Meaning Making in a Problem Based Learning Class

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Abstract: This paper explains how the context of an academic programme can frame student meaning making and the actions of their tutors even when the notional pedagogic approach is one of Problem Based Learning. This study follows Jewitt in combining Activity Theory and Multimodality in order to explore the interaction between context and meaning making. It concludes by identifying how the facilitator seeks to balance the two roles of allowing student exploration of the problem and ensuring they meet the demands of the academic module. In turn, differences in the student approach to meaning making are noted as the focus of the task shifts.

Key Words: Problem Based Learning; Multimodality; Activity Theory; Scaffolding

Introduction

Problem Based Learning (PBL) has been identified as a means to encourage independent student learning and meaning making. PBL initially emerged in a group North American Universities that taught medicine in the late 1960s as a reaction against traditional teaching models (Savin-Baden 2000; Savin-Baden and Major 2004). The original format was to present the students will a problem and allow them to develop their own solution, aided by a facilitator and some guidance materials. The goal was that the students came to their own understanding and the expectation was that this led to better retention of the key concepts compared to conventional classroom and tutorial based teaching. To support student making meaning making process, PBL adopted the concept of scaffolding (Choo 2012; Greening 1998; Hmelo-Silver, Duncan, and Chinn 2007) where a tutor provides support by helping the students frame the problem so as to guide their meaning making but still allow them independence in how they tackle the task.

However, PBL has been criticised as a learning model with students frustrated at having to work from incomplete information (Hmelo-Silver 2004) and that some or all the group might disengage from the task (Woodward-Kron and Remedios 2007) undermining the process of group problem solving. Equally, although PBL stresses independence of student meaning making, this activity takes place in a context.

The context is framed by the subject matter, academic rules and expectations such as the available time frame and the set assessment process of a particular course or university. This creates a tension between the open ended meaning making process that represents the idealised version of PBL (Dantas and Kemm 2008; Haggis 2009) and the reality that students need to be guided, not just in terms of problem solving, but also to meet the demands of their course timetable and assessment. This, in turn, has implications for how the tutor or facilitator has to manage the challenge of both creating space for student led meaning making and acting as the arbiter of academic process.

This interaction between the task framework and the desired approach of student led problem solving is not widely explored (Savin-Baden and Major 2004). Thus the focus of this paper was on how task and framework combine to influence both the student meaning making process and the actions of the PBL tutor.

This stress on the interaction between context and the meaning making process meant using a methodology that combined aspects of Activity Theory (Mercer and Howe 2012; Engeström 1999) with a multimodal approach to understanding meaning making (Jewitt 2008) in order to explore the meaning making process in detail. There were several advantages to this combination. First, although the concept of resemiosis (ie taking account of the wider environment) is present in multimodal approaches (Iedema 2003) in reality it is hard to capture in such an analysis. Activity Theory (AT) has a stronger emphasis on how context (Leontev 1978) frames and constrains meaning making. On the other hand, it was only through a detailed multimodal analysis that it was possible to track how the students used different semiotic resources as the task developed and to understand how the tutor’s role in guiding the student group differed from the activities of the student group.
Literature Review

Problem Based Learning

PBL was introduced as a student centred learning pedagogy and it was argued it was radically different to other methods of independent student study (Hendry, Frommer, and Walker 1999). Central to the PBL model is that the student should be an active participant in meaning making and that this is achieved by researching a topic, integrating their new and existing knowledge and constructing an explanation or solution (Savery and Duffy 1996). Advocates of PBL (Hmelo-Silver, Duncan, and Chinn 2007) argue that students would be much more likely to retain their knowledge acquired this way than if it was presented by a conventional mixture of lectures and tutorials (Camp 1996).

In the early stages of PBL the tutor was often an expert in facilitating group discussion and group problem solving rather than an expert in the particular subject field (Dolmans et al. 2002). The tutor’s role was to guide the students but to allow them to take control of their own learning process (Tan 2004) and the tutor needed to gauge how to respond at different stages (Holmes and Kaufman 1994) to create the space for students to make mistakes but assist them in working as a group and guiding their emerging understanding. This acknowledged that problem solving is never a linear process and there is a need to leave space for students to make mistakes and backtrack as they progress through the task (Simon 1985).

Since active student problem solving is at the core of PBL, a key concept to delivering PBL is that of scaffolding (Greening 1998; Choo 2012; Hmelo-Silver, Duncan, and Chinn 2007) as a tool to bridge the gap between independent learning and the particular goals of a given academic module. This means providing the students with the information and the environment needed to successfully deal with the task they were set and enabling students both to work as individuals and to make use of the group learning aspect of PBL (Ribeiro and Mizukami 2005). Critically important in this regard is the role of the tutor who needs to provide enough information, in an appropriate form, to help the students but not do so in a manner that removes their independence as learners.

Scaffolding can take different forms with each mode being used to support a different stage in meaning making (Hill and Hannafin 2001).

<table>
<thead>
<tr>
<th>Scaffolding Mechanism</th>
<th>Function Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conceptual</td>
<td>Mechanism designed to assist with defining things to consider. • Creating an outline of a paper before you start to write or examining a map of a location to determine best ways to reach your destination (either in a paper or a physical place).</td>
</tr>
<tr>
<td>Metacognitive</td>
<td>Assist with establishing what is known and how to think. • Providing learners with structured “reflection reminders,” which may come in the form of daily journal entries. • Enabling scaffolded inquiry so that as learners are engaging the process, they are assisted in ways that make the most sense for them.</td>
</tr>
<tr>
<td>Procedural</td>
<td>Assist with how to use a resource. • Providing and encouraging the use of help functions in productivity tools to assist the learner with trouble-shooting and problem-solving. • Creating Web site maps so the learner can get a sense of the scope of the site, as well as indicators of how varied elements in the site are linked together.</td>
</tr>
<tr>
<td>Strategic</td>
<td>Alternative ways to do a task. • Arranging for an expert consultant to demonstrate how to perform a task so learners can observe and ask questions while learning a new technique. • Creating “question pools” where learners can pose questions for others to provide responses, enabling multiple perspectives on a problem.</td>
</tr>
</tbody>
</table>

(source: Hill & Hannafin, 2001, p. 45)

Figure 1: Scaffolding Mechanisms

However, some of student dissatisfaction with PBL can be related to having to work out a solution from limited knowledge when they are aware that the tutor could provide this information (Hmelo-Silver 2004). Equally, not all students find the group nature of PBL comfortable, sometimes
because they are afraid to display their lack of knowledge or feel marginalised if the language of instruction is not be their first language (Woodward-Kron and Remedios 2007). Finally, although PBL stresses the student led nature of the problem solving process in reality it takes place in a defined academic framework with a clear end goal (and assessment). In consequence the conventional role of the facilitator, who allows students the space they need for problem solving, is less easy to sustain in practice as they can be easily drawn to a more directive role in an attempt to ensure that the students meet the timescale for the task (Greening, 1998; Tan, 2004).

Multimodality

Multimodality concentrates on how meaning is constructed and conveyed. It was developed by Halliday (1978) to reflection how the social environment and norms affected meaning making rather than the traditional focus in semiotics on language (Iedema 2003). Halliday’s work was, in turn, expanded through the concept of Multimodal discourse Analysis (MDA) to capture other modes of social interaction (O’Halloran 2008) such as vision, gesture, colour, setting and abstract notation systems. As MDA has developed, an important issue is how different semiotic resources interact and secondly how to take account of the wider context. Inter-semiosis (O’Halloran 2008) has become the means by which different semiotic tools are combined. Usually in a given situation one mode is dominant (Kress and van Leeuwen 2006). In a pedagogic context multimodality has been used to study student meaning making. Many authors (Airey & Linder, 2009; Maher, 2011; Martínez, 2000) stress that science, for example, is inherently multi-modal (Marquez, Izquierdo, and Espinet 2006) as teaching will involve practical demonstrations, verbal descriptions, visual images (graphs and pictures) as well as the use of specialist scientific notation.

Re-semiosis is an important part of multimodal theory as it reflects the process by which meaning shifts due to the wider context (Iedema, 2003). The weakness is that although re-semiosis is acknowledged as an important part of meaning making it is rarely captured in formal coding structures. In practice many multimodal analyses concentrate on verbal and non-verbal meaning making but overlook the importance of changing context. Jewitt (2005) had emphasised that: ‘social semiotics and multimodality offer conceptual tools for the analysis of meaning making. This leaves out the socially situated character of meaning making’ (Jewitt, 2005, p. 16).

As indicated in figure 1, scaffolding can take a number of forms and one advantage of a multimodal style of analysis is it allows tracking of the use of scaffolding in meaning making across both verbal and non-verbal instances.

Activity Theory

Activity Theory (AT) shares some aspects with multimodality, not least that meaning making is shaped (Vygotsky 1962) by the social environment and the cultural tools for understanding (Leont’ev 1978). Other researchers (Hedegaard, 2001; Mercer and Howe, 2012) discuss how existing tools are appropriated into new situations and Kress (2009) argues that this connects with the concepts in multimodal semiotic research as ‘learning is the result of a semiotic (...) meaning-making engagement with an aspect of the world, as the result of which the learner’s semiotic (...) resources for making meaning’ (Kress, 2009, pp. 19-20).

Engeström (1999) developed these concepts to construct a framework that can be used to understand a problem solving process and the means by which knowledge is mediated by the social context (Engeström 1999). Activity Theory thus can be used to study the effect of the different tools available for PBL but also a means to understand language use, negotiation between students, and the extent that all members of the group participate (Molina-Azorín et al. 2009). In addition, it provides a tool to analyse and categorise group discussions and group dynamics and the interaction between personal learning and group learning and how these interactions are framed by the social context (such as being at a University).

In this research, following Jewitt (2005), AT and multimodality are seen as complimentary theoretical structures. Both focus on meaning making and the extent that this is mediated by the external environment (Mutton, Burn, and Hagger, 2010). These concepts are then applied to understand the student and tutor interaction in an engineering PBL class.

Research Methods

The research design adopted in this study is largely based on the work of Jewitt (2005) were they argued that the concept of resemiotics is present in multimodal theory but underdeveloped. Her suggestion was to use Activity Theory to address this gap, as:
‘Multimodality allows me to focus on all the different resources that are displayed … as part of classroom interaction. Activity Theory offers a useful framework for situating people’s semiotic choices and use of technologies with the context of a curriculum subject and the classroom. I bring these two ways of thinking together to help ‘locate’ people’s use of representational and communicative modes in the complex social interaction of the classroom’ (Jewitt, 2005, p. 4).

Focus of the study

The focus of this particular study was an engineering PBL class where the students were expected to design a model bridge that could withstand a given stress test using prescribed building tools (basically glue and a fixed number of short wooden sticks). The class took place in the second year of the degree and the students had had experience of the PBL methodology in shorter projects in their first year. The class was spread over six weeks and the first five sessions were videotaped (the final session was the final assessment and test of their model).

Data recording

Data recording occurred when the researcher was present and used a single video camera as the main tool. The sessions were recorded without breaks to allow later examination of the entire interaction and prevent self-selection in the gathering of evidence (Asch 1992).

To ensure completeness, the goal was to capture as much of the interaction on film as possible but this still left a problem of focus. There is a problem when the intention is to capture the meaning making actions of the students (which may require a close up focus) and to also capture the information providing and meaning making actions of the tutor at the same time. (Wilkinson and Brady 1982). In this case, the decision was usually to focus on the students’ response to the tutor (especially when he was delivering a whole class presentation) rather than on the tutor, and to rely on short sections and audio recording to reflect his input at these stages.

Data Coding: Activity Theory

Once the data was recorded it was transcribed and images and speech recorded to show the interaction between verbal and non-verbal modes of meaning making. The basic coding of the sessions was done first in terms of multimodal concepts and then in terms of those drawn from Activity Theory. However, by its nature multimodal description is complex, indicating interactions between small blocks of speech, gesture, tool use and body language making it impractical to analyse the full set of tapes in detail (O’Halloran 2008). Here, Activity Theory was used both as an analytic approach in its own right and to select a representative sample of short blocks (each 3-5 minutes long) that could be analysed using a multimodal approach.

Engeström’s (1999) development of activity theory provides a basic coding structure (Bouckaert 2009), especially to allow a focus on aspects such as setting group norms and the range of tools accessed in the process of collaborative learning. Using Engeström’s coding structure meant each block of meaning making was coded in terms:
Table 1: Main categories (Activity Theory)

<table>
<thead>
<tr>
<th>Concept</th>
<th>Definition</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>Object</td>
<td>The underlying purpose of a task</td>
<td>At its core, to design a bridge that will meet certain criteria</td>
</tr>
<tr>
<td>Subject</td>
<td>The individual(s) carrying out the task</td>
<td>The group of five students who make up the PBL team</td>
</tr>
<tr>
<td>Tools</td>
<td>The resources used in carrying out the task</td>
<td>Paper and pencil, ICT, White Boards, laptops, mobile phones, calculators are all used at different stages</td>
</tr>
<tr>
<td>Rules</td>
<td>The rules that regulate the conduct of the task</td>
<td>Both the task rules and the assessment rules are discussed at various stages</td>
</tr>
<tr>
<td>Community</td>
<td>The wider group involved with the task</td>
<td>There are other PBL groups in the same class room but the only interactive outsider is the facilitator</td>
</tr>
<tr>
<td>Division of Labour</td>
<td>How the various jobs required are divided between the subject and community</td>
<td>At different stages the students work individually, allocate tasks between themselves and the tutor takes on different roles.</td>
</tr>
</tbody>
</table>

This conceptual framework was used to break down the overall sessions into segments and identify which category was relevant at which stage. A typical example of this coding structure, drawn from the first class, is:

Table 2: Coding of Interaction (AT)

<table>
<thead>
<tr>
<th>Timing</th>
<th>Description</th>
<th>Object</th>
<th>Subject</th>
<th>Tools</th>
<th>Rules</th>
<th>Community</th>
<th>Division of Labour</th>
</tr>
</thead>
<tbody>
<tr>
<td>10.15-11.10</td>
<td>Discussion of possible solution between individual students</td>
<td>1:1 discussions</td>
<td>calculator</td>
<td></td>
<td></td>
<td>Discussion led by 1 student</td>
<td></td>
</tr>
<tr>
<td>11.10-11.30</td>
<td>Checking understand and possible solutions</td>
<td>1:1 discussions</td>
<td>Paper, written notes</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11.30-12.55</td>
<td>Working on solution</td>
<td>Individual work</td>
<td>calculator</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12.55-13.05</td>
<td>Tutor input</td>
<td>Student work carries on</td>
<td>Reference to text book</td>
<td></td>
<td></td>
<td>Facilitator led</td>
<td></td>
</tr>
<tr>
<td>13.05-13.45</td>
<td>Student work</td>
<td>Mostly individual work</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

This Activity Theory coding was also used to identify segments of three to five minutes that were typical of key stages in the meaning making. These were selected to provide a range of instances from whole class presentations to interaction with the tutor to stages when the students were working on the model bridge by themselves.
Data Coding: Multimodal Meaning Making

The Activity Theory analysis was used as the first stage. Then all the videos were transcribed and coded again but this time using five categories of multimodal meaning making derived from Hmelo-Silver’s research design (Chernobilsky, Nagarajan, and Hmelo-Silver 2005; Hmelo-Silver, Chernobilsky, and Jordan 2008), supplemented by adding a concept of internalization (to capture who was leading the meaning making between the students and the facilitator) and of scaffolding (Hill and Hannafin 2001; Stålbrandt 2007) to explore the process of learning. The resulting categories were:

1. Content of the talk;
2. Collaboration;
3. Responses of ideas/complexity;
4. Knowledge;
5. Metacognition;
6. Interpretation; and
7. Internalization.

This led to two levels of analysis once this coding was completed. Where appropriate the entire PBL module was subject to analysis when it was sufficient to count the usage of particular semiotic modes. This reflects the problem that rendering multimodal research onto a conventional paper form is time-consuming (O’Halloran 2011) and hard to report.

This constraint of only being able to handle relatively short blocks of time (unless the reporting concentrates essentially at the quantitative level) led to the identification of seven short sessions from across the five classes for detailed analysis in terms of how the different semiotic modes varied across individuals and by focus. In these shorter blocks it was feasible to move beyond counting instances and noting who made use of which semiotic modes to explore the flow and interaction of meaning making. The criteria for this selection gave:

<table>
<thead>
<tr>
<th>Video-Taped Session</th>
<th>Time</th>
<th>Focus</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.25-4.00</td>
<td>Facilitator led, focus on the theory behind the bridge design task</td>
</tr>
<tr>
<td>1</td>
<td>24.27-27.38</td>
<td>Interaction within the student group, focus on the theory behind the bridge design task</td>
</tr>
<tr>
<td>1</td>
<td>54.21-56.27</td>
<td>Group-Facilitator discussion, shift of focus from the theory to the model building task</td>
</tr>
<tr>
<td>2</td>
<td>30.50-36.15</td>
<td>Interaction within the student group, followed by a group-facilitator discussion, shift of focus from the theory to the model building task</td>
</tr>
<tr>
<td>3</td>
<td>08.26-13.10</td>
<td>Shifts from student group, to facilitator input to group-facilitator discussion. Most of the focus is on the theory behind the bridge design</td>
</tr>
<tr>
<td>4</td>
<td>19.47-23.26</td>
<td>Two of the students discussing how to build the model</td>
</tr>
<tr>
<td>5</td>
<td>22.20-26.44</td>
<td>Group-Facilitator discussion focussed on the model designed between sessions 4 and 5</td>
</tr>
</tbody>
</table>
Results

Across the five video-taped sessions there were a number of important shifts of focus. In the first class, the students were mostly engaged in understanding the theoretical issues behind the bridge design. In the second, there was a balance between a focus on the theoretical basis and the actual design of the model. The third class saw a long input by the tutor to the entire class about what was expected and examples of how to build a bridge were provided. The fourth class involved just two of the students discussing how to prepare the model and the final one involved the students and the tutor reviewing the model they had prepared after the fourth session.

It was possible to identify two shifting variations in the meaning making process. One was between a focus on the theory underpinning the bridge design as opposed to concentrating on how to build the bridge. The second was between sessions were meaning making involved the tutor or where it just involved members of the student group. This also allowed a distinction to be drawn between the meaning making approach of the tutor as opposed to those of the students.

Context and Meaning Making

One important finding was the role of context. This influenced meaning making in various ways, ranging from directions as to when the task had to completed, the tools to use but also the theory derived from the wider academic subject matter. An example of the latter was provided in the second class as: ‘What you've got is a whole lot of material, because this really is superimposed on EM1032, which was the previous introduction to design. So what we’ve made this as a PBL subject’ (PBL facilitator, session 2, 26.15). However, at other stages, the PBL tutor concentrates on the context of the bridge as: ‘So the first thing that I want you to think about is how you’re actually going to get a strong structure. Think back to that wire frame job’ (facilitator, session 1, 37.12).

Here, the context within which this problem solving task takes place falls into three layers. The first is the context of designing a bridge (ie any bridge) and incorporates concepts from engineering in terms of the ability to bear a given weight and different design options. The second is the context provided by the rules that surround the building of this particular model bridge. These are variously the resources available, how it will be tested and the timescale that the students have. The final element to the context is the shifting set of goals (ie requirements that the students need to meet before the next class) or guidance provided. In combination, these different aspects form the environment within which the meaning making by both the students and the facilitator needs to be understood.

Shift in student meaning making

The shift from theory to model building was reflected in how the student group interacted and the type of semiotic resources they relied on. Some of the common weaknesses in PBL were observed. In particular, group learning was relatively rare and some students remained 'silent' either all or most of the time. In addition to this, two of the students behave very differently when the facilitator was present or if the discussion was within the student group. One only spoke when the facilitator joined the group and another spoke far more often when the facilitator was absent.

There is evidence that the students used verbal and non-verbal resources for different aspects of meaning making. For example, in terms of scaffolding they did this very rarely but always non-verbally and always in connection with the model building phase. Examples of this include where a student supports a verbal question about the nature of compression by ‘squeezing hands together’ as an instance of conceptual scaffolding (Hill and Hannafin 2001). Later in the same discussion a different student also uses his hand to demonstrate ‘the intended range of movement by hand gestures’, again an instance of non-verbal conceptual scaffolding.

However, a wider shift in student meaning making occurred as the focus developed from theory to practice. Where they were engaged in the practical task of building the bridge, it was noted that non-verbal meaning making dominated, where the focus was on the underlying theory, meaning making either was balanced between verbal and non-verbal or was dominated by verbal semiotics.

The theoretical aspect was dominated by concept-related talk and the practical steps by elaborated explanation as they engaged in more open discussion. Thus the dominant mode (Iedema 2003) between verbal and non-verbal semiotics varied. In the theoretical sessions speech tended to dominate, but in some instances reliance on non-verbal gestures and tools were essential to support the meaning making. In the practical sessions either there is a balance in the importance of the two modes or in some instances the non-verbal mode was dominant and speech used simply to vocalise the meaning that is being constructed using gesture and the tools.
For most instances, although both verbal and non-verbal modes are important in meaning making there is clear evidence that in most stages one or the other was dominant (Iedema 2003). In addition, there is evidence they use different semiotic modes as they vary meaning making supporting Kress’ (2010) concept of affordance.

The role of the tutor

In understanding the role of the tutor, there were two main issues. One was whether or not, in Activity Theory terms, he was part of the ‘subject’ or part of the ‘community’. In other words how did he engage in active meaning making with the student group? The second issue flowed from this, how did he balance the twin tasks of guiding student meaning without explicit intervention against his role as arbiter of the academic task and constraints?

The tutor plays a different role to that theorised in early versions of PBL. While he does make substantial use of scaffolding to guide student learning he also plays a direct role in setting task boundaries and in evaluating progress. Some of this occurs relatively early where he seeks to ensure they are approaching the task effectively, as: ‘there’s some major problems there. This sort of scene here is a major problem. … . Well the problem there is here, and you’re going to have a problem there on the truss’ (facilitator input, session 2, 35.19). By session 5, on reviewing their partially conducted model, this has become ‘Well I’d lift that out and sort of throw it into the rubbish, that’s what I’d be doing’ (facilitator input, session 5, 29.30). In this respect, he is more concerned with ensuring their design meets the expectations of the academic assessment than in allowing them to carry on constructing their own meaning of the task.

The potential ambiguity of role was identified when the Activity Theory coding was analysed, as in those terms it was noted that there were different perspectives between the tutor and the students, as:
This supports the argument that he is never part of the ‘subject’ remaining outside their perspective on the task. Overall he took on a role that was a hybrid of the traditional PBL facilitator and of an academic aware that the student design has to meet very specific requirements. What stands out is that he uses very different semiotic resources to the students as he carries out his role, in particular:

- He seeks to collaborate with the students (ie he was not making meaning just for himself but to guide their learning);
- He rarely simply agrees with a statement by one of the students (this can be either a statement of relative power or that, in most instances, he is seeking to elaborate on their question and help them develop their understanding). The latter interpretation is supported by his frequent use of complex interpretation in his speech;
- He makes substantial use, using both verbal and non-verbal resources, of scaffolding as he seeks to guide and indirectly lead the student meaning making.

Some of this approach to meaning making reflects the role expected of a facilitator in a PBL context. However, there are instances where he offers very direct evaluation of the student performance and he frequently restates the rules for the task to ensure the students are focussed on what matters in this particular context. This shift of mode of interaction does create some tension with the concept of student-led learning that is, at least in theory, central to PBL.

**Discussion**

The two research approaches were supportive in this case. Activity Theory helped structure an overview of the entire PBL class, place that into context and explore how aspects such as tool usage altered as the session developed. Multimodality allowed a closer investigation of the resources in use and consideration of the shifting role of the tutor. This indicates that the nature of the task was influencing both the semiotic tools available and, more importantly, those accessed by

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**Figure 3: Differing roles of students and tutor**

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the students. When the task was essentially one of calculation, they were using verbal resources primarily in their meaning and supporting this verbal meaning making by tool use and making calculations and sketches on paper. On the other hand, especially once they commence trying to build a bridge model, the richness of the available non-verbal tools, and the non-verbal nature of the task, shifted their meaning making to either a reliance on non-verbal semiotic resources or that non-verbal and verbal resources carried equal weight.

In turn this indicates that very few instances of meaning making can be understood purely in terms of either speech or the usage of non-verbal semiotic resources. In some instances, speech is used by the students to vocalise what is being done with the wooden sticks they are using to build the bridge (this in particular applies to the fourth class when two students were working together). In other instances, speech is supplemented by pointing (even if just at the display on the OHP) as a means to reinforce and clarify exactly what is the focus of the meaning making.

Activity Theory argues that context is important not just for understanding a given task but also that the socially constructed context creates rules for the conduct of a task and gives a particular meaning to the process of carrying out the task. In this instance, all these dynamics can be seen to be at play and that context is drawn from a number of different sources:

1. The basic theoretical underpinnings for the student task are taken from concepts embedded in engineering and physics (so this sets a constraint for how a model bridge can be designed);
2. The academic programme the students are undertaking sets the context of the task in various ways. In terms of the resources available, in terms of the timescale available and in terms of the test that the bridge will be expected to pass (so in this case the context provides the task rules and these influence how this particular task is undertaken);
3. It is suggested that the context provided by the dual role of being a PBL facilitator and an academic leader influences the actions of the facilitator (so his actions can be seen as reflecting an understanding of how these roles can be combined);
4. One possible reason for the students’ limited engagement in group meaning making is that this may reflect either their personal beliefs about an appropriate approach to learning or their internalisation of the learning norms for their subject community (so again, the actions of the students can be seen as internalising a particular model of what it means to be a student).

Conclusions

PBL is promoted as a different approach to student learning from other forms of student-led activity and project work. These differences are in terms of the scope and independence of student meaning making and the role of the supporting tutor in assisting but not leading their meaning making. Using a combination of Activity Theory and multimodal analysis of the semiotics of meaning making, this study calls into doubt these claims. In particular, context is very important and that context is not just set by constructing an exercise for the students but by the wider constraints of their academic programme of study. Here, the tutor both sought to carry out the traditional role of a PBL facilitator (with substantive use of scaffolding to help the student’s interpret the problem) but also that of an academic with a fixed task, known assessment point and defined period of time.

By its nature this is a single case study instance and, as such, care needs to be taken in generalising from the findings. However, key aspects such as student dissatisfaction with only have partial information and that part of the group disengaged are common in the PBL literature. This provides some support that what was observed was not unique (Yin 2009), however, further study using variations of academic subject matter, may help understanding as to the interaction of context and meaning making behaviour.

One weakness in data gathering was the use of a single camera. This forced choices in terms of focus and the usual decision was to concentrate on the student group. When the tutor was speaking to the entire class, as opposed to interacting with the students, this meant there was little focus on how he used semiotic modes in his meaning making (although the audio recording captured his speech). Since the focus was on the students and student-tutor interaction this gap was not essential in understanding the overall flow of the PBL class.

Acknowledgements

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