# Representing talk and action in collaborative activities for video analysis

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**Abstract.** This paper introduces a collaboratively developed methodology for the qualitative analysis and visual representation of video data. The data to be analysed were video recordings made by secondary school students whilst engaged in a collaborative, in-the-field, data collection process using hand-held data logging equipment for monitoring Carbon Monoxide and wind values. We describe the requirement for, and the collaborative and evolutionary development process of, a visual method through drawing overview activity maps. Following this we discuss some issues arising and future challenges for overview activity maps.

## Introduction

Despite an increasing emphasis on technology-mediated scientific enquiry, there is a marked need for analytical tools for studying how technology can be best integrated in the design of effective learning experiences. Several authors have stressed the need for an established framework for analysing technology-supported collaborative interactions (e.g. Lehtinen, 2003; Littleton & Light, 1999; Pea, 2004). The challenge for researchers is to develop a framework that will situate the learning experience in the social and cultural context. Moreover, such a framework must allow for the analysis of the collaborative experience as a whole that is more than the sum of individual actions. Ideally it must also be sufficiently flexible to allow for the changing needs of accepted practice in interaction analysis (Jordan & Henderson, 1995).

We report on the process of developing a tool for analysing technology-supported collaborative interactions towards building a framework of this kind. The context for this work is two related projects that investigated the potential of mobile technology to support collaborative scientific enquiry. Both projects involved small groups of students (3-4 in each) investigating pollution levels in their local area. Students were aged between 14 and 16 years. They used the same hand-held data-logging technologies in 30 minute, exploratory sessions to develop collaborative ideas about the behaviour of Carbon Monoxide in different locations and wind conditions. The projects differed, however, in the level of structure provided to students (asked to develop hypotheses versus asked to explore using the equipment) and the facilitator role (degree of support through questioning to encourage participant to verbalise their ideas). The data analysis we report focused on these data-collection sessions in the field. For further detail on the projects see Underwood et al (2004) and Stanton Fraser et al (in press).

Our initial analysis was driven by broad research questions such as:

- How did the students engage in the data-collection process
- how did they engage with multiple devices
- what sorts of behaviours/interactions were enabled
- and how the social and physical context supported or hindered the learning experience

We collaboratively created a series of overview activity maps to analyse the video-ed sessions. The activity maps enabled our analysis to become more focussed as interesting patterns of talk and behaviour were identified across all sessions. The process of developing the maps was thus data-driven, based on observation of emerging patterns and enabled us to progressively refine our research questions.

**Methodology**

The video data available from each session was supported by a collection of multimedia, including: students' handwritten wind data, automatically captured CO data, Global Positioning System (GPS) location data and photographs taken by the facilitator. A large portion of this data collection occurred in parallel and so it was a combination of all the data available that provided the most complete record of what happened and when. We found we needed a method of analysis that allowed for incomplete data in some sessions. This occurred for a variety of reason, including wind or noise on camera, being too distant from speakers, recordings not always being continuous video, students forgetting or otherwise to focus on devices or speaking people.

The initial activity map (v1, see figure 1) was created to provide a timeline of the actions that occurred within a single group during a session. Version 2 (figure 2) was created to allow the capture of some of the variables that were not constant across sessions (e.g. group size, hypotheses verbalised, planning where to take readings) for an early categorisation of the types of actions observed. At this stage we also agreed the variety of types of location visited by all groups. These locations included: open field, bust stop, tree area, vents on buildings and machinery. Also, we identified social interactions that influenced actions, such as facilitator input, distractions and changes to the initial plan that were made on the fly. These initial maps provided the means to extract patterns from the data but also to identify important information that was not adequately represented (e.g. physical location, whether standing still or moving, malfunctioning of equipment) that led to refinement of the maps. We identified a further need to define the observed behaviours to ensure each researcher was categorising in the same way.

Developing the maps further was a collaborative process during which we categorised talk and actions (communicating readings, commenting on readings, hypothesising, discussing, distracting); structured interactions in terms of devices and people; and defined a framework for capturing the context data that was relevant to our study.

A key aspect of the development of the activity maps was finding ways of representing the information visually that would enable us to 'scan' the data and rapidly identify clips/points of interest: e.g. spotting changes in behaviour when a person switched to using a different device in the same session, knowing where to target different kinds of interaction / behaviour / comments. This involved minimising

text and substituting for symbols, colour-coding, arrows to show links (see figures 3 and 4).

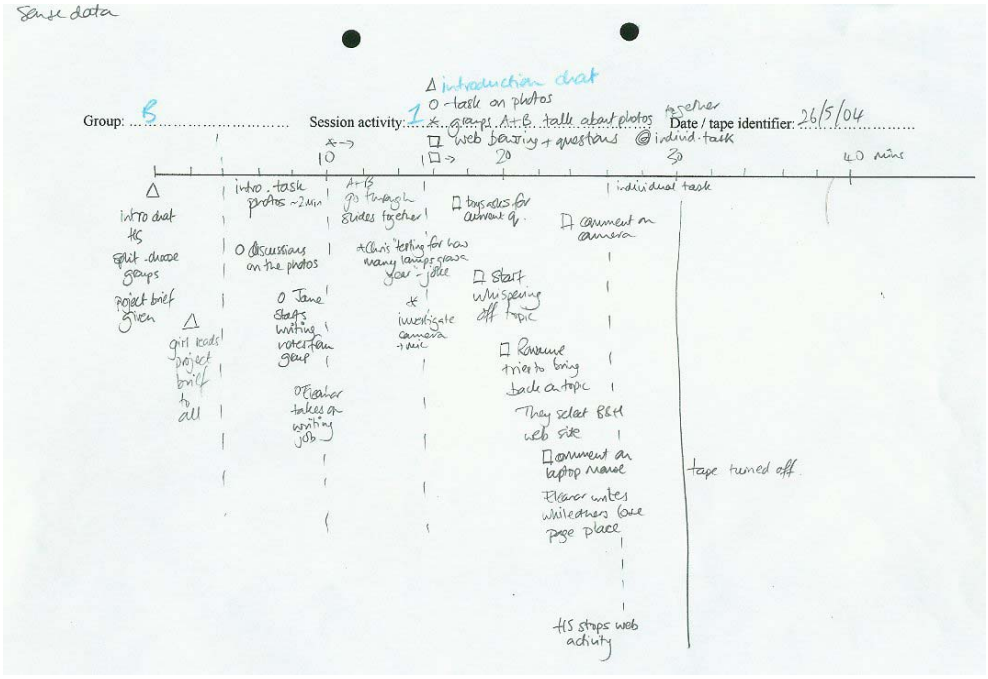


**Figure 1 - activity map version 1**

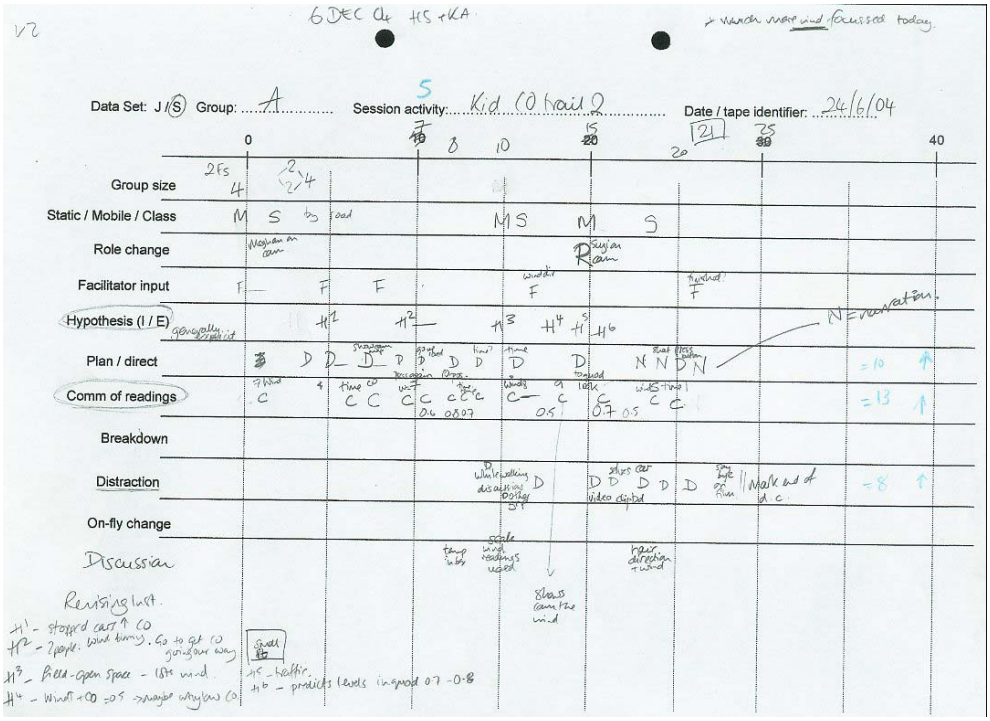


**Figure 2 - activity map version 2, where letters on map refer to category of behaviour on that line e.g. S = static, M = mobile, F = Facilitator comment, H1 = hypothesis 1**

The final version of the maps (figure 4) allowed us to combine an individual and group perspective on the data. More specifically, on an individual level we were

able to match actions and talk to people and the equipment they were using at the time, analyse individuals' use of technology, and detect who requested to swap devices with whom during the session. On a group level we were able to analyse individual contributions to group activity, identify how the context influenced group activity, and identify how the technology enabled or hindered collaboration and group activity (ease/difficulty of sharing information/creation of device roles).

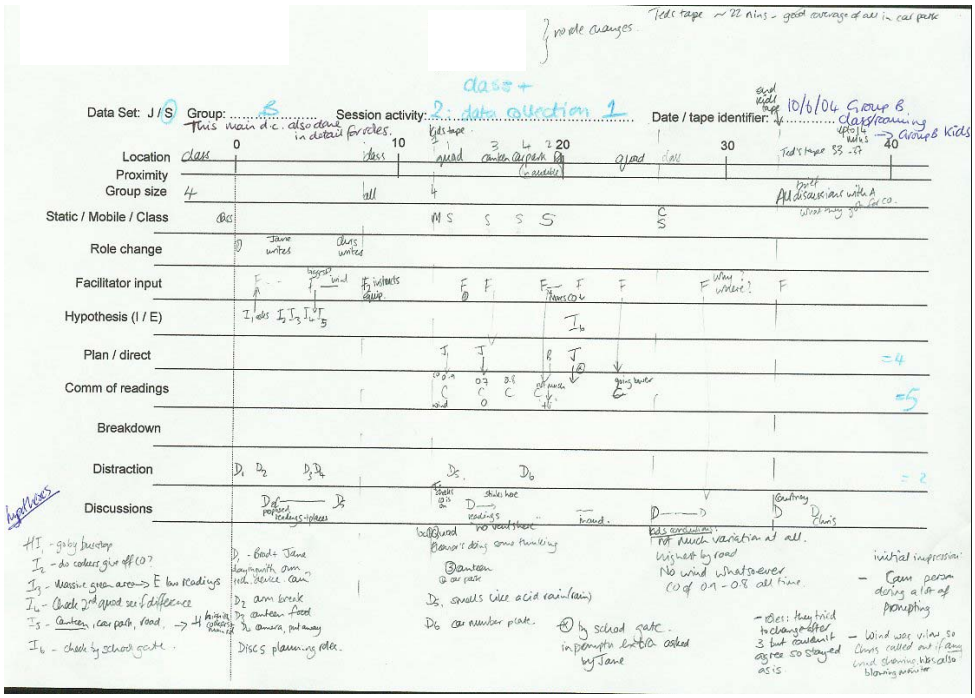


**Figure 3 - activity map version 3, letters on map refer to method used in figure 2**

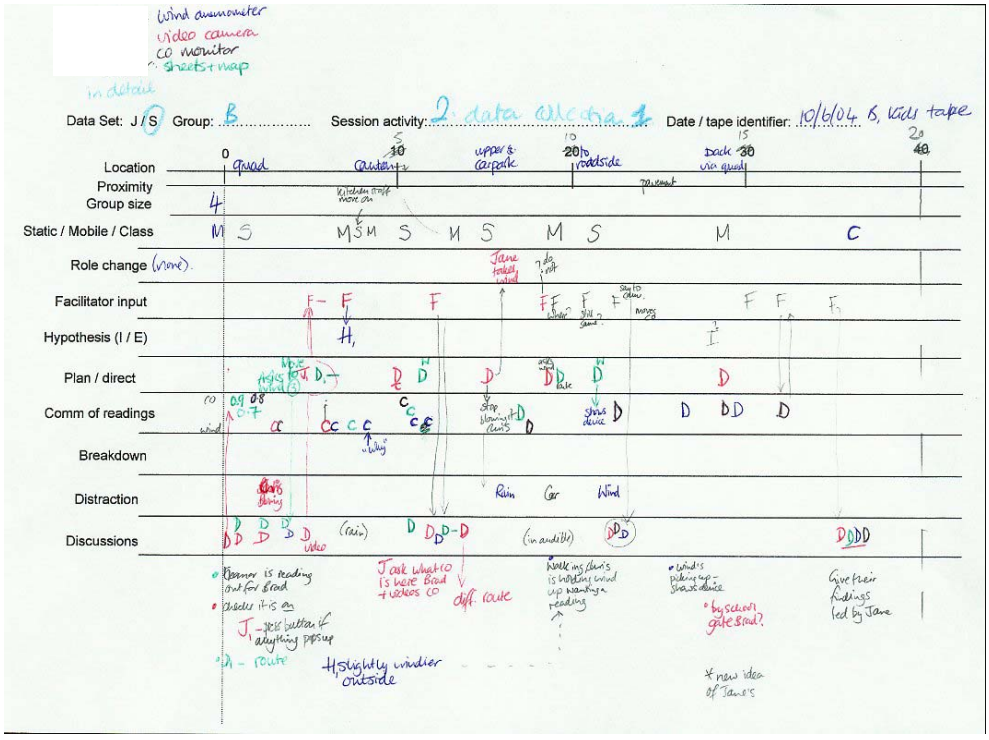


**Figure 4 - activity map version 4, letters on map refer to method used in Figure 2**

## Discussion

The iterative development of the activity maps enabled events within the data to be flagged as interesting and for us to use significant behaviour patterns to drive the focus of the analysis. The open nature of version 1 (almost a blank sheet) led to the use of categories to focus attention on particular types of interaction and behaviour and enabled researchers to work through data separately but in parallel. We fortified our individual analysis through joint working sessions to develop our ideas about the ways we defined particular behaviours. We were also able to share ideas about how best to arrange the activity maps e.g. to change the way we 'chunked' the maps. In version 2 we had provided vertical lines at set time intervals. These were found to be less meaningful than the idea of chunking activity by location of the group.

The collaborative nature of researchers being fully involved in video analysis in parallel with similar data meant the development of our categories for analysis focus was much reduced than it would be for one researcher working alone on each data set in turn. Our foci were subtle in their differences: by the very nature of our multidisciplinary backgrounds (of user centred design, psychology, education, computer science).

The visualisation of data in this way provided a very rapid way to scan through tapes in an initial pass, and identify which would be most useful for more in-depth analysis. It meant that transcription effort could be targeted efficiently, rather than across the board. Furthermore we found we were able to easily analyse from an individual or whole group perspective, or isolate a sub-group or particular device combination when investigating the roles students took on with each device.

In developing activity maps we propose to tie in various supporting data where available, for example by overlaying a graph of the collected wind and Carbon Monoxide readings, or location readings. This will help us identify reasons behind flurries of activity we have noticed e.g. in identifying the triggers to discussions that were student led rather than facilitator led.

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