Analyzing the Emergence of a Learning Issue in a Problem-Based Learning Meeting

Timothy Koschmann[*], Phillip Glenn[**], and Melinda Conlee[*]

[*]Department of Medical Education, [**]Department of Speech Communication, Southern Illinois University

Abstract - Though much has been published concerning the intended or realized benefits of participating in a Problem-Based curriculum, we know little about what participants (faculty and students) actually do when they say they are doing Problem-Based Learning (PBL). The current paper is part of an ongoing to effort to apply methods borrowed from studies of discourse to understanding PBL as a form of enacted practice.   In particular, the paper provides a description of the interaction within a PBL tutorial meeting leading to the generation of a Learning Issue (LI). We introduce the term *Knowledge Assessment Segment* (KAS) for important stretches of interaction during which participants identify learning issues. We present a detailed analysis of a selected segment. Specific features discussed include: how the group's perspective on a topic changes over the course of the discussion, the tutor's role in providing "scaffolding" for student reasoning, and the group's incorporation of "thinking about thinking." The purpose of descriptive studies of this sort is to enhance our understanding of what it means to *do* Problem-Based Learning.

Much has already been written about how one might implement a problem-based curriculum[1,2,3] and the intended[3,4,5] or realized[6,7,8] benefits of participating in such curriculum. We know much less, however, about what participants (faculty and students) actually *do* when they say they are doing "Problem-Based Learning" (PBL). Such knowledge would be useful, both to assist in evaluating claims about the effectiveness of PBL and to aid in understanding what constitutes effective tutorial practice.[*] More fundamentally, however, developing a description of what participants *do* when they say they are doing PBL would provide us with a better understanding of what PBL actually *is*.

In developing such an understanding we focus on the discourse that occurs within PBL meetings. In earlier work we described, at a molar level, the structure of the clinical reasoning applied by the group

to a problem[9] and presented a more detailed description of theory-making and argumentation within this setting.[10] In the current paper, we apply methods borrowed from studies of talk-in-interaction[11] to focus on the interaction leading to the production of a "Learning Issue," an important component of the PBL process.[3]

The Genesis of a Learning Issue

In the course of exploring a problem, the members of the PBL group inevitably discover areas in which their collective knowledge is deficient. Recognizing such a deficiency, they may elect to treat it as a "Learning Issue" (LI), that is, as a topic requiring further study outside of the tutorial meeting[3]. Recording an item as a LI, therefore, represents a commitment on the part of the group to further research the topic prior to the next meeting. Learning Issues have been shown to be critical determinants of student self-directed learning[12,13] and, on this basis, they represent an important component of the method.

It is the policy of the particular implementation of PBL under study that LIs are always to be generated by the students in the PBL group, rather than determined

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[*] We have suggested elsewhere[5] that the term 'tutor' is an inappropriate one for the role assumed by the faculty member in the PBL meeting. However, in deference to established usage, we will refer here to the faculty member and PBL group meeting as the "tutor" and "tutorial meeting", respectively.

in advance by the faculty.[†]   Producing a LI is a collaborative enterprise, therefore, requiring the students to assess their current understanding and evaluate their current need to know. To become a Learning Issue a topic must satisfy three conditions: there must be *a recognizable knowledge deficiency, the students must see the missing knowledge as relevant to or necessary for the eventual practice of medicine, and, finally, there must be consensus about the timeliness of undertaking the study*.

Students reveal many misconceptions and examples of incomplete understanding within their discussions of a problem. These only become LIs, however, when they are recognized by and become explicit for the group. The students must also grant the *relevancy* of the knowledge to clinical practice. Barrows[3] suggests, "Those learning issues that are directly related to analyzing the problem are the most important" (p. 63). To the degree that the group's exploration of the problem represents an "authentic" learningexperience,[3,5] this constraint ensures the relevancy of the Learning Issues not only to the problem, but also to eventual practice.

In certain circumstances, a group may decline to treat a topic as a LI even though their understanding is clearly incomplete and they acknowledge the relevancy of the item. In these cases, decisions about the timeliness of a LI may be of a strategic or tactical nature. The students may believe that the deficiency does not fall within the scope of their current learning objectives and is one that would be more appropriately addressed later in their training. Alternatively, an issue may be set aside because of concerns on the part of the students that they will not have adequate time to thoroughly research other, presumably higher-priority, LIs.[‡]

To better understand how this process of recognition and negotiation is accomplished, we undertook a study of the group's interaction leading up

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[†]This is not necessarily true of all PBL implementations.[14] Implementations also vary in the ways in which the lists of LIs are utilized within the curriculum.[15,16,17]

[‡] An approach described in Barrows[3] and used by many groups is to do a two-staged evaluation of LIs. As areas of uncertainly arise in the discussion, satisfying the first condition, they are noted on the board. At the end of the meeting, the group clarifies what the issues actually are, prioritizes the list (using the second and third criteria), and decides how to divide the work of researching the issues among the members of the group.

to the identification of a LI. We term these portions of the group interactions — *Knowledge Assessment Segments* (KASs).

Knowledge Assessment Segments

Our chosen title for this form of instructional interaction may require some explanation. Assessments are a common part of everyday conversation through which speakers provide evaluations of persons, events, and objects[18]. Assessment of student understanding has been a frequently documented feature of instructional discourse. This often occurs in the form of IRE sequences (teacher <u>I</u>nquires, student <u>R</u>esponds, teacher <u>E</u>valuates), which have been described in classroom recitation[19,20] and tutorial dialogue.[21,22]

In certain discourse situations, however, speakers may be constrained in providing assessments.[§] Though PBL tutors continuously evaluate each student's developing understanding by monitoring individual contributions to the group discussion (see "educational diagnosis" in Barrows[3]; also "the Principle of Accommodation and Adaptation"[5], they are trained to assiduously avoid displaying their own knowledge or explicitly evaluating that of the students (see "The General Principles for Tutorial Teaching," (Barrows[2], p. 19). The rationale for this policy is that students must develop skills for assessing their own understanding in order eventually to become "reflective practitioners".[24] Problem solving in group settings is thought to be conducive to the development of such skills.[5]

When we refer to these segments as 'Knowledge Assessment Segments,' therefore, we are focusing on the ways in which the group (students and tutor) assess student knowledge within their ongoing deliberations of a case. Understanding how this is accomplished is an important contribution to our understanding of how participants do PBL, since it elucidates the mechanism by which students evaluate their individual knowledge bases and their progress within the curriculum.

We define a Knowledge Assessment Segment as *a topic-delimited segment of instructional discourse in which participants raise a topic for discussion and one or more members elect to display their understanding*

[§]See, for example, accounts of how broadcast interviewers withhold assessments of interviewee's responses.[23]

of that topic.   Note that in defining a KAS in this way, we do not stipulate that the discussion necessarily results in the generation of a LI. There are, in fact, many discussions within PBL meetings that satisfy the requirements of this definition, but within which one or more of three conditions for the establishment of a Learning Issue are not met.

Unlike traditional classroom recitation,[19,20],talk within a PBL meeting is for the most part informally organized.[**]   A broad set of conversational options are, therefore, open to a participant in a KAS. A respondent to an initial query, for instance, might supply an answer or restate the inquiry to clarify or modify it. Alternatively, the respondent might present arguments for why the matter should or should not be treated as a LI. Often such arguments may be tacit. A KAS might be brought to a close, for example, simply by raising a new topic for discussion.

This study is part of a larger project that has involved videotaping numerous meetings within the PBL curriculum over a period of approximately five years.   Recorded sessions reflect a variety of circumstances including: early in the first year when students receive their first exposure to PBL and late in the second year when students are well-acclimated to the method, both with novice and highly-experienced tutors, and in meetings augmented with special technologies[5]. Recording of PBL activities vary in time, ranging from a single case (2-3 meetings each of approximately 2 hours duration) to a complete unit lasting 12 weeks.   From this growing corpus of observational data, we isolated specific segments for careful study.

Field notes and certain high-level representations of the group's deliberations (e.g., Conlee & Koschmann[9]) are helpful in suggesting likely places that interactions of the type we have been describing might occur.   Such segments tend to occur more frequently in the first and second meetings devoted to a case (see Barrows[3] for a detailed description of the sequence by which PBL groups undertake a case). The isolated segments representing KASs are generally quite brief (of 2 to 5 minutes in duration). The one selected for analysis here we transcribed using Conversation Analytic notational conventions

(developed by Gail Jefferson; cf.,[11,25][††]).   Referring back to the original videotape and field notes, we conducted a fine-grained analysis using the transcript as a guide and resource. This was done jointly by all three authors to establish a consensual interpretation of what was accomplished by the participants within the segment. To further enrich these descriptions (and provide a reliability check for observations), we analyzed this segment in weekly data sessions with faculty and graduate students in the Departments of Speech Communication and Linguistics at Southern Illinois University.   Many hours, as a result, were devoted to the analysis of each segment.

In the section that follows we present a case analysis of a KAS.   We are cognizant, in presenting this sample, of the admonishment made by McDermott, Gospondinoff, and Aron[26] that, "There is a requirement, often neglected, that such a description of behavior and its contexts be presented in a way that readers can decide for themselves whether or not to believe the [analyst's] account of what it is that a particular group of people is doing at any given time" (p. 245). We propose to address this requirement, not only by providing the reader with a complete copy of the working *transcript*, as is usually done, but also by providing access to a digitized copy of the video *segment* from which the transcript was prepared.

"Risks of CT vs. X-Rays"

The segment analyzed here occurs late in the group's second meeting on a case involving an adolescent female patient presenting with a complaint of abdominal pain. The tutor (identified in the transcript as "Coach") is highly experienced and widely recognized for his skill in teaching in collaborative settings.   The students (all identified by pseudonyms) are second-year medical students enrolled in a PBL curriculum.   All participants provided written consent before being videotaped.

Immediately prior to the beginning of this segment, Joel asserts that performing a CT (Computerized Axial Tomography) scan constitutes standard practice in cases of this kind.   Patrick's response (in lines 1 and 4) raises a question of safety: [‡‡]

[**]Though not entirely so. See Barrows[2] for a description of the ground rules governing participation in a PBL meeting.

[††]A description of the *transcription conventions* is provided.

[‡‡]Note that in the transcript excerpts, word spellings reflect speaker variations in pronunciation and speech rhythm. These "nonstandard" forms are extremely common in spoken

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Patrick:    You think you can get can
            get a lot of risks doing a
            CT to the pelvis.
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Patrick challenges Joel's preceding assertion while at the same time opening the issue to further discussion. By raising safety as an issue, his question is implicitly disaffiliative, though presenting it as a question may serve to soften its critical tone. Joel refutes this challenge and calls on Patrick to account for his query:

```
Joel:  No why.
       (2.5)
Joel:  What would be the risk.
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By this reply, Joel shifts the burden to Patrick to specify what risks there might be. Following a silence during which no one takes the opportunity to explain why there would be risks, Joel produces a question which pursues the issue. Jackie allows that there may be cause for concern under certain circumstances:

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Jackie:  Wuh- only if it was ectopic.
         Or if she was pregnant
```

Jackie seems to take a middle ground between Joel and Patrick: yes, there are risks, but "only" under special circumstances.   Patrick (lines 13-15) then inquires about other possible risks, even if the patient were not pregnant:

```
Patrick:    Well even even (.) well
            would you have (.) danger
            of X-raying (.) °the
            ovaries (and      )°
```

Patrick's follow-up query refines the focus of his earlier solicitation from risks "to the pelvis" more specifically to risks to "the ovaries and stuff". This would seem to suggest a broader domain for risks (to certain body areas without particular conditions such as pregnancy being present) than did Jackie.   In his

question, he provides a candidate answer: this is where the risk may be.
At this point, the tutor enters into the discussion :

```
Coach:   Is there a ↑risk to CT?
         [                         ]
```
((with arresting hand gesture))

While asking this question he makes a hand gesture similar to that of a crossing guard delaying oncoming traffic. His gesture and turn at talk serve to direct the attention of the full group to Patrick's question. Coach's inquiry also calls upon the group to shift from discussing the advisability of performing a CT scan on a particular patient to the more abstract consideration of the medical risks of CT.

His inquiry only calls for a 'yes' or 'no' response which, after a brief pause, Jackie, Patrick, and Joel provide.   He repeats the question, providing the students opportunity to elaborate further.   Before allowing the students to respond, however, he produces a different version of the question, once again slightly respecifying the issue under discussion:

```
Coach: I mean what is the risk in a
       CT.=Is there a
       difference between X-r-CT and
       an ordinary X-ray?
```

By setting up a contrast, he provides the students with a new framework for considering the risks of CT scans.   He simultaneously expands (by bringing in conventional X-rays) and restricts (by focusing specifically on the contrast between the two imaging techniques) the scope of the original discussion.

Patrick (lines 28 and 31-33) attempts to respond to Coach's inquiry. Joel (lines 36 and 38) further refines the question raised by Coach (i.e., How does a CT scan compare to an X-ray?) by focusing specifically on differences in the amount of radiation used in the two techniques:

```
Joel:   ↑What is the dosage (1.2)
        relative to a normal X-
        ray to a CT
```

He provides an answer to his own question, marked as tentative by being packaged as another question:

```
Joel: CT- ↑serial CT um is serial X-
      rays is it not?
```

Jackie provides confirmation (line 42) and then proceeds to construct her own answer to Coach's question about the differences in the two forms of imaging:

```
Jackie: Right=you're taking slices
        [                         ]
        ((making chopping hand
        gesture))
        so naturally if you do: (0.8)
        two views of an abdomen with
        a plane film and you do (0.8)
        fifteen with the CT _I mean_
        but I don- I don't know I
        can't remember (.) the elative
        dosage for one slice of CT
        versus
```

She reasons that an abdominal X-ray usually has only two "views" while a CT scan involves fifteen or more "slices." She concedes, however, that she does not know how large a dose of radiation is required for each "slice."

At this point the discussion has revealed a deficiency in the students' collective knowledge. Patrick, Joel, and Jackie have attempted collaboratively to construct a model of how CT scans are produced, but, by Jackie's admission, they are missing a crucial piece of information—the amount of radiation exposure acquired from a CT scan. By the ground rules of the method, if other members of the group possessed further information, it is their responsibility to share it.[2] Since no one in the group appears able to provide this particular piece of information, the first condition for the establishment of a LI appears to have been satisfied.

Though the Coach could now ask whether or not this item should be considered a LI, he instead encourages Jackie to continue to reason through her answer:

```
Coach: Wel-wt think-think it through
       what does the X-ray beam have
       to do in ordinary X-ray=How
       much en- what does the energy
       have to do,
```

In responding, Jackie focuses on the need for the X-ray beam to penetrate the body:

```
Jackie: Well it's gonna
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        penetrate the whole
        [                  ]
        ((draws both hands across
        abdomen))
        body. er I mean which ever
        way it's going through.
```

Coach (lines 57-59), in a sequence resembling a classroom IRE (Mehan[19]; Cazden[20]; see earlier discussion,) evaluates their contributions and then provides the 'correct' answer:

```
Coach: Right
       And change (.) the chemical
       (.) constituents (.) in a film
       right?
```

By acknowledging Jackie and Melissa's responses, but immediately supplying his own alternative, Coach demonstrates that their answers are not entirely sufficient. He tags his answer with the particle "right?" to solicit confirmation from the students, which Jackie and Joel provide in lines 60 and 61.

Having now led the group to consider the mechanism by which a conventional X-ray image is formed, he then asks them (line 62) to construct a similar model for the production of a CT scan. Joel (line 63) begins by expanding the acronym, and Jackie overlaps to provide agreement. Coach breaks in (lines 65-66) to redirect attention to the mechanism:

```
Coach:  =What's what's the receptor
        then if it isn't a film, what
        is it
```

This query focuses specifically on the mechanics of how a CT scan is actually produced. Patrick, Joel, and Jackie offer an assortment of rather vague responses ("It's electronic," "Isn't it not an X-ray receptor," "It's computerized").   Coach (line 75) encourages them to continue.

In lines 76-77, Joel indicates his understanding that the radiation dosage associated with a CT scan is approximately equivalent to that of a single X-ray. This assertion constitutes a reply to the question he himself posed earlier in lines 36-38. He marks this knowledge as uncertain (and thus open to correction or criticism by others) by prefacing his claim with "I

understand that . . .".§§   When Coach (line 78) challenges his assertion, Joel expresses additional uncertainty with his response:

```
Joel: That's what my understanding
      ↓is I- I'm not I'm just saying
      (    )
```

He reinforces this impression with hand gestures that resemble the motions of someone juggling a set of balls.

Melissa proposes that this topic be recorded as a LI. Joel and Jackie both concur:

```
Melissa:  Why don't we just put it up
          as a learning issue.
Joel:    >Let's throw that up<
                            [
Jackie:                    Yeah.
```

Coach (lines 78-79) returns to Joel's claim about the radiation dosage of a CT scan. He asks Joel to quantify his degree of certainty:

```
Coach:  >I was going to say< how sure
        are you on a scale of  zero to
        ten.
```

Joel first answers facetiously (line 87) that he is not certain at all. The subsequent pause (line 88) suggests that Coach is seeking a more specific answer.***   Joel then estimates his certainty as "Three," although he marks this as tentative by a questioning intonation. With a chuckle, Coach replies (lines 91-92) that perhaps it should be treated as a LI. Joel concurs (line 93).

By bringing ultrasound imaging into the discussion, Jackie's question in lines 94 and 97 might be seen as yet another respecification of the topic. Alternatively, her inquiry could be construed as calling into question the need for the previous discussion. By asserting that there is an alternative imaging technique available that does not entail the risks of radiation, Jackie's question might be paraphrased more bluntly as, "Why do we need to know about CT scans when we already know that there is a safer alternative?" The

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§§See Pomerantz [27] for a description of how evidence is presented in situations of doubt.

***See Schegloff, Jefferson, & Sacks[28] for a discussion of the preference for self-correction in conversational repair.

fact that Jackie had initially suggested that ultrasound be used for this patient (lines 2-3) supports this interpretation.

By his response (lines 98, 100, 102-105), Coach makes clear that he reads her inquiry in just this way, that is, as a meta-level critique of the group's need to know about the risks associated with CT scans. He argues that the group's hesitation about ordering a CT scan for a pregnant woman indicates an issue which, in his words, "you oughta know." In line 106, Jackie concedes the point pertaining to the need to know, but reasserts in line 108 that an ultrasound would be the appropriate test to use. Brenda endorses this position (lines 107, 109, 111) and Jackie (lines 112-113) elaborates that any form of X-ray is contraindicated in pregnant women.

Although group members continue to provide information relevant to this topic, no one challenges the move to make this a learning issue. The students have shared what they know about the risks of CT and X-Rays, "assessed" their collective knowledge as deficient, and made the decision, under the guidance of the Coach, to "throw that up" (that is, mark it on the board in the conference room) as a learning issue. This is a crucial moment in the Problem-Based Learning method. Its success in this instance relies in part on the ability of group members to asses not only the accuracy, but also their relatively uncertainty, about what they know.

Observations

In this particular segment, Patrick initially raises a topic for discussion. His question focuses on the possible risks to the pelvis (and later he specifies risk to the ovaries) of the patient. Coach's question expands the topic to the risk of CT generally. To facilitate the students' reasoning about this question, he asks them to contrast CT scans with conventional X-rays. Joel refines this inquiry further by focusing on the differences in radiation dosages between CT scans and X-rays. Coach, in his questioning, brings the students back to a discussion of the process by which images are produced in CT scans and conventional X-rays. Melissa suggests they make this a learning issue, and others agree. Coach questions them about the certainty of their knowledge; after hearing that they are not very certain, he concurs that this should be a learning issue.

Though we defined a KAS as a "topic-delimited" segment of talk, participants continuously re-negotiate the boundaries of the topic through the course of the

interaction. In general, any group member may clarify, expand, restrict, or otherwise alter a topic; it is not static but dynamic and emergent. Much of the conversational work that takes place within this segment is devoted to specifying just what the topic of the discussion actually is. This process is important, for it directly affects how a learning issue gets identified, which in turn will crucially influence the success of subsequent research on the issue. Coach's dogged efforts to refine the object of discussion can be seen as exemplary in this regard.

As tutor, Coach plays several important roles over the course of this interaction. By entering into the conversation at line 16, he plays the role of the moderator. His question (and accompanying gesture) guides group members to focus attention on the topic Patrick raised. In so doing, Coach provides implicit endorsement for this topic as worthy of further exploration. Later, his leading questions pertaining to differences in the process of image formation in CT scans and conventional X-rays provide a form of "scaffolding;"[29] that is, they provide a framework for reasoning about the topic and applying prior knowledge. The intent is for the students to eventually internalize this process of inquiry so that they may be able to incorporate it into their own independent problem solving.[30,3]

Another contribution of the tutor is to facilitate the students' reflection on the nature and sources of their own knowledge. When Coach asks Joel to estimate his degree of certainty (lines 85-86), he encourages a form of "thinking about thinking"[31]. This is perfectly in keeping with the previously articulated motive of KASs, to engage students in an assessment of their own knowledge. In so doing, therefore, the tutor makes the implicit motive of the interaction explicit.

Interestingly, the Coach makes this move *after* at least three group members have agreed to make this a learning issue. He might have remained silent, recognizing that the students have identified this knowledge deficiency; he also might have immediately agreed. Instead, he gets Joel to quantify his certainty, and *then* agrees that this should constitute a learning issue. By this move, Coach slows down the group process momentarily to do a bit of teaching: to show, by example, how to think about one's own thinking.

The current study is meant to contribute to our understanding of how collaborative and learner-directed methods of instruction, such as problem-based learning, are enacted in practice. It represents an attempt to describe microgenetically one specific feature of this process, i.e. the emergence of a Learning Issue. Though the example presented here was a selected one, we suspect that anyone who has participated in a PBL curriculum would view this segment of interaction as typical of and recognizable as the type of discourse that ordinarily takes place within PBL meetings. Following in the traditions of Conversation Analytic studies (c.f., Schegloff[32]), we provide a carefully constructed account of a single case rather than a summary of many cases taken in the aggregate.

This type of account may prove useful on several levels. On a *practical* level, a fine-grained analysis of the performance of a highly skilled tutor can provide us with many clues about how to do more effective tutoring. On a *methodological* level, studies of the type presented here offer a new means for "opening up" that which occurs within PBL meetings. On cursory inspection, the discussions that take place within these meetings may seem disorganized, even chaotic. Participants overlap each other, pause, stumble over words, express some ideas in vague or uncertain ways, even laugh in response to some statements. However, through detailed analysis a precise order emerges, and all the features listed in the previous sentence play a part in that orderly process. As McDermott et al.[26] argue, "By pointing to the order in . . . apparently chaotic behavior, we . . . raise the possibility that most behavior is ordered in ways about which we as observers or participants are systematically inarticulate" (p. 246). By becoming more "systematically articulate" about what takes place within these meetings, therefore, we come to develop a better understanding of PBL on a *theoretical* level, as well. That is to say, it provides us with a basis for understanding what it means to *do* Problem-Based Learning.

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