Collaboration in Communities of Inquirers: An Example from a Geography Field Trip

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Abstract: Technology supported inquiry learning is a situation rich with possibilities for collaboration and the resultant collaborative learning which may ensue. However the complex settings in which it takes place give researchers a challenge in selecting the appropriate analytic lens. This paper is based on the work of the Personal Inquiry project (PI) which is exploring inquiry learning conducted by students aged 12-15 years across formal and informal settings, and the technology toolkit (nQuire) we have designed to orchestrate the inquiry process. We draw on a case study of geographical inquiry incorporating a field trip and describe the possibilities for collaboration which resulted in this setting. We use a range of data collected before, during and after the field trip to examine the learning behaviours which occurred. We found shifts in behaviour during the field trip, identified different working patterns enabled by the toolkit and identified future areas for research.

Introduction

This paper is based on the work we have conducted as part of the Personal Inquiry: Designing for Evidence-Based Inquiry Learning across Formal and Informal Settings project (the PI project). This project was funded by the Technology Enhanced Learning program (http://www.pi-project.ac.uk/). We conducted an investigation into how appropriate support for school students to learn the skills of evidence-based inquiry and investigating could be developed. Our focus in this project is on understanding how learning can be supported across formal and informal settings, and how collaborative learning can be orchestrated in such settings. As is normal in scientific investigations these inquiries are carried out by groups of young people. We are attracted to the description of collaboration offered by Mercer and Littleton (2007, p.25):

> '…participants are engaged in a co-ordinated, continuing attempt to solve a problem or in some other way construct common knowledge… involving a co-ordinated joint commitment to a shared goal, reciprocity, mutuality and the continual (re)negotiation of meaning'

In this paper we will analyse one example of science inquiry conducted in formal education, supported by technology developed in the PI project.

Technology Support for Collaboration

The orchestration of the inquiries involves a range of scientific data gathering equipment such as sensors and cameras managed by a web-based software toolkit (nQuire) that supports students working through the different phases of their scientific inquiries. nQuire provides scripting support for personal inquiry learning (for authoring, orchestration, monitoring, configuring and carrying out inquiries) that encompasses regulatory processes, transformative processes, collaboration and mobility (see Mulholland et al., 2010). It provides teacher support for authoring, orchestrating and monitoring inquiries and student support for carrying out, configuring and reviewing inquiries. nQuire supports opportunities for collaboration by making data available at either individual, group or class levels.

nQuire has been used to define the structure of the inquiry. The Urban Heat Islands phenomena involved data collection by students walking across the centres of two towns. The structure of the inquiry and the experimental design were scripted in participation with the teachers. The prepared structure was then used to guide the students through the data collection and analysis which we are using as the case study of collaboration presented in this paper.

Group Work

We are interested in exploring how technology, and mobile technology in particular, offers the possibility of supporting the transitions made by learners across settings in a range of trials involving young people aged 12-15 years working at school, at home and in settings such as field trips and after school clubs. (See e.g. Scanlon et al., 2009). The group activity we are exploring in this case is the field trip which is important for facilitating learning and conceptual understanding in science education. Jewitt et al. (2001) for instance reinforce the

importance of action in meaning making and we are interested in embodied meaning making in inquiry learning settings.

We are considering the work of two groups of pupils who were collecting data on a field trip. In the first stage students were deciding what to measure and the locations to visit as whole class and as an individual created their own hypothesis for investigation. The pupils were placed into groups to collect their data, in stage 2 and in stage 3 they shared their resultant data with the whole year group, and in turn used other pupils' data in their work, but were required to produce an independent, individual report to submit. (See Figure 1)

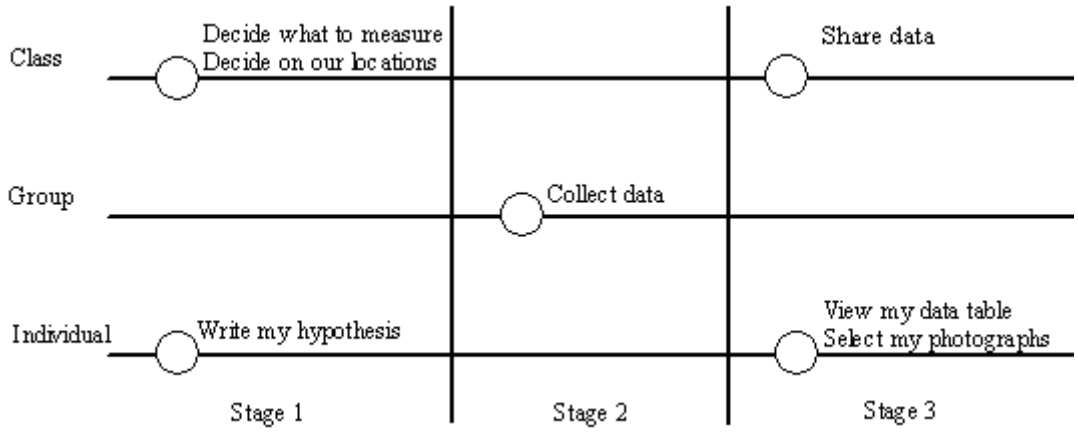

Figure 1. Activities at the Individual, Group and Class Levels within the Urban Heat Islands Inquiry.

The UHI Case Study

This trial was based around students' coursework for a public examination on Urban Heat Islands (UHI). The technical development focussed on supporting the fieldwork aspect of the students' projects. We worked with the whole of year 10 Key Stage 3 classes (aged 14-15 years) that were studying geography at Oakgrove School in Milton Keynes, and their two geography teachers. The 76 pupils were divided into 3 classes. Shared design of the project and the PI toolkit was developed through a series of meetings with the teachers in the term leading up to the students' coursework. Meetings were held with Sciencescope to confirm the best use of sensors and validate the fieldwork methodology. The research was conducted with the approval of the Open University ethics panel, and the school is identified as a research partner.

During the study period, each class attended three geography lessons per week for eight weeks. The sequence of activities is illustrated in Table 1 and includes an introduction to the topic, individual and class working on background and defining hypotheses for the study, fieldwork and presentation of data and analysis.

Table 1: The sequence of UHI inquiry activities over the eight week study.

Week 1	Topic introduction Background research and hypothesis	Week 4	Data collection field trip
Week 2	Methodology specification Student coursework Introduction	Week 5-6	Data presentation
Week 3	Practice data collection	Week 7-8	Data analysis and conclusions

During the fieldtrip, the students used Sciencescope data loggers and sensors to collect wind speed, temperature, infrared irradiance and carbon monoxide data, and took GPS readings of the data collection locations. These were entered into the Personal Inquiry toolkit running on Asus Eee PC netbooks provided to each group of four students, and students were encouraged to add text comments for each location. Cameras were provided to each group to take evidence supporting photographs of locations.

Evaluation

Data from the netbooks was uploaded by the technical research team to a central server that could be accessed by the students from any location (home, school IT suites, etc) through a group login / password. Photographs were saved onto USB drives. An export function in the toolkit allowed students to output data in .xls (Excel) or .kml (Google Earth) formats for representation and visualisation during the write-up period of their project.

We gathered the following data over the study period:

- Audio recordings of meetings with the teachers, and video recordings of a participatory design
- 18 exercise books, coursework journals and coursework

workshop
• Video and audio data (40 hours) from eight weeks of lessons, three lessons a week, for three classes
Pre and post interviews with teachers and student post interviews
• Teacher resources
• 70 post questionnaires
• Student webform data
• Interviews with some parents

Examples of Group Interactions

In what follows we are looking at whether and to what extent the students engaged in co-operative, collaborative or individual activities and how this changed during the course of the field trip activity. For this we have drawn on Sociocultural Discourse Analysis (SCDA), which adopts a view of language as 'a social mode of thinking - a tool for teaching-and-learning, constructing knowledge, creating joint understanding and tackling problems collaboratively' (Mercer, 2004, p. 137). Thus we have largely focused on how talk was used on the field trip. We illustrate below an example of collaboration, which emerged outside of the required data collection activity but still on the field trip, as well as two examples of co-operation. Co-operative group interactions were more common than collaborative exchanges, and manifest in different ways, thus the two examples have been selected to illustrate this. This is supplemented by extracts from the post interviews with the pupils.

In presenting and analysing the examples, we define individual activity as where pupils worked largely on their own in meeting task requirements, such as a pupil taking photographs, or a pupil completing the webform without help from his/her group. Co-operative activity occurred where groups offered their readings to the person inputting information into the netbook, and offered suggestions for the supplementary comments about the surroundings, but did not otherwise engage with or question contributions. Collaboration, as defined above, was less common, characterised by emergent understanding built up through successive exchanges that incorporate and extend previous contributions. The extracts have been chosen to illustrate these forms of talk as they occurred on the field trip. For ease of readability, transcribed extracts have been largely confined to the verbal exchanges, with some information included to indicate a point of reference. The names of pupils involved have been anonymised.

An Example of Collaboration: Discussing Air Temperature

(Elisabeth and Vera having a conversation as they walk along, between data collection stops)
Vera: in hot countries 'cos they wouldn't, kind of, do a lot
Elis: Yeah the air temperature would be roughly the same as the irradiance
Vera: It might even be less 'cos the houses they paint white it reflects it.
Elis: Yeah.
Vera: It would be higher for like irradiance, but it might be a bit lower in terms of the
Elis: But the fluctuations would be lower
Vera: Yeah
Elis: Because of the already existing air temperature.

Within this example we can see how the two girls are building on each other's responses, but also querying, negotiating and offering countering arguments, in justifying and constructing together a shared and detailed reasoning for their predictions. Thus their joint reasoning emerges out of the collaborative exchange, as their individual experiences and views are juxtaposed through the talk as it unfolds. Such an exchange may not have been anticipated by their teachers, as the girls called upon experiences outside of the school and fieldwork context.

An Example of Co-operation: Helping with Comments Boxes on the Webform

Flora: They've all got their engines on
Cath: They've all got their engines on which is contributing to the heat
Josh: Yeah, yeah, so like taxis' engines or whatever
(announcement at station)
Pete: Taxis, sorry what was that?
Cath: Erm, taxis have all got their engines on
Pete (typing): 'got engines on'. OK cool.

As the day went on, the groups got more used to what they had to do at each collection point, how to use the devices to collect their data, and often what order the person with the laptop wanted the data so that they could enter readings more easily. Their interactions, as in the following example, illustrate how they had established an efficient pattern of working as they co-operated to take and gather their data. This extends to offering suggestions for comments in the free text boxes.

Example of Co-Operation: A Well-oiled Machine for Gathering Readings

Pete: OK. Minimum air temperature.
(Flora holding up temp sensor, Cath holding wind temp measure)
Flora: Minimum 7.2, maximum 8.6
Pete: OK wind speed
Cath: 0.0 and 1.0.
Flora: And I've got a picture
Pete: OK how is the land being used?
Dan: Like that's gonna work in the corner (wind speed)
Pete: Shall I put main road
Cath: Yeah main road
Josh: Say junction
Flora: Traffic light
Cath: Yeah there's traffic lights behind us

Mainly towards the end of the field trip, the groups got tired and were less willing to offer help in writing comments into the webform, thus the work became more individual, and reliant on the person in control of the netbook. The comments groups had to work with when back in the classroom therefore were often dependent on which person was holding the netbook and whether they filled them in.

The group felt using the netbook helped when collecting and inputting the data, and in sharing and using the data back in the classroom. A comment from our group pupil post interviews illustrated this:

Researcher: And how would using that compare to if you were walking around with your books, writing stuff?
P1: It would just be awkward
P2: awkward
P1: It was windy...
P2: the pages might be everywhere
P1: everywhere.
P2: And you would just get tired and it would take more time
P1: Yes, takes ages.
P2: It would be messy, this one is quite straight, the hand writing you could be really scribbly and you would be like, what's that number?
P1: Spread it around, but if one person writes it
Researcher: You could share, that's a good point.
P2: With that, you can have one copy and share it.'
Note: individual pupils were not identified in the final interviews.

The webform on the laptop acted as a form of 'guided participation' (Rogoff, 1990), in the field trip as the webform highlighted the type of readings they needed to take and points they should note. There were some suggestions from pupils of how technology could support the data inputting process, particularly with data collection in relation to infrared irradiance, where some pupils commented that they occasionally forgot to add in plus or minus sign for the values.

Groups also showed how they had co-operated on the field trip when talking about the photographs they took to illustrate their data. They commented on the link between what the group entered into the comments boxes on the webform with the pictures taken on the camera, thinking forward to how they would use the textual and image data in writing up their coursework to evidence their findings. A comment from the group pupil post interviews illustrates this:

Researcher: How did you choose which photos to take?
P1: … but some of them depended on the comments
P2: Oh yeah,
P1: one of them was about traffic lights so we took a picture of the traffic lights.

This identifies that the pupils were utilising the different technologies at their disposal to provide a coherent picture of the data they were collecting – by complementing the text written to describe the area, with data about the temperature, carbon monoxide, infrared irradiance and wind speed readings, with photographic evidence. Thus the pupils potentially had the foresight to consider that when back in their classrooms, they could piece together why certain readings may have been higher or lower at certain points on their trip (e.g. high carbon monoxide readings close to traffic lights where cars would often be at standstill).

Collaboration on the Field Trip

The trajectories of pupils working on this complex inquiry offer a rich source of data through which to consider the collaborative activities undertaken. Our analysis builds on the concept of 'collaborative emergence' defined by Sawyer and Berson (2004). They define it as 'characterised by improvisation, unpredictability, and responses that are contingent on each other', p390. The authors use this to suggest how group discussions enable a form of understanding created by the group working together, as a sum of all contributions. They suggest the role of external representations in group work, such as maps, photographs, and writing on screen, can 'enhance the educational benefits of collaborative conversation' (p390). They define notes pupils make as more than memory dumps – in the group context they can become a source of collective and collaborative discussion, from which to re/create understanding. This was particularly observable in the first example given, where the girls discussed the environmental readings and how they might be influenced by various environmental features. Thus they were going beyond the task requirements (to collect readings at certain points in the cities they were studying), in jointly constructing an understanding of the nature of the factors they were recording, through their emergent discussion that built upon, agreed with or contested each other's views in improvising and justifying their view in response to their partner.

We are currently analysing episodes from the further seven trials we have conducted on the project (see e.g. Sharples, 2009). So far we have analysed the discourse surrounding collaboration in the urban heat islands field trip and a field trip which took place at a nature reserve on the topic of noise and bird feeding (see Schwegmann et al., 2010).

Conclusions

In the PI project we are interested in exploring how technology and mobile technology in particular, offers the possibility of supporting the transitions made by learners across settings. These settings are an important site for collaborative work and offer the possibility of analysing moves from individual to group working. So far we have identified how our toolkit orchestrated the possibilities for collaborative working and in this paper have given some illustrations, using dialogue during a field trip, of what happens during such an inquiry. We have illustrated how this activity involved co-operative, collaborative and individual activities at different stages and for different reasons. We have presented some evidence that the different working patterns and requirements were recognised. We have not found evidence of 'ground rules' established within groups or the classes for how they should interact and work together when collecting data. We now intend to extend this analysis to other examples of orchestrated inquiry learning in our project.

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