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When is a Problem-Based Tutorial Not Tutorial? Analyzing the Tutor's Role in the Emergence of a Learning Issue

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In the shared vocabulary of Problem-Based Learning (PBL), curricular meetings convened to explore a teaching case are referred to as tutorials and the faculty member responsible for facilitating these meetings is designated the tutor. Some (c.f., Barrows, 1988; Koschmann, Kelson, Feltovich, & Barrows, 1996) have expressed dissatisfaction with this usage, expressing concerns that such terminology might provide a misleading picture of the faculty member's role and of the PBL process generally.

Tutorial, of course, had an established meaning well before PBL was introduced. The Oxford English Dictionary (2nd Ed., Oxford: Clarendon Press), for example, provides as one definition, "a period of individual instruction given by a college or university tutor to pupils, either singly or in small groups" (Vol. 16, p. 732). This denotes that a tutorial is a particular form of instructional activity, one in which a low ratio of learners to faculty affords special opportunities for individualized attention to learner needs. By this definition, applying the label of 'tutorial' to PBL group meeting might seem appropriate. Barrows (1988) has argued, however, that the PBL tutor should be more facilitory and less didactic, more guide-like and less directly instructive than a conventional tutor. In order to better understand these distinctions, we need to examine what tutors actually do, both in PBL meetings and in other settings.

In this chapter, therefore, we apply methods borrowed from studies of talk-in-interaction (Atkinson & Heritage, 1984) to document what actually occurs within PBL meetings. We focus upon a particular segment of interaction in a tutorial meeting—interaction leading to the production of a "Learning Issue." Fox (1993) conducted similar analyses of one-on-one tutorial interactions involving graduate students and undergraduate tutees. Taking Fox's findings as representative of more conventional pedagogical approaches to tutoring, we make comparisons of the tutor's role across the two settings. In so doing we

hope to deepen our understanding of what it means to be a tutor and to participate in the joint activity known as a tutorial.

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 (Barrows, 1996). 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 (Barrows, 1994). Learning Issues have been shown to be critical determinants of student study outside of the meeting (Dolmans, Schmidt, & Gijselaers, 1994a; 1994b) and, on this basis, are an important contributor to self-regulated learning (Winne, 1995).

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 in advance by the faculty.[1] 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,

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[1]This is not necessarily true of all PBL implementations (cf., Barrows, 1986). Implementations also vary in the ways in which the lists of LIs are utilized within the curriculum (Coulson, & Osbourne, 1984; Blumberg, Michael, & Zeitz, 1990; Dolmans, Schmidt, & Gijselaers, 1994c).

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 (1994) suggests, "Those learning issues that are directly related to analyzing the problem are the most important" (p. 63). This ensures the relevancy of the Learning Issues not only to the problem, but also to eventual practice.

To better understand how this process of recognition and negotiation is accomplished, we undertook a study of a group's interaction leading up to the identification of a LI. We term this portion of the group interaction a-Knowledge Display Segment (KDS).

Knowledge Display Segments

We define a Knowledge Display Segment to be a topic-delimited segment of discourse in which participants raise a topic for discussion and one or more members elect to display their understanding of that topic.[2] Note that in defining a KDS 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. We use the term "segment" to suggest that these activities happen over stretches

[2]In an earlier publication (Koschmann, Glenn, & Conlee, 1977), we had referred to segments of this type as Knowledge Assessment Segments. Because "knowledge display" appears to be more descriptive of what participants actually seem to do in these segments and because, in particular, what we see is different from assessment, in the way in which the term is used in conversation analytic research (c.f., Pomerantz, 1984a), we decided to use a new term.

of talk longer than a single sequence, but briefer than an entire interactional episode (Crow, 1994).

Our focus is on the ways in which the group (students and tutor) display understandings within the context of their ongoing deliberations of a case. Documenting how this is accomplished is an important contribution to our understanding of how participants do PBL, since it elucidates the mechanisms by which students evaluate their individual knowledge bases and their progress within the curriculum.

Unlike traditional classroom recitation (cf., Mehan, 1978; Cazden, 1988), talk within a PBL meeting is for the most part informally organized.[3] A broad set of conversational options are, therefore, open to a participant in a KDS. 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 KDS 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 (cf., Koschmann et al., 1996). These studies vary in duration, ranging from a single case (2-3 meetings each of approximately 2 hours duration)

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[3]Though not entirely so. See Barrows (1992; 1996) for a description of the ground rules governing participation in a PBL meeting.

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, 1997) 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.[4] These isolated segments representing KDSs are generally quite brief (of 2 to 5 minutes in duration). The one selected for analysis here was transcribed using conversation analytic notational conventions developed by Gail Jefferson and summarized in Appendix A (cf., Atkinson & Heritage, 1984; Goodwin, 1981). 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 first by the three authors to establish a shared interpretation of what was accomplished by the participants within the segment. Subsequently, we presented the segment in one of the weekly data analysis sessions of the Department of Speech Communication at Southern Illinois University.

We present here a detailed case analysis of a KDS. Following in the traditions of conversation analytic studies (c.f., Schegloff, 1987), we provide a carefully constructed account of a single case rather than a summary of many cases taken in the aggregate. 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"; see closing discussion) is highly experienced and widely recognized for his skill in teaching in collaborative settings. The students (all

[4] See Barrows (1994) for a detailed description of the sequence by which PBL groups undertake a case.

identified by pseudonyms) are second-year medical students enrolled in a PBL curriculum. All participants provided written consent before being videotaped.

We are cognizant, in presenting this sample, of the admonishment made by McDermott, Gospondinoff, and Aron (1978) 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.[5]

"What would be the risk?"

At 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 5 and 7) raises a question of safety: [6]

```
Patrick:  You think you can get
          can get a lot of risks doing a CT to the pelvis.
```

---

[5]Instructions for obtaining a digitized copy of the video segment can be found at the following website: http://edaff.siumed.edu/dept/studies/xscript/risks.html.

[6]Note that ending punctuation in this transcription system indicates intonation, not grammatical category. Patrick's turn is a question (Joel treats it as such by providing an answer in line # 6); the period at the end indicates a downward terminal intonation. In the transcript excerpts, word spellings reflect speaker variations in pronunciation and speech rhythm. These "nonstandard" forms are extremely common in

This potential objection (presented in a question) to performing a CT scan problematizes Joel's preceding proposal on the basis of safety. In so doing, it directs the focus of talk, momentarily at least, away from the patient and onto the procedure itself. It shifts the topic from the relevance of a CT scan for cases of this kind to risks in doing CT scans. We treat his utterance, therefore, as constituting a possible opening for a KDS and choose it as a starting point for our analysis.

Joel replies to the question, disagreeing with the premise that a pelvic CT scan carries "a lot of risks." His "why?" constrains Patrick to account for his preceding question. A pause follows, then Joel produces a more elaborate version of his question:

```
Joel:     No why.
          (2.5)
Joel:     What would be the risk.
```

One might expect this to be Patrick's question to answer, and Patrick's alone. However, Jackie speaks next. She seems to take a middle ground between Joel and Patrick: yes, there are risks, but only under special circumstances:

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

In this moment group members orient to fore-grounding shared, group knowledge over individual knowledge. The point of the talk is not to see what Patrick, or Joel knows; the point is to provide discursive space for any relevant information from any group member. Thus Jackie self-selects to answer the question.

---

spoken (as opposed to written) language. They should be viewed as examples of how language is actually used, particularly in informal settings, rather than flaws in performance.

Patrick (lines 18-20) 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's answer.

Group members have provided different, even competing, answers to whether the CT scan poses health risks, perhaps displaying collective uncertainty. At this point, the tutor enters into the discussion:

```
Coach:      Is there a  risk to CT?
```

While asking this question he makes a hand gesture similar to that of a crossing guard delaying oncoming traffic. He recycles Patrick's question with slight modification from the advisability of performing a CT scan on a particular patient to the more abstract consideration of the medical risks of CT.

As worded, his inquiry only calls for a 'yes' or 'no' response which, after a brief pause, Jackie, Patrick, and Joel provide. He then asks another question which invites elaboration. Before the students can respond, however, he produces a different version of the question, once again slightly re-specifying 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 33 and 36-38) attempts to respond to Coach's inquiry. Joel (lines 41 and 43) 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
```

Joel then answers his own question, marking the answer as tentative by putting it in question form:

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

Jackie provides confirmation (line 47) and then constructs her own answer to Coach's question about the differences in the two forms of imaging:

```
Jackie:     Right=you're taking slices
            ((making chopping gesture with right hand))
            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 relative dosage for
            one slice of CT versus
```

She contrasts an abdominal X-ray, usually providing only two "views," with a CT scan involving fifteen or more "slices." If each slice or view produces exposure equivalent to an X-ray, it would follow that a CT scan would place a patient at a higher risk than a single X-ray. She then expresses doubt about the relative dosage required for each, thereby claiming insufficient knowledge (Beach and Metzger, 1997) about the issue.

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 produced by 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 (Barrows, 1988, 1996). Since no one in the group does, a collective knowledge deficiency appears to have been revealed satisfying the first condition for the establishment of a LI.

Though 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,
```

Jackie's response focuses on the need for the X-ray beam to penetrate the body:

```
Jackie:   Well it's gonna
          penetrate the whole
          body. er I mean which ever way it's going through.
```

She illustrates this by bringing the backs of her hands together pointing toward her midsection. As she speaks she draws her hands across her abdomen fingers pointing inward bringing them around to both sides of her body. She repeats the gesture as she attempts to repair her sentence.

Coach's single word utterance in line 60 solicits Jackie to extend her answer. Similarly, his "Right" (line #64) is less an assessment than an invitation to continue. By initiating his next sentence with an "and" he marks his utterance as a collaborative continuation of Jackie's "Well it's gonna penetrate the whole body".

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

The full stops following "change", "chemical", and "constituents" might be heard as an invitation for her (or one of the other students) to finish the sentence. He tags his answer with the particle "right?" to solicit confirmation from the students, which Jackie and Joel provide in lines 67 and 68.

Having now led the group to consider the mechanism by which a conventional X-ray image is formed, he then asks them (line 69) to construct a similar model for the production of a CT scan. Joel (line 70) begins by expanding the acronym, and Jackie overlaps to provide agreement. Coach breaks in (lines 72–73) 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 82) provides a confirmation.

In lines 83–84, 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 41 and 43. He marks this knowledge as uncertain (and thus open to correction or criticism by others) by prefacing his claim with "I understand that . . .".[7] When Coach (line 85) 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 (   )
```

[7]See Pomerantz (1984b) for a description of how evidence is presented in situations of doubt.

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 on the white board 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 92–93) 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 94) that he is not certain at all. The subsequent pause (line 95) suggests that Coach is seeking a more specific answer.[8] Joel then estimates his certainty as "Three", though his intonation marks this response as tentative. With a chuckle, Coach replies (lines 98–99) that perhaps it should be treated as a LI. Joel concurs (line 100).

By bringing ultrasound imaging into the discussion, Jackie's question in lines 101 and 104 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 fact that

[8]See Schegloff, Jefferson, & Sacks (1977) for a discussion of the preference for self-correction in conversational repair.

Jackie had initially suggested that ultrasound be used for this patient (lines 6-8) supports this interpretation.

By his response (lines 105, 107, 109–112), 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 suggests a misunderstanding that has important implications for later practice. In line 113, Jackie concedes the point pertaining to the need to know, but reasserts in line 115 that an ultrasound would be the appropriate test to use. Brenda endorses this position (lines 114, 116) and Jackie (lines 120, 122–123) 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 scans and X-rays, assessed their collective knowledge as deficient, and made the decision, under the guidance of 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 assess not only the accuracy, but also the relative degree of uncertainty, of what they know.

Some Observations on Tutorial Practice

To summarize, Patrick initially raises a topic for discussion. His question focuses on the possible risks to the pelvis (which he later narrows to a 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 exposure between the two imaging techniques. 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 asks them to assess 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 KDS 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 persistent efforts to refine the object of discussion can be seen as exemplary in this regard.

There is an extensive literature exploring the effect of tutor expertise on tutorial interaction and subsequent student performance (c.f., Regehr et al., 1995). In an early study, Silver and Wilkerson (1991) found that in discussions in which tutors considered themselves to be experts, the tutors spoke more often, took longer turns at talk, and provided more direct answers to student queries, in short, they were considered to be more directive.

In the segment analyzed here, it is Coach's expertise that enables him to recognize the misconception underlying Patrick's initial query. Though his role in the ensuing discussion might be construed by some as directive, it is also clearly true that his facilitation was crucial to the students' learning in this situation. His leading questions provide a form of "scaffolding" (Wood, Bruner,

& Ross, 1976) in that they offer a framework for reasoning about the topic and applying prior knowledge. The overarching goal is for the students to internalize this process of inquiry so that they may eventually be able to incorporate it into their own independent problem solving (Barrows, 1994; Feltovich, Spiro, Coulson, & Feltovich, 1996). Further, when Coach asks Joel to estimate his degree of certainty (lines 92–93), he encourages a form of "thinking about thinking" (Olson & Astington, 1993) by pushing Joel and the group to reflect on what they do and do not know. The important question, therefore, is not whether expertise itself is harmful or even if tutor-led inquiry is detrimental, but rather, in what settings and for what purposes does tutor inquiry serve the objective of advancing student-centered learning?

Schegloff (1995) has argued that "the absence of actions can be as decisive as their occurrence for the deployment of language and the interactional construction of discourse" (p. 186). Completely absent in this segment are any examples of Coach providing direct instruction. To see how the discussion might have played out differently had such action been taken, we turn now to Fox's analysis of more conventional tutorial interaction.

Conventional Tutorial Interaction

Fox (1993) conducted a study of a series of one-on-one sessions involving graduate student tutors and undergraduate tutees in a variety of domains (i.e., chemistry, physics, math, and computer science). Like the current study, she applied an analytic framework derived from ethnomethodological conversation analysis (Atkinson & Heritage, 1984; Psathas, 1985). For the purposes of the discussion that follows, we will treat her description as representative of conventional tutorial interaction. As Fox (1993) describes it, "Face-to-face tutoring consists mainly of two activities: description and explanation of some domain by the tutor, and working and solution of problems by

the student" (p. 69). We will examine each of these activities in turn and discuss how they are manifested in conventional and PBL tutorials.

Since one of Fox's central interests was how tutees come to "situate otherwise abstract and a-contextual forms" (pp. 1-2), she provides few examples of tutors presenting extended descriptions and explanations. One of her transcribed segments, however, does provide a clear example of directed instruction. The segment is from a Calculus tutoring session and is presented as follows:

```
T:   Okay, so (1.1) chain rule?
     (1.5)
T:   Ring a bell?
S:   Yeah, yeah chain rule rings a bell.
               [
T:              Okay.
T:   Okay.  So what that says is if you have (2.1) a function
     sitting inside of another function.
     (0.8)
S:   Right
T:   (And) to differentiate it, you take the outside derivative
     (1.0) the ef prime (1.7) and then you multiply it by the
     inside derivative, (0.6) the gee prime.
```

(pp. 23-24, transcription conventions modified)

This brief exchange can be seen to be fit the requirements of a Knowledge Display Segment, as defined earlier. Though it is much shorter than the KDS analyzed in the PBL tutorial, it has the same structural features—the tutor raises a topic for discussion, the tutee acknowledges the topic, and the tutor provides an expository description of the topic under discussion. In both cases, the participants can be seen to orient toward a joint activity of displaying their understanding of a specified topic. Unlike the "What would be the risk?" segment, however, the tutor brings the segment to an abrupt close by supplying her own description of the object (i.e., the chain rule) thereby preempting an opportunity for student articulation.

The differences among the two segments highlight the fundamentally different pedagogical goals underlying conventional and PBL tutoring. Whereas the goal, from

the tutor's perspective in a conventional tutorial, is to bring the tutee to a negotiated level of understanding,[9] the primary objective of the PBL tutorial is just to make deficiencies in the learner's understanding evident. These deficiencies need not, and usually are not, immediately redressed but instead deferred as Learning Issues for later independent study. Further, it can be seen that the PBL tutor is attempting to effect a more global change in the tutees' orientation toward learning and knowing. This is evident in the way in which Coach provides a framework for thinking about the question and in the way in which he probes the students concerning their confidence in their answers. Therefore, while KDSs may occur naturally within the discourse of both conventional and PBL tutorials, they tend to serve different purposes in these two settings.

This difference in goals can also be seen in the ways in which problem solving is approached in conventional and PBL tutorials. Fox describes problem solving in tutorial interaction as proceeding, "with the student narrating steps, the tutor asking questions or making suggestions, the student asking for confirmation, the tutor checking understanding, and so on, in some cases with multiple levels of embedding, until the tutor and student agree they have come to an acceptable stopping point" (p. 23). She provides an example of this process, as excerpted here:

```
T:   And what are these, these are?
     (0.9) those aren't lengths, so what are they
S:   That's the work?
T:   Work or e-nergy.
               [
S:              Energy?
T:   okay? So this is an energy.
```

(pp. 22, transcription conventions modified)

[9]See Fox's discussion of the way in which it is meaningful to speak of the tutee's understanding "matching" that of the tutor (pp. 54–55).

This exchange can be seen to follow the pattern of the well-documented IRE recitational sequence in which the instructor inquires, the student responds, and the instructor evaluates (Mehan, 1978; Cazden, 1988).

Compare this to the more elaborate exchange in the "What would be the risk?" segment beginning at line 54 and continuing to line 89. Here Coach begins by asking about how an ordinary X-ray image is produced. He inquires, "What does the energy have to do?" Jackie replies that the energy must penetrate through the body. Coach's "and" (line 60) encourages her to continue her narrative and explain what happens after the X-ray beam has passed through the body.

Jackie evidences some confusion when she says, "er I mean which ever its going through" and repeats the gesture she made previously. Coach's "Right" (line 64), therefore, is less an evaluation of her answer than an instance of what is referred to in studies of tutorial dialogue as a "pump" (Graesser, personal communication). He builds upon her answer in lines 65 and 66, pausing repeatedly to provide her with opportunities to participate.

Coach then shifts the discussion to an exploration of what the X-ray beam must do in a CT scan. Joel provides an expansion of the acronym "CT" which Jackie endorses. Coach pushes the students to explain the mechanism for image production, just as he had done previously for ordinary X-ray images. Joel suggests that CT scans use an "electronic receptor" and Jackie allows that it's "computerized." As before, Coach's "Right" acknowledges their answers but does not necessarily imply endorsement.

Rather than attempt to elaborate on his answer, Joel states simply "I understand that the CT is just about equivalent to an X-ray." By shifting the topic from the mechanism of production (back) to radiation exposure, Joel is conceding that he is unable to answer Coach's question. Coach's neutral "Is it?" neither confirms nor disconfirms Joel's assertion.

In comparing the problem solving exchange from Fox's study of one-on-one tutoring with this extended segment of interaction, several differences are apparent. Most important is the way in which the tutor in the PBL tutorial withholds assessment of the various answers provided by the students. In the conventional tutorial, the student's answer to the tutor's inquiry is produced and confirmed in the moment; in the PBL tutorial, the answer is deferred pending further study. Just as was the case with "description and explanation," the different strategies utilized by the tutors suggest that they are pursuing a different set of goals in the two settings.

Conclusions

Despite the differences between tutorial interaction as described by Fox and what we have observed in PBL tutorials, there are also important similarities—both entail teaching in the context of joint problem solving and both involve an asymmetric exchange in which the tutor assumes a distinguished role and is called upon to model expert problem solving strategies. Further, as Fox observes:

> Tutoring involves constant, and local, management. This requires a pervasive mutual orientation between tutor and student, such that every session (indeed, every utterance) is a thoroughly interactional achievement, produced by both tutor and student. (p. 3)

Finally, her observation concerning the goal of tutoring being "to situate otherwise abstract and a-contextual forms" (p. 2) and her description of the general indeterminancy of language within tutorial dialogue both appear to apply with equal validity to PBL tutorials (cf., Glenn et al., in press).

Nonetheless, there remain marked differences between the roles of PBL and conventional tutors. Fox stipulated that there are a set of norms to which tutors and tutees "orient in interpreting and creating the contexts in and through which they act" (p. 114). It would appear to be the case, however, that there are

norms which apply to the conduct of PBL tutorials that do not apply to more conventional tutorial interaction.

Newman, Griffin, and Cole (1989) observed that introducing a new term "is a way to signal that old phenomena are being reconceptualized with a different kind of theory" (p. 59). Given the different set of norms by which tutors and tutees structure their interactions in conventional and PBL tutorials, we reiterate the recommendation made previously (Koschmann et al., 1996) that a new title be given the faculty member in the PBL tutorial as a means of signally that the tutor's role has been reconceptualized in this setting. We believe adopting the label tutor/coach or, more simply, coach would have this effect.

The norms that organize participation within PBL meetings are themselves abstractions that must be continually reinterpreted and made relevant within the bustle and confusion of the ongoing interaction. On cursory inspection, the discussions that take place may seem disorganized, even chaotic. Participants overlap each other, pause, stumble over words, express ideas in vague or uncertain ways, and laugh in response to some statements. Through the type of analysis conducted here, however, a more precise order can be seen to emerge. As McDermott et al. (1978) argued, "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 articulate about how PBL is enacted in practical settings, we come to develop a better understanding of PBL on a theoretical level, as well. Studies, such as the one reported here, therefore, begin to provide us with a foundation for understanding what it means to do Problem-Based Learning.

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