: [((attempts to press the part onto the robot))] 24. Isabell: nei (.) her (inna) <i>no here inward</i> 25. (1,8) 26. Mona: (jamen) <i>(yeah)</i> 27. (8,7) 28. Isabell: [((takes the part and robot))] 29. Isabell: [den ska sånn: (.) den ska: <i>it goes like that: it goes</i>] 30. [((builds it))]</p>	<p>((orients to herself as K+))</p> <p>((orients to herself as K-))</p> <p>((aligns with M as K- and I as K+))</p> <p>((M reorients to herself as K+ and I realigns accordingly))</p> <p>((I projects herself as K+ and M as K-))</p> <p>((M aligns with I's projection))</p> <p>((I, as K+, instructs M as K-))</p> <p>((I gives parts to M and continues instructing M))</p> <p>((M attempts to claim a K+ identity)) ((I reorients to M as K- and I as K+))</p> <p>((M aligns with her as K- and I as K+))</p> <p>((I instructs and builds and projects herself as K+ and M as K-))</p>
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Transcript 1. Excerpt (1).

Excerpt (1) shows how a group can in-and-through epistemic negotiations, invite cooperation and share knowledge and resources to solve problems and complete assignments. Both participants display and express what they know and what they do not know and are sensitive towards the co-participant when providing and receiving help. Additionally, what makes this a strong orientation to cooperation and an open epistemic negotiation is that Isabell lets Mona try for a long time and for several rounds, before taking over the project. Also, as Isabell takes over, she still involves and invites Mona to build by showing and telling Mona how it is supposed to be built.

Excerpt (2): joint – closed

Excerpt (2) displays how participants cooperate but do not share knowledge in the same open manner as the participants in excerpt (1) did. Both parties orient towards completing and doing the assignment together, but they do not share their knowledge (how or why they know/understand something). However, they share resources and they both know what they are doing and orient to what they are supposed to do next.

Per and Aslak are working at the PC coding the robot to manoeuvre in diverse ways on the playmat. They appear to have divided the labour so that Aslak is the one working at the PC while Per operates other resources, such as the measuring tape. Aslak writes on the PC and is about to code the next move that the robot should do (lines 1–2), hence orienting to himself as knowledgeable. Per does not seem to follow, as he initiates repair with an open-ended repair initiator (line 5) regarding what the next action will be. Aslak repeats what he is doing and is about to explain why (line 6), but Per interrupts and overlaps as he, eagerly and with faster talk, expresses and points on the screen, that it should be zero point five (lines 7–9). On lines 7–9 Per orients to himself as more knowledgeable as he initiates and does repair regarding what Aslak has written. By doing this he orients to his repair sequence and the knowledge he brought forth as more pressing than what Aslak was trying to say on line 6. Per adds *huska du* “remember” as a way of saying that this is something that Aslak should have known and, thus, projects Aslak as less knowledgeable. Aslak does not seem to follow or understand, since there is a pause after Per’s turn (line 8), which is long enough for Per to orient to it as Aslak not knowing what to do. Per, then, attempts to write on the keyboard (line 11), but pushes the wrong buttons and opens up another program (or window), so Aslak pushes Per’s hands to the side and asks for confirmation regarding what he is supposed to write (lines 12–13). In other words, Aslak orients to himself as more knowledgeable regarding the use of the PC but checks with Per what he is supposed to write.

<p>1. Aslak: sänn (.) [ässå ta- (.) å så ta vi me: <en sveng> like that and then ta- and then we include <a turn></p> <p>2. Per: ()</p> <p>3. (2.2)</p> <p>4. Per: hmm?</p> <p>5. Aslak: vi tar me: en sveng (.) for då finn vi ut () we include a turn because then we find out ()</p> <p>6. Per: (e: de s-) (i:s it s-)</p> <p>7. Per: [de må var en komma nullfem >huska du,< () it has to be one point zerofive >remember,< () (points at screen)]</p> <p>8. ()</p> <p>9. (3.6)</p> <p>10. Per: () (puts fingers on keyboard)]</p> <p>11. Aslak: [en komma null fem? () one point zero five: () (pushes Per away from keyboard and writes on PC)]</p> <p>12. ()</p>	<p>((orients to himself as K+))</p> <p>((P orients to K- and to A as K+)) ((A aligns with P's orientation))</p> <p>((P interrupts A to orient towards another epistemic domain and project himself as K+ and A as K- regarding what has been written on the PC))</p> <p>((P orients more strongly to him as K+)) ((A disaligns to P's stronger orientation by orienting to himself as K+ PC-use, but aligns to him as K- regarding info))</p>
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Transcript 2 Excerpt (2).

This excerpt indicates that there is cooperation and that the participants orient towards a joint project and goal. However, they do not share their knowledge with each other in a way that makes both participants knowledgeable regarding the information and the assignment, in the same way as in excerpt (1). They simply tell each other what to do and what to remember without providing information regarding why or how they know it. That is, they agree on a minimally required epistemic balance and only situationally relevant knowledge to simply be able to move on (see, e.g. Rusk, Pörn, & Sahlström, 2016). Although Aslak does not appear to remember what Per is saying that he should remember, Per does not try to explain and share the knowledge with Aslak. Instead, he attempts to take over the keyboard as he orients towards Aslak using up too much time doing nothing. Hence, some knowledge is shared, but it is only the minimally required knowledge that is needed to move on with the assignment. This is in contrast to what participants do in excerpt (1).

Excerpt (3): individual – open

Excerpt (3) displays how participants share what they are doing and, thus, share the knowledge and understanding, but still do not cooperate. They orient to a joint project and goal, but they do not cooperate to reach the goal. That is, they do not share the local physical resources. So, in contrast to excerpt (2), in which the pge.

Håvard and Kari are building the robot. Throughout the entire situation, it is only Håvard who is building (line 1). Kari is more of a bystander who can participate by providing information or knowledge regarding the building, but since Håvard is not sharing the resources she cannot actually participate in the building activity per se. However, Håvard does share his understanding and knowledge by showing how he is building and that he thinks that he maybe can do it (lines 5 and 9). In other words, Håvard is orienting to himself as more knowledgeable, but he is not using a strong knowing stance when claiming his knowledge. Kari makes a couple of attempts to participate in the building (lines 3 and 7), orienting to a knowledgeable status, but Håvard insists that he may be able to get it done without her help. Albeit, Håvard is employing a moderate epistemic stance. Kari makes her attempts to be invited into a laughable statement on line 11, when she reuses the word *kanskje* “maybe” that Håvard has used a few times to respond to her attempts, and almost sings or, possibly, imitates Håvard’s dialect, saying *kanskje, kanskje, kanskje æ klar det, kanskje æ klar det, kanskje æ overlev å hopp i en vulkan* ‘maybe, maybe, maybe I can do it, maybe I can do it, maybe I survive jumping into a volcano’. Finally, Håvard fits the piece to the robot and Kari expresses *jajaja* “yesyes” to indicate that Håvard did good (line 15). Håvard, also, triumphantly expresses *sånn* “like that” (line 16) as he turns to the PC screen for the next part of the instructions.

1. Håvard: [(building and mumbling throughout the entire situation)]
 2. (9.0)
 3. Kari: >kan æ prøv<
 >can I try<
 4. (2.0)
 5. Håvard: *kanskje* ()
 "maybe"
 6. (5.6)
 7. Kari: skal æ prøv
 should I try
 8. (1.3)
 9. Håvard: nei vent (.) kanskje æ klarer de
 no wait maybe I can do it
 10. (1.8)
 11. Kari: kanskje kanskje, (0.8) kanskje æ klarer de: og kanskje æ klarer de:
 maybe maybe, maybe I can do it: and maybe I can do it:
 12. (1.8)
 13. Kari: kanskje æ (kanskje æ overlev å hopp i en vulkan)
 maybe I (maybe I survive jumping into a volcano)
 14. (1.0)
 15. Håvard: (nei det gjør du ikke)
 (no you wouldn't)
 16. (2.0)
 17. Kari: jaijajaja
 yeayeayea
 18. Håvard: sånn. ((turns to PC and scrolls to next part of instructions))
 like that.

((orients to himself as K+))
 ((projects herself as K+))
 ((disaligns moderately with K's projection))
 ((K aligns with H's orientation))
 ((projects herself as K+))
 ((disaligns with K's projection and
 and asks for more time))
 ((K aligns with H's orientation))
 ((H snaps the piece into place))

Transcript 3. Excerpt (3).

This excerpt shows how Kari attempts to be invited and move towards a more knowledgeable epistemic status, but Håvard orients to himself as more knowledgeable and wants to continue trying to fit the piece for a while longer. Kari does not demand invitation and does not become frustrated, instead she jokes about how Håvard rejects her attempts to participate in building the robot. Throughout the situation, Håvard shows what he is doing and does not claim that he will surely make it, that he can do it. He does not claim a strong knowledgeable status, instead he positions himself in a more moderate status by hedging his knowledge with *kanskje* “maybe”, which is why this is still an open conversation and not closed by Håvard. The word *kanskje* is also at the centre of Kari’s joking. However, the situation is characterised by the group dividing the work (or in this case not sharing the work) individually and occupying local epistemic statuses of more and less knowledgeable throughout the situation. Kari attempts to project a more knowledgeable status for herself (lines 3 and 7) but aligns with Håvard’s claims that he may be able to do it and that he only needs a little more time.

Excerpt (4): individual – closed

Excerpt (4) displays how participants organise group work without cooperation and without sharing knowledge or resources. That is, they work individually and share no knowledge or resources regarding the assignment with each other. Hanna and Peter are building the robot. Peter is building, and Hanna is sitting beside him looking around the room without showing any sign of actually attempting to be part of the building process (comparing to excerpt [3]). The situation starts with Hanna asking Peter where he is at in the process (line 1). However, she is not looking at the robot or at Peter when asking this, she looks around the room and displays that she is not available for further participation in what they are doing. Peter’s next turn involves him beatboxing for himself and then launching a new topic, a new sequence, regarding the fact that he is hungry (lines 3–6). Hanna’s disengagement with the assignment becomes clearer as she yawns on line 7 and shows no intention of trying to get involved in the building.

<p>1. Hanna: [kor langt e du egentlig kommet, how far have you actually come, 2. (looks around the room)]</p> <p>3. Peter: [ts ts ts tss ts ts æ e heilt sánn: (.) serr >tom i magen< I like totally: forreal >empty in the stomach< 4. (beatboxing and continuing to build the robot))</p> <p>5. (3.0)</p> <p>6. Peter: [æ glemd á spis () I forgot to eat ()]</p> <p>7. Hanna: [(yawns)]</p>	<p>((H orients to K-))</p> <p>((P orients to K+ and does not share knowledge))</p> <p>((H's disorientation indicates alignment with P's orientation))</p>
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Transcript 4. Excerpt (4).

This excerpt shows how participants can orient to their own individual projects and not share knowledge with each other, although they are supposed to be cooperating. Additionally, the physical resources are not shared. Peter is oriented to as more knowledgeable and Hanna as less knowledgeable, and these epistemic statuses are upheld and not challenged. Hanna is not holding Peter accountable for not sharing the knowledge regarding how far along he is, although she would be interactionally eligible to do it. Both participants' orientation towards this as individual work is clearly indicated by Peter not responding to Hanna's question and her not being interested in following it up and making Peter accountable for not answering it. They both seem fine with the situated division of labour.

Excerpt (5): the fluid and dynamic reality of group work

Excerpt (5) exemplifies that, although we have divided the cooperation and sharing of knowledge into four different categories, no group can be categorised as either cooperative or not. It is more a question of situations, sequences, in which participants' social practices are not orienting towards cooperation and knowledge sharing. Excerpt (5) displays the complexity, and that groups move between the categories, depending on how the situations unfold and which information and physical resources that participants have access to. The reason for categorising is to analytically distinguish between the different forms of social practices that are used for different purposes and what they may look like. Excerpt (5) shows how the participants move from individual orientation towards cooperation and sharing knowledge.

Hanna and Peter are building the robot, and, in this situation, it is Hanna who is holding the robot and building it. Peter claims a knowing stance as he points at a part of the wheel, indicating that they need to fit the pieces there (line 1). Hanna agrees and orients to herself as less knowledgeable when she asks him how they are supposed to fit it there. Peter, then, claims a very strong unknowing stance and leans back to intensify it (lines 2–5). Hanna confirms Peter's newly constructed epistemic status as less knowledgeable and aligns with them not knowing what to do (line 7). However, she still attempts to fit the piece on line 8, hence orienting to herself as knowledgeable to the degree of at least having an idea of how to try and fit the piece. However, Peter now claims a strong knowing stance by saying that she is not supposed to do it like that (line 9). He even stands up and takes the robot (line 10). This time, Hanna does not align with his projection of him as more knowledgeable and tells him to stop and hushes at him and attempts to share her understanding of what they should do (lines 12–15). Peter again claims that she should not press the pieces against each other at the same time as Hanna grabs the robot and insists that Peter should stop (lines 17 and 19). Both

<p>31.Peter: ((comes back to the table)) ja (0.4) Tine (0.6) nei (0.8) ø: Hanna mente 32. jeg (0.6) Tine. (0.9) jeg mente Hanna (0.4) alle di andre robotan:æ (1.1) 33. har (1.8) dideræ (0.6) oppressa (.) alle di andre robotan har dider oppressa 34. ((tries to press something on the wheel of the robot)) 35.Hanna: Jo men 36. yea but 37.Hanna: æ veit ikkje kosjn vi ska da () 38. I don't know how we should then 39.Hanna: ja men (er det) sånn (0.5) putta, 40. yea but (is it) like that put 41.Peter: JA? 42. YES? 43. ((1.2)) 44.Hanna: sånn 45. like that 46.Peter: ðe va jo 47.Hanna: () 48.Peter: ðen ska væ sånn 49.Hanna: og så, and then,</p>	<p>((shares, shows and expresses new K+ orientation)) ((aligns with P)) ((orients to K-)) ((change of state from K- to K+)) ((orients to K+)) ((orients to K+)) ((claims stronger K+)) ((moves on))</p>
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Transcript 6. Excerpt (5).

Excerpt (5) displays how the participants appear to be at a deadlock in the first part of the situation (lines 1–28). They do not share their knowledge and how or why they think that the piece needs to be fitted in a specific way. Instead, they hush at each other and claim strong epistemic stances (either unknowing or knowing) without justifying the stances for their co-participant to evaluate. The strong stances are at the extremes of the epistemic gradient that Heritage (2012) refers to, and when claiming such positions, you do not leave much room for negotiation. Therefore, the first part of excerpt (5) becomes a deadlock between strong stances saying the opposite of one another. The other part of the situation (after Peter comes back to the table, lines 29–53) is of a different nature as Peter shares what he has found out with Hanna agreeing with him, but that they do not know how to do it in practice. They take turns trying to fit the piece, and in the end, they succeed in getting it into place. The other part of the situation is more open towards sharing knowledge and resources. The participants do not occupy or claim strong stances; instead, they are open to negotiation, joint cooperation, and involvement. They both involve each other in, and contribute to, the process.

Discussion

The five situations presented above exemplify various ways that pupils engage, interact and communicate while solving tasks in small groups (cf. Figure 2). In all cases, pupils have been given tasks by the teacher and they are expected to cooperate, either to build the robot according to instructions, or, as in the case of Aslak and Per in excerpt (2), to program the robot so that it can carry out specific operations. However, what we find is that tasks are solved both through joint efforts, but also individually. The pupils in excerpts (1) and (2) cooperate towards solving the task, but the way they communicate while doing so, differs. While the pupils in excerpt (1) *share knowledge* through epistemic negotiations—what we have defined as a *joint – open* situation—the epistemic stances that pupils in excerpt (2) take, closes down the communication. In the two cases where the task is solved individually, excerpts (3) and (4), we also find that the epistemic stances either open up for communication, as in excerpt (3), or closes it down, as in the case of Hanna and Peter in excerpt 4. However, we meet Hanna and

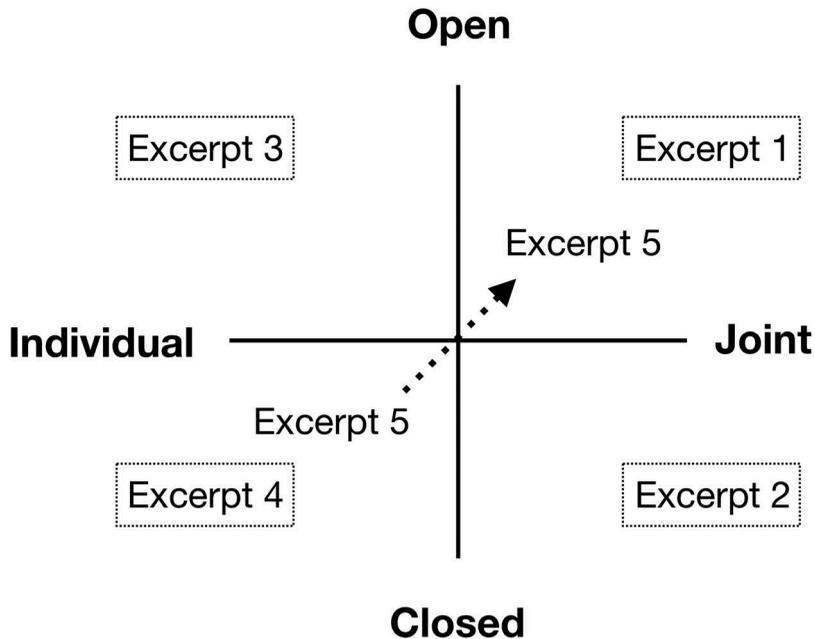


Figure 2. Model for analysis with excerpts

Peter again in excerpt (5), and in this situation, they move from an *individual – closed* to a *joint – open* situation when Peter comes back with new information after checking how one of the other groups have fitted the piece to the robot. As mentioned above, the excerpts were chosen to exemplify situations where the two dimensions in the model – *joint/individual* and *open/closed* – come into play. Nevertheless, in all the groups the interaction is fluid and dynamic; no group remained in an *individual – closed* “state” throughout the work process, but some of the groups stayed in particular squares for longer periods of time than other groups. In future use of the data, we will investigate further what it is that causes these changes in the social organisation and cooperation.

When studying the situations closely, we find that there are some important factors that seem to either foster or hinder epistemic negotiations and cooperation. These factors are *access to physical resources*, *participants’ expressed knowledge*, *participants’ expressed sensitivity to co-participants’ knowledge*, and *access to new knowledge*. In all cases, the pupils have access to limited physical resources (one robot and one computer). Building the robot requires that they follow instructions from A to Z, and it is difficult to divide the work between themselves. In the cases where they do cooperate, they take turns adding new bits to the robot, and, in some cases, share knowledge about what needs to be done. Access to, and the expression of, knowledge is another decisive factor with regard to the epistemic negotiations that take place between the pupils. Lack of knowledge hinders progress in solving the task, while access to new knowledge, as in the case of Peter and Hanna in excerpt (5) not only moves the work forward but actually changes the situation from *individual – closed* to *joint – open*. According to Heritage (2012), management of knowledge is a central factor to understanding how people cooperate. This is particularly evident in excerpt (1), where Isabell not only

shows communication skills in the way she supports Mona in the work but also shows that she is sensitive towards the fact that Mona may need more time to move forward. She doesn't just take over when she sees what needs to be done, but allows Mona to continue and, instead, supports her efforts. In other words, how the participants express what they know (or do not know) matters. Taking strong knowing or unknowing stances, that position on the extremes of Heritage's (2012) gradient, seems to close down the epistemic negotiation. Participants do not seem to find a way around the strong stances, because if someone says that they really do know (or do not know), what more is there to negotiate about? Whereas, more hedging and moderate stances appear to keep the negotiation open for diverse possible solutions.

The findings presented through the excerpts raise important issues regarding group work. Mainly, it raises issues regarding how pupils are prepared for cooperative work. To succeed, they need to master a number of different skills regarding cooperation and communication, and they need access to strategies that they can make use of when they encounter difficulties. Through a better understanding of the dynamics and the social organisation of group work, we can better pinpoint which skills may be of importance to focus on in subjects that require pupils to work collaboratively. This study continues scratching the surface of these issues, but there is a need for more studies that describe and understand the actual social practices in group work from diverse perspectives to sift out which skills that should be focused on in future education. Based on the findings of this study, some of these skills might be how to keep the stances moderate and, thus, keep the negotiation open. Pupils need to be made aware of, and given the chance to, train these skills and strategies.

Notes

1. Any feature of a turn in a sequence that is specifically situated, recurrent and that attracts distinctive responses, which distinguish it from related, or similar, conduct can be identified as a practice (Drew & Heritage, 2006; Sidnell, 2012). A central feature for a practice to be effective is that it must be recognisable to the recipients what social action the speaker intends to accomplish. The analysis of practices to perform different social actions can be validated by examining the recipients' responses – the next turn proof procedure (Drew & Heritage, 2006; Sacks, Schegloff, & Jefferson, 1974; Sidnell, 2012). Every contribution (e.g. turn, utterance) to the interaction is situated in the context, shaped by the context, and renews the context (Seedhouse, 2004).
2. First Scandinavia is a foundation based in Bodø, Norway. The foundation owns the Newton-room concept and has been involved in establishing more than 30 rooms in Norway, and is currently expanding their activity internationally.
3. The transcription system used in the article is based on the Jefferson (2004) system.

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