GROUP PRACTICES IN A COLLABORATIVE DESIGN PROJECT – A VIDEO-ETHNOGRAPHIC STUDY

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ABSTRACT

CONTEXT: There is a growing interest in engineering education that the curriculum should include collaborative design projects. The problem-based and project-based learning context of this study is a design project in the fifth semester of the problem-based Architecture and Design programme at Aalborg University. The students had the task to design a real office building in collaborative groups of five to six students. PURPOSE: Collaboration and collaborative learning imply a shared activity, a shared purpose, and a mutual interdependence to achieve the intended learning outcomes. In earlier studies we have highlighted the cognitive importance of tools and the use of a wealth of bodily and material resources in students' collaborative interactional work in the design project. In this study, we focus on students' collaborative group practices in the design project. The fine-grained details of collaborative work in engineering students design projects are currently under-researched. METHODOLOGY: The preparation for an upcoming status seminar was video recorded in situ. Video ethnography, conversation analysis and embodied interaction analysis were used to explore what interactional work the student teams did and what kind of resources they used to collaborate and complete the design task. Complete six hours sessions of five groups were recorded using multiple video cameras (two to five cameras per group). OUTCOMES: The fine-grained patterns of social interaction within groups were found to be complex and dynamic. In the video recordings it was observed that students often changed constellations and break into subgroups of one, two or three students to do some work and to congregate later as a whole group. Thus, we found that the patterns of collaboration in groups practical day-to-day work were not static but displayed a myriad of different patterns. CONCLUSION: Our results challenge a naïve individual-collaborative-binary and point to the need to investigate group practices and individual and collaborative learning in design project groups and other collaborative learning environments in more detail. Physical settings in active learning environments should make fluid collaboration patterns in students' collaborative work feasible and it should be encouraged by instructors.

KEYWORDS

Design project, Collaborative learning, Group practices, Video ethnography, Standards: 5, 7, 8

INTRODUCTION

Design "constitutes the essence of engineering" according to Mitcham (1994) since an engineer is "concerned with how things *ought* to be … to *attain* goals and to *function*" (Simon, 1996, pp. 4-5). For this reason there has been a growing interest that engineering curricula should include collaborative design projects and is included in the CDIO-standards (e.g. Crawley et al., 2014; Edström & Kolmos, 2014) as engineers are expected to be able to design things and processes that can serve human needs and protect the environment. The ability to develop and design products, processes and systems and demonstrate the capacity for teamwork and collaboration have become essential requirements for an engineering degree in many countries. For example, the Swedish national university regulations require that to be awarded an engineering degree, students must "demonstrate the ability to develop and design products, processes and systems [and] demonstrate the capacity for teamwork and collaboration" (Almost similar requirements in Denmark).

Given that design-based learning activities have become a key component in engineering education, there is a need to better understand students' learning processes within design projects. Moreover, within design projects it is also important to better understand how students develop the "capacity for teamwork and collaboration".

However, collaboration and cooperation are often not always clearly distinguished. In line with (Dillenbourg, 1999), Stahl (2013, 2016), and others, we see cooperative learning as an activity there students divide up group work and then put the individual contributions together, whereas in collaborative learning students do the work together. Collaboration and collaborative learning implies a shared activity, a shared purpose, and a mutual interdependence to achieve the intended learning outcomes (Dillenbourg, 1999). Stahl (2013, 2016) argues that in studies of collaborative learning it is important to focus on small group phenomena and to use the group as a unit of analysis. According to Stahl, collaborative groups build knowledge through shared understanding, co-construction, and interaction in a joint problem space. Furthermore, he proposes that studies on teamwork and collaboration build on post-cognitive theories. Thus, a project group in a collaborative design project can be seen as a community of inquiry. Indeed, students' cognition in an engineering design project (Brereton, 2004) has been seen as an example of "distributed cognition" (e.g. Goodwin, 1995; Hutchins, 1995), since achievements do not only arise from individuals thinking, but also through collaborative thinking distributed among the members in the design team *and* from the use of epistemic tools (Goodwin, 2018).

Although collaboration is seen as an important element of design, the dominant empirical method to investigate *students'* design processes have until recently to been variants of "think-aloud" exercises with verbal-protocol-analysis (Craig, 2001) mostly with *individuals* in *artificial* settings (Bernhard et al., 2016) with tasks that were completed in rather *short time*, i.e. one to two hours (e.g. Atman et al., 2007; Atman et al., 1999; Cardella et al., 2008). More recently, studies using different forms of ethnographic methods to investigate students in naturalistic educational settings have started to appear using audio-recordings (e.g. Gilbuena et al., 2015), video-recordings (e.g. Campbell et al., 2018; Goncher & Johri, 2015), and photos and field-notes (e.g. Juhl & Lindegaard, 2013). Adams and Siddiqui (2015) describe the collection of a more extensive set of video recordings, but these are only from design-review conversations and not from the design process per se.

It has passed more than 30 years since Tang and Leifer (1991) argued for the use of video recordings and interaction analysis (Jordan & Henderson, 1995) to study group design activity. Nevertheless, there are still very few studies using interaction or conversation analysis to study engineering students group design activities in regular educational settings. To our knowledge, Campbell et al. (2018) seem to be one of the rare cases that, beside our own studies have studied engineering students' design *process* using interaction analysis.

In our own previous studies, we have made video-recordings and studied a design project in the fifth semester of the PBL-based Architecture and Design programme at Aalborg University. We found that the fifth semester students displayed epistemic fluency (Markauskaite & Goodyear, 2017) by fluent use of a rich repertoire of bodily-material resources as epistemic tools to think collaboratively in design activities (Bernhard et al., 2019). In their collaborative work and reasoning, students' employed gestures, gestured drawings, sketches drawn by hand or on an iPad, concrete models made of foam or paper, and digital 3D CAD drawings drawn on a computer, i.e. they worked both "by hand and by computer" (Bernhard et al., 2020). We also have shown how the students developed a professional dialogical practice using bodily, material and historical resources, rather than only being manifested in verbal discourse (Davidsen et al., 2020). Moreover, we have analysed and discussed the different knowledge forms embedded and emerging in students' collaborative and embodied interactions (Ryberg et al., 2020). Finally, we have used our empirical material to explore the notion of ecotones and to use post-digital theory to address problematic dichotomies such as the digital versus analogue/material (Ryberg et al., 2021).

In the literature regarding collaborative learning the *composition* of the studied collaborative group(s) is commonly static and does not change (e.g. Borgford-Parnell et al., 2013; Menekse et al., 2017). However, when analysing videos of students' interactions in our earlier studies we also noticed that students approached a particular design problem in shifting subgroups of one, two or three students or as a whole group. This implied that the collaborative group, indeed, was not static and it challenges a naïve individual-collaborative-binary. As this, to our knowledge, was not well discussed in the literature it led us to the following research question: *How could the dynamics of individual and collaborative work in students' group practices in a design project be described and visualised?*

SETTING AND METHODOLOGY

The setting of this study is the Architecture and Design (A&D) programme given within the frame of the Aalborg problem-based learning (PBL) model which was created in response to the call that engineering programmes should include collaborative design projects of varying length and complexity. The A&D programme includes elements of architecture education, but also builds on knowledge, skills, and competencies from engineering. In the Danish context this was a novel approach when the programme started in the 1990s, as traditionally the fields of architecture and engineering are separated. The creation of the A&D programme was an attempt to combine the "technical theoretical" knowledge of engineering with the "aesthetic and artistic" artisanship of architecture, to create a new interdisciplinary education.

To achieve a rich picture of students' individual and collaborative work and enabling studies to increase our understanding of engineering students' learning processes in collaborative design projects we have recorded a very large corpus of video data from A&D-students at Aalborg University in their first, fourth and fifth semesters. The interaction within groups during projects has been recorded making extensive use of the latest advances in video-technology such as multiple cameras and 360-degree cameras ("Big Video", e.g. Mcilvenny

& Davidsen, 2017). Working in students' regular environments and using as unobtrusive methods for data collection as possible will help to ensure "ecological validity" and achieve an emic (participant) perspective of how students' processes of learning are played out in their regular environment in engineering design projects (Hutchins, 1995).

The data analysed in this paper is from a period 14 days into a project work where fifth semester A&D students are tasked with designing an office building for an external partner. The particular session studied is where a student group (group 3: four females, two males) is preparing to take part in a formal review session the next day. After the review session the groups have approximately four weeks left to complete their design of the building.
The interactions (Goodwin, 2018; Heath, 2016; Jordan & Henderson, 1995; Tang & Leifer, 1991) within the group were recorded using five digital camcorders (including one body-mounted GoPro camera) during the complete session. In this case the session lasted almost six hours. To facilitate analysis, recordings were synchronized.

As can be seen in the photos in Figures 1–3 the groups' workspace is encircled by a fixed wall with windows, and two "walls" consisting of whiteboards, pinboards and blackboards. One of the "board walls" is used for various design ideas and sketches with each board having a particular type or category (e.g., printed computer designs or drawings). The other board wall is used as a calendar and overview of tasks (with different colour-codings). In the midst of the group space is the "working table", which is littered with paper, sketches, laptops, models, iPads, bottles etc.

The preparation for the review session was selected for analysis as it is what Jordan and Henderson (1995) refer to as a natural unit of analysis – limited in time and with a particular purpose. As mentioned in the introduction we have previously analysed the recorded videos in regard of other research questions than is the focus in this study. In this study the focus is on students grouping practices and how they work together in different constellations. In the previous studies large parts of the verbal interactions (in Danish) have been manually transcribed by a researcher, but in this study we performed the analysis by directly "manually" viewing and analyzing students' interaction as recorded on the videos.

The videos were analyzed by primarily viewing the video from one of the cameras and coding in which constellations students worked (e.g., individually, in subgroups, or in whole group). Furthermore, students' membership in subgroups were noted, and it was noted the time constellations changed. To count as a member of a constellation a student had to actively display participation either verbally or bodily. If the coding was unsure, use was made of other videos which enabled view from a different angle. Examples of students' interactions being coded as individual work, dyads, triads, or whole group are displayed in Figures 1 – 3 and in transcripts 1 – 3 below. Although transcripts were primarily not used in our analysis, we have included them (translated into English) for illustrative purposes.

An overview of students' work in shifting constellations during the project meeting is displayed in Figure 4, with each student colour coded. Episodes of work in different constellations have been numbered sequentially. Apart from noting if students' activities were off task, the content of the interactions were not coded. Had the focus of the study been another than the present one, for example on some type of content in the interactions, the division of episodes would probably have been different.

The study was conducted under the ethical guidelines in place at Aalborg University and at Linköping University in accordance with Danish and Swedish laws. Informed consent forms

were signed by each research participant. In this paper, participants have been given pseudonyms to protect their anonymity.

FINDINGS

An apparent finding viewing the video recordings is that students are, indeed, working in many different constellations during the project meeting. Before presenting and discussing the more general results in Figure 4 we will first present short extracts from students' activities as examples of individual work, work in dyads and triads, and in whole group.

Examples of different constellations

To exemplify different constellations, we have taken selected still photos from the video recordings to represent typical activities. In the pictures we have included, somewhat simplified utterances by a student and we have also included some comments. Full transcripts are also included. In the transcripts (x.y) denotes a pause in units of seconds, while (.) denotes a short pause. Double parenthesis, ((comment)), are made around comments. Symbols for prosody are not included in the transcripts and they have been translated from Danish into English. Reference to episode number is according to the numbering in Figure 4. Timing is made relative to the start of the recording of videos. It should be noted that none of the transcript display the full episode as space do not permit it.

Individual work changing into a dyad (episode 19 and 20)

In the first example we can in Figure 1a see the female students Ina, Heidi, Mette, and Sine working individually (episode 19) around the group's main table. The male students in the group, Anders and Sven, are somewhere else and their activities are therefore not recorded.

Figure 1. Episode 19 and 20 – Ina first does individual work and then calls for Mette's attention to discuss a design decision (a dyad).

Ina is trying to resolve an issue with conflicting requirements making drawings and trying things out with a Styrofoam model (Figure 1b). In turn 2 (Figure 1c) she finally calls for Mette's attention and she, still sitting on her chair, "rolls" over to Ina's place. Here we can clearly see the initiation of a dyad between Ina and Mette both by their verbal exchange and by the embodied action in form of a physical movement of Mette to Ina's place. We can also see that Heidi and Sine continue to work individually.

Transcript 1 (Related to Figure 1 – part of episodes 19 and 20. 01:03:40 – 01:11:57)

1.	Ina	((**Figures 1a – 1b.** From 01:03:40 Ina first sits silently and make drawings on her iPad, but after a while she puts it away and instead put some layers of a 3D Styrofoam model and begin to use a pencil to trace the contours of the styrofoam model onto a paper.))
2.	Ina	Mette? ((**Figure 1c.** Calls for Mettes attention at 01:11:14)) (3.2)
3.	Mette	why why
4.	Ina	this is also two hundred (.) I just started to think about it
5.	Mette	Ehmmm (9.0)
6.	Ina	Mette?
7.	Mette	yes
8.	Ina	that is because (.) I do not know if it is stupid (.) what I am doing
9.	Mette	what are you doing? (4.5) ((**Figure 1c.** Mette moves over to the position of Ina still sitting on her chair))
10.	Ina	that is because I have actually changed something in it
11.	Mette	have you changed it?
12.	Ina	it is because I think
13.	Mette	It is over here at the rear (.) because I think this that you (.) that you (.) well (.) here you get both (.) here you get both a terrace (.) but you also get a terrace here too ((**Figure 1d.** Mette has rolled over to Ina and points to the 3D-foam model))

Dyad changing into a triad (episode 22 and 23)

Figure 2. Episodes 22 and 23 – Ina and Mette (a dyad) continue their discussion from episode 20 turn to Sine (a triad) to be allowed to make adjustments.

Ina's and Mette's interaction in episode 22 is a continuation of the discussion in episode 20, but now as is displayed in Figures 2a – 2d Ina has moved over to Mette's place at the table. They make use of CAD, photos, and different gestures to discuss the issue at hand (turns 14 – 24). As a change might affect what Sine is working with, she is addressed by Ina in turn 26

(Figure 2e.). The dyad Ina-Mette is changing into a triad Ina-Mette-Sine (episode 23). Heidi is still working individually. The 10.6 s pause in line 25 should be noted.

Transcript 2 (Related to Figure 2 – part of episodes 22 and 23. 1:19:12 – 1:20:37)

14.	Ina	that is because (.) you go out right here (.) then one go around around around and in there (.) that is around (.) and then it is (.) I have tried to make a footbridge ((**Figure 2a.** As Ina is saying "go out right here, then one go around around around and in there" her index finger walks around the drawing of the building demonstrating what she means.))
15.	Mette	yes (.) and so it is too
16.	Ina	but it of course (.) requires that there is also a whole floor free outside at the walk (.) u::m
17.	Mette	yes (.) here
18.	Ina	yes (.) but it might well (.) because try not to see them here too ((Ina turns around and look at the board with the photographs.))
19.	Ina	if you say there are windows all round (.) right too ((**Figure 2b**. Ina points to a photograph while talking about "windows all round".))
20.	Ina	and then (.) if you say that there are open offices on the other side, (.) so that if that was the case (.) such that light came in gradually through the office ((**Figure 2c.** Ina illustrates with a gesture how light passes in))
21.	Mette	u::m (.) that can one certainly do (.) you can also see how narrow that passage is (.) it is right in the middle there ((**Figure 2d.** While stating how "narrow that passage is" Mette is pointing to a photograph.))
22.	Ina	well
23.	Mette	there is not very much that is there
24.	Ina	well (.) okay ((Both Mette and Ina turn to the computer again))
25.	Pause	(10.6) ((Triad starts [episode 23] after the pause))
26.	Ina	Sine, do you think it is okay for us to make some small adjustments, without ((**Figure 2e.**))
27.	Sine	yes, but I think so, but are there more details or is it just like that in general?
28.	Ina	it is only in relation to the drawing (.) it's more because we want to make it there and we're just making some changes to it
29.	Sine	yeah yeah (.) but that's what I think (.) but it's just so you don't spend time on drawings and that's really what we should be doing.
30.	Ina	yeah yeah (.) but we would like to make drawings based on it (.) so that's why
31.	Sine	well (.) it's up to you
32.	Ina	yes (.) wasn't it (.) Mette?
33.	Mette	u::m

Whole group interacting (episode 65)

Finally, in Figure 3 and transcript 3 we see an example of a whole group interaction. Mette is in Figure 3a using a 3D-foam model to present the solution they arrived at in the relation to the design issue presented above in earlier examples. Heidi comes up with a suggestion for improvement in Figure 3b that is further clarified in Figure 3d. As can be seen in transcript 3 all group members, except for Anders, is contributing to the discussion in this excerpt. However, as he is standing near Sven and Ina behind the seated Sine and Heidi, and he by his body language display that he is actively participating, we will even from this short excerpt code him as participating in a whole group constellation. Indeed, later in episode 65 he is actively verbally participating.

Transcript 3 (Related to Figure 3 – part of episode 65. 4:31:55 – 4:32:28)

34.	Mette	with a passage all way around and then ((**Figure 3a.** Mette dislocates the top floor in the 3D foam model and indicates with a hand movement the location of a passage.))
35.	Heidi	but I also think (.) what if you now (.) imagine that you are dragging that (.) then you could also imagine that you could drag the window borders in (.) well so there still is a roof sticking out that would create a possibility for some shelter ((**Figure 3b.** Heidi first points at a drawing on the iPad, then moves her hand to the 3D foam model and turns her hand to make a gesture.))
36.	Ina	yeah
37.	Sine	yeah precisely ((Mette goes to a table on the side and fetches a drawing.))
38.	Heidi	for example (if one had it here)
39.	Ina	that could also work (1.9)
40.	Heidi	yeah but ((Points to the 3D-foam model))

41.	Ina	Is it
42.	Heidi	Here (.) here is the window (.) but there is still a roof here for example and then you actually have a room up here ((Points on the 3D-foam model))
43.	Ina	yes (.) and it was actually here ((Moves closer, leans forward, and points on the 3D-foam model.))
44.	Mette	I was in some doubt what you meant (.) so with window borders on ((**Figure 3c.** Points in drawing.))
45.	Heidi	eh:: yes if one imagines something there also ((Heide points to the drawing and Sven makes a gesture with his right hand))
46.	Sven	(if) you to pull it back
47.	Ina	but you keep the shape
48.	Heidi	the window is maybe actually (0.6) here ((**Figure 3d.** Makes a gesture in relation to the 3D-foam model.))

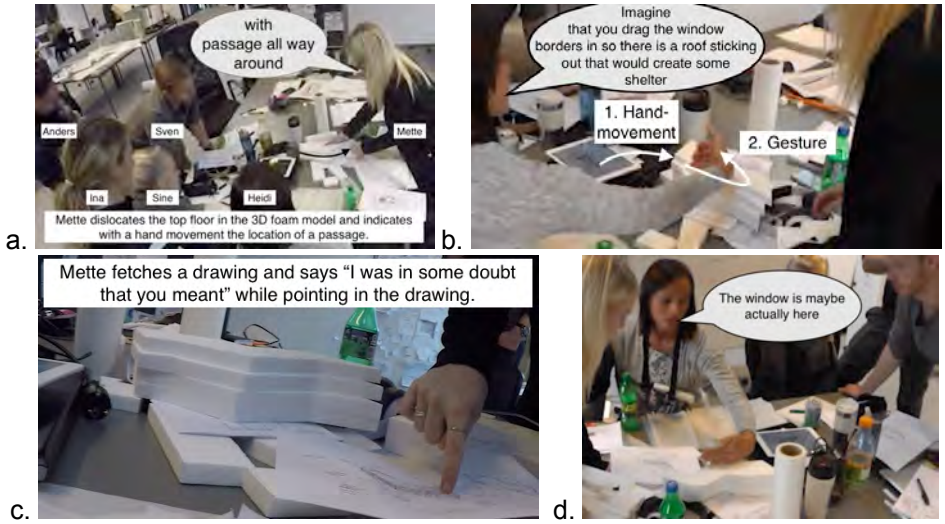

Figure 3. Episode 65 – whole group design discussion using iPad, 3D foam model, and a drawing.

General findings

Students' different constellations for collaboration are displayed in Figure 4. To not overly extend the figure on the vertical axis constellations where students worked in groups of four, five or six (whole group) have been put in the same group. Indeed, all these constellations could in some sense be seen as whole group like constellation. Furthermore, it should be noted that only students' activities performed in the main group room could be coded due to the fixed mounting of cameras. For example, during episodes 5 – 59 Sven and Anders mainly worked at another place and the same was valid for Sine and Heidi during episodes 48 – 59. Although Heidi wore a GoPro camera it was mounted on her chest and thus it was not possible to discern her gaze and with certainty discern her interactions with other persons. Therefore, we have not yet fully analysed the recordings made by the GoPro.

Roughly speaking the work in the project meeting can be divided five phases. In the first phase from the start of the day until when Sven left at 0:44 (all timings in hour minutes from the start of recordings) and Anders shortly thereafter the students worked as a whole group. They ate breakfast together at the main group table. As they also informed each other of the present status of the work they had done hitherto and discussed the planning of the day we have seen episodes 1 – 4 as an on-task activity, although it also had an important social aspect.

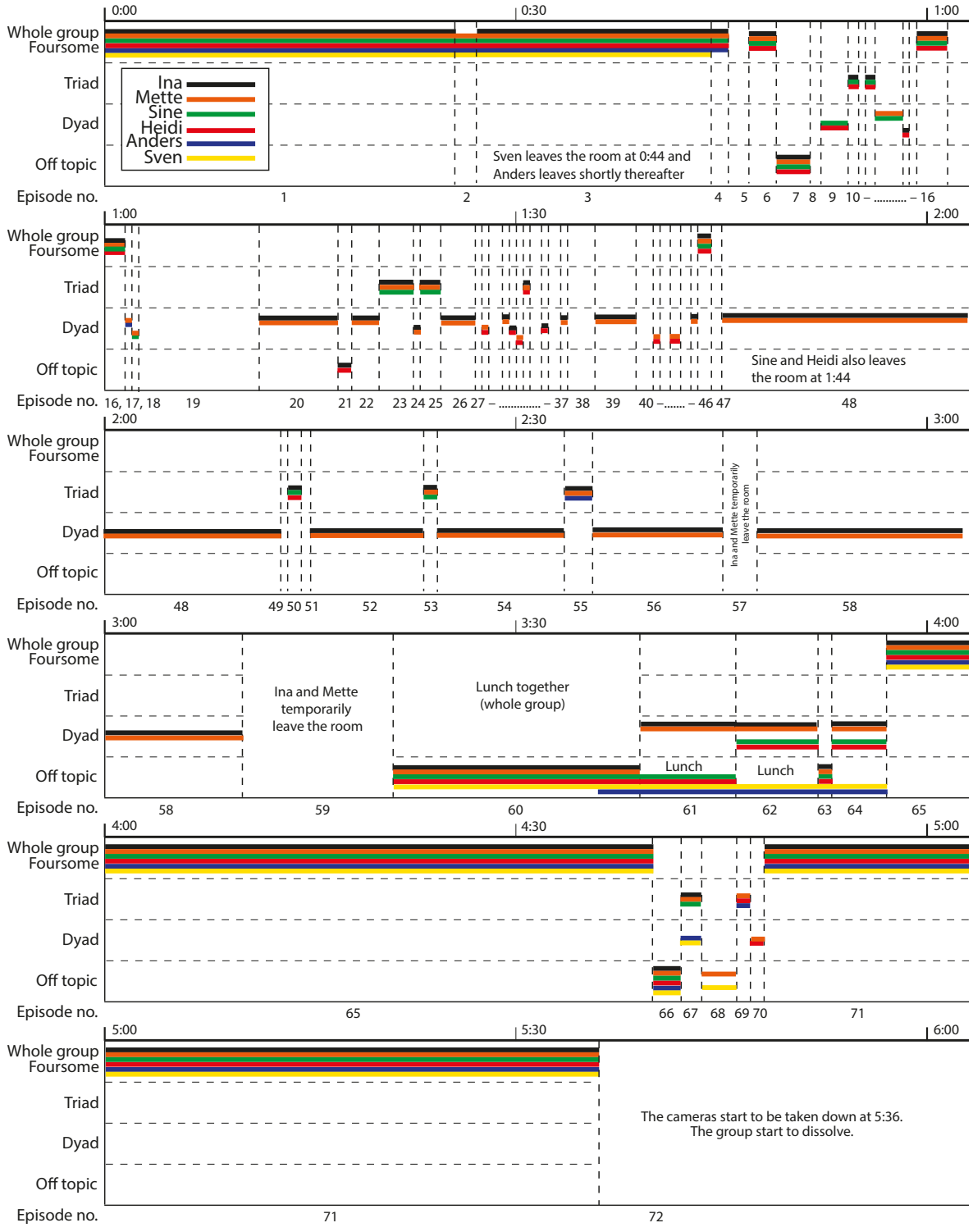

Figure 4. Timeline for students' collaboration in the project meeting displaying their different forms of collaborations during the meeting as seen in the main group room. Each student is colour coded making their participation in different constellations visible. The scale on the time axis is hour and minutes.

From 0:45 to 1:44 (episodes 5 – 47) we have a second phase there the male students Anders and Sven have left, and the female students Ina, Mette, Sine, and Heidi remains in the main room. To a considerable extent they work individually but this phase is interspersed with several longer and shorter collaborations in dyads and triads in shifting constellations as can be seen in Figure 4. Some “whole group” discussions in this group of four can also be seen. In turn 25 in transcript 2 it was noted that it was a 10.6 s pause between the dyad in episode 22 and the triad in episode 23. In a similar vein we usually observed pauses of 5 – 10 seconds in the interactions when students shifted from participating in one constellation to another as for example in episodes 30 – 33. In these short pauses the students would typically have a quick look in their computer, on a note, or to a drawing. To not clutter Figure 4 to much we have not represented these, very short, pauses in the figure. Nevertheless, we think that these pauses are important in the interactions and for the collaborative work.

A third phase is from 1:44 to approximately 3:10. In this phase it looks like the students work together in three different dyads (Ina + Mette, Sine + Heidi, and Sven + Anders). Through the fixed cameras we only have access to work by Ina and Mette. It could, however, be noted that the dyadic work in this phase is not static and we have “guest visits” for co-ordination purposes by Sine in episode 53 and Anders in episode 55. Moreover, in episode 50 Ina walks away for a guest visit to Sine and Heidi and in episode 57 both Ina and Mette walk away for a visit. Recordings by the GoPro-camera also might be interpreted as that Sine, Heidi, Sven, and Anders have worked together as a group of four during this phase.

The fourth phase can be seen as starting at 3:10 when Ina and Mette leaves to buy lunch. At almost the same time ten minutes later the whole group congregates at the main table to have lunch together (Anders, however, leave almost immediately to return 15 minutes later). At 3.39 Ina and Mette start to work together in a dyad and at 3:46 Sine and Heidi also start to work together in a second dyad. Anders is eating lunch for some more time and Sven is doing off topic tasks.

In the fifth and final phase starting at 3:57 the students’ work as a collaborative group until the end of recordings at 5:36 (with a short break at 4:40). They present their solutions to different design issues to each other and receive feedback. But they also, as can be seen in Figure 3. and in transcript 3, receive creative suggestions from other group members which illustrates the strength of collaborative work. Furthermore, their work is coordinated, and plans are made for the presentation at the upcoming review seminar.

It could be noted from the compilation presented in Figure 4 that beside the common lunch there were very little “off-topic” activities observed. Indeed, in this group students’ telephone conversations and messaging seem to be confined to the lunch break and the break at 4:40. Furthermore, it can also be noted that besides episodes 62, 64, and 67 no subgroups (i.e., dyads and triads) worked simultaneously in parallel in the main group room. The students split up and moved to different locations when they started to work in dyads for a longer time.

CONCLUSION AND DISCUSSION

This study set out to answer the research question *how could the dynamics of individual and collaborative work in students’ group practices in a design project be described and visualised?*

In this study we have hitherto only have had time to do an in-depth study of the group practices in one collaborative design group. This somewhat limits the conclusion that can be drawn. Nevertheless, we argue that anyway several conclusions can be drawn from our findings. In the literature (e.g. Borgford-Parnell et al., 2013; Menekse et al., 2017) intra group practices in static groups are reported. On the contrary we found, by analysing video-recordings, that the fine-grained patterns of students' social interaction within the observed collaborative design group to be complex and dynamic and it display fluidity as well as structure (cf. Sørensen, 2022) as the students during the day worked in many different constellations. It was observed that students often changed constellations and break into subgroups of one, two or three students to do some work and to congregate later as a whole group. Thus, we found that the patterns of collaboration in groups practical day-to-day work were not static but displayed a myriad of different patterns. To our knowledge, this study is one of the first studies to report this fluidity of constellations and to report complex collaborative patterns in students collaborative group work.

Furthermore, in line with the observation by Ryberg et al. (2018, p. 240), we also noted that the distinction between cooperative and collaborative work seem to blur when we studied students' interactions in detail as they, in their activities, alternated dynamically between individual, cooperative, and collaborative patterns of work. Thus, our results challenge a naïve individual-collaborative-binary and a naïve cooperative-collaborative distinction.

For engineering education researchers to be able to make more realistic and sound pedagogical recommendations, and for engineering educators to make sound decisions, they need to have a good understanding of how students' design processes play out in reality (i.e., to have what is sometimes called "ecological validity"). As already mentioned, a limitation of this study is that we hitherto only have had time to study the group practices in one collaborative design group and it limits the pedagogical recommendations we can make based on our empirical material. Still, one conclusion is that localities where collaborative work is taking place need to be designed, or adapted, for flexible group work and another tentative conclusion might be that instructors should encourage fluid collaboration patterns in students' collaborative work.

Thus, our results points to the need to investigate group practices and individual and collaborative learning in design project groups and other collaborative learning environments in more detail. It would be important to better understand which features (e.g., collaborative patterns, skills needed by students, etc.) are important for successful learning and good collaborative work in students' collaborative design projects and how these can be fostered and developed in engineering education. We have collected a large corpus of video data from A&D-students at Aalborg University in their first, fourth and fifth semesters. For example, we have video recordings from four more groups of fifth semester A&D students. Thus, we have an excellent empirical material to continue study the questions raised by this study. For example, it would be interesting to compare the collaborative patterns of groups. Moreover, we have not in this stage of our analysis related the collaborative moves to the fine-grained content of interactions.

Finally, this study shows that the features of "Big Video" technologies and interaction analysis make them ideal for, in an unobtrusive way, study students' "messy", collaborative design processes in real educational settings.

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